Monitoring of Markets and Sectors
MMS Project

Final Report

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Edited by:

Johan Eyckmans, Stijn Kelchtermans, Stijn Vanormelingen, Kristien Coucke, Annabel Sels, Cherry Cheung, Daniel Neicu (*Hogeschool-Universiteit Brussel, HUB*), Frank Verboven (*Katholieke Universiteit Leuven*), Catherine Schaumans (*Universiteit Tilburg*), Luc Mariën (*Federal Public Service Economy, FOD Economie*)

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Acknowledgments

The AGORA-MMS project was initiated 2008 by the Federal Public Service Economy (FPS Economy in the sequel) in collaboration with the Belgian Federal Science Policy office. In December 2008, the contract was awarded to the HUB team and in the summer of 2009, researchers were hired and data access was arranged. The project effectively started in the fall of 2009. Financially, the project would not have been possible without the generous support by the Belgian Federal Science Policy office. We would like to thank Mr. Aziz Naji of the Belgian Federal Science Policy office for following up the AGORA-MMS project.

For the purpose of the project, the HUB team was given the possibility to hire two junior researchers for contributing to the development of methodology, data work and data analysis. They spent more than half of their time working at the FSP Economy. On top of the junior researchers, a broad team of senior researchers were involved in this project. Of the Hogeschool-Universiteit Brussel (HUB team in the sequel) these were Johan Eyckmans (promotor), Stijn Kelchtermans (co-promotor), Kristien Coucke, Annabel Sels, Stijn Vanormelingen (HUB and IESE Barcelona) and Alberto Gaggero (HUB, between September and December 2009). Frank Verboven (Katholieke Universiteit Leuven, Centrum voor Economische Studiën) and Catherine Schaumans (University of Tilburg, economics department) took care of a particular case study on competition in local markets. Also the feedback and suggestions by Marcel Canoy (Ecorys Nederland) is gratefully acknowledged.

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1 Introduction

The AGORA-MMS project was initiated by the division Sector and Market Monitoring within the Federal Public Service Economy (FPS Economy in the sequel). The overall mission of the FPS Economy consists of creating the necessary conditions for the competitive, sustainable and balanced functioning of the goods and services markets. The division Sector and Market Monitoring plays a key role in achieving this mission in two ways. First, the division takes part in the activities of the Price Observatory, i.e. the Belgian public price monitoring authority, within the Institute for National Accounts. Second, the monitoring division performs sector analyses for the FPS Economy. One of the strategies to achieve the mission is to "identify economic sectors and markets that show signals of suboptimal functioning, looking for the causes of these dysfunctions and suggesting solutions". The term "suboptimal functioning" should be understood here in a very broad sense and is definitely broader than ensuring fair competition (in the narrow sense of competition policy) or monitoring price evolutions. The EU adopted a similar evidence-based sector monitoring strategy for its Single Market Review in 2007.

The AGORA-MMS project contributes to the sector monitoring objective of the division Sector and Market Monitoring of the FPS Economy by proposing and implementing several methodologies to analyze sectors from different perspectives, taking into account multiple indicators that are calculated on the basis of the rich datasets the FPS Economy has access to.

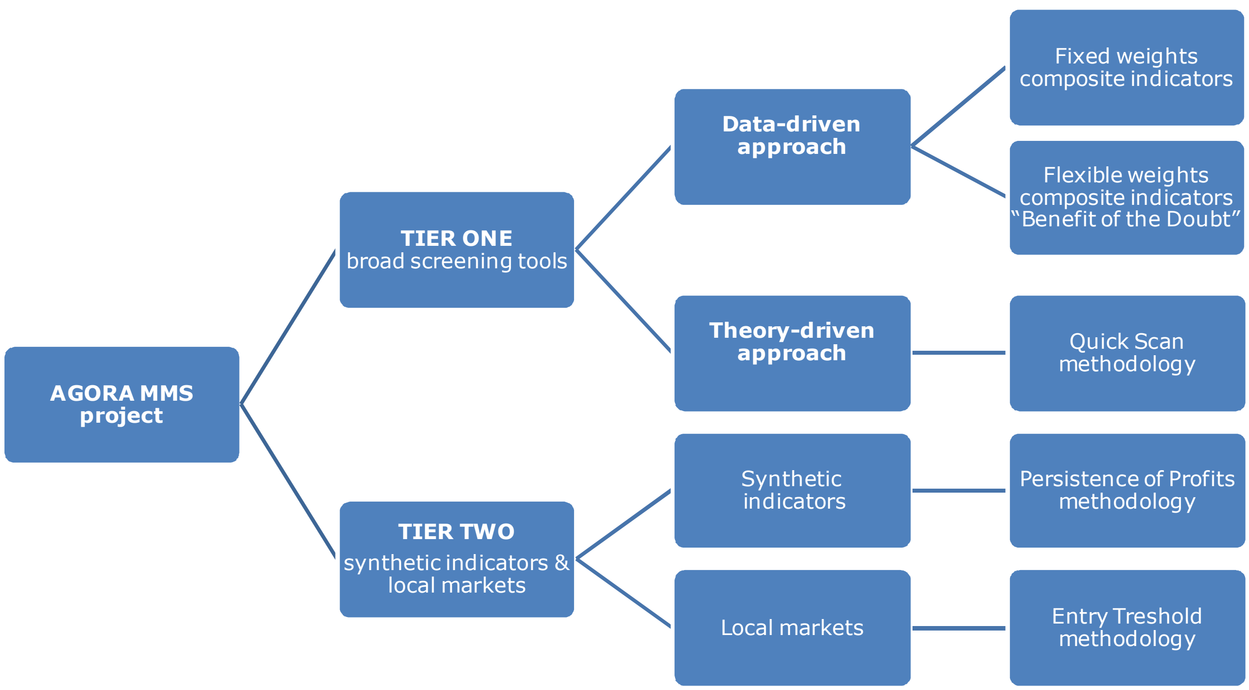
Being part of the overall AGORA program of the Belgian Federal Science Policy, the MMS project aims to leverage public data sources. These include data sources available through the Data Warehouse of the FPS Economy (via Statistics Belgium[1]) coming either from own statistical surveys (like the Structural Business Survey and Prodcom) or from external sources like the annual company accounts and international trade data (both from the Belgian National Bank BNB), data on company turnover (from the VAT administration) and on employment (from the social security institutions). In addition, data on R&D expenditure were kindly provided by Federal Science Policy. Drawing upon this broad set of data sources that cover most of the Belgian economy, the MMS project has developed a range of different analysis techniques that can be applied on a recurring basis by the FPS Economy.

The main objectives of the AGORA-MMS project were (i) developing a methodological framework for the detection of market malfunctioning, (ii) identifying indicators to measure different aspects of market functioning, (iii) calculating these indicators using the rich set of databases the FPS Economy has access to, and (iv) constructing a composite indicator of market functioning based on these detailed indicators. The final product is a database which contains the individual indicator values and composite indicator scores for all the sectors, classified according to the NACE nomenclature.

[1] Statistics Belgium is the same as ADSEI (Algemene Directie Statistiek en Economische Informatie) or DGSEI (Direction Générale de la Statistique et de l'Information Economique) of the FPS Economy (http://economie.fgov.be/en/statistics). It was formerly known as NIS/INS (Nationaal Instituut voor de Statistiek or Institut National de la Statistique).

In order to achieve these ambitious objectives, the AGORA-MMS researchers started with an extensive literature review and an analysis of sector screening tools that have been developed in other countries and at the level of the European Commission. In March 2010, the project team organized an international expert meeting in Brussels to learn from other experiences in this field and to propose its own concepts of market monitoring tools. One of the main lessons from this workshop was that a unique and generally accepted methodology for screening sectors on market functioning does not exist. Complex cause-and-effect relationships and detailed sector conditions matter and complicate the task of developing a broad screening tool in a "one size fits all" way. Taking into account the conclusions of the expert workshop, the AGORA-MMS project has developed a multi-tier approach. The approach and its results were presented at a second international expert meeting in May 2011 in Brussels.

Figure 1: Overview of methodologies developed in AGORA-MMS project



In a first tier, two broad screening tools were developed that incorporate several indicators of market functioning. From the literature review, it was concluded that there is little theoretical guidance for this type of indicators and therefore we opted for two approaches in tier one. In a first approach, the project focused on data-driven methods that aggregate several indicators of market functioning into a single number: a composite indicator score. Two types of composite indicators were constructed. First, "traditional" composite indicators were constructed assuming, as is mostly done in the literature and policy research, equal weights for the indicators for all sectors. Second, a more sophisticated aggregation method was implemented that determines the indicators' weight endogenously appealing to the idea of “benefit of the doubt”. For each sector, indicators’ weights are chosen as to maximize that sector score, provided the same weights are applied to all other sectors. This second methodology is particularly suited for a situation in which there is little guidance from economic theory about causal relations between indicators. Both of these composite indicators led to rankings of all sectors that can be analyzed in detail.

For the second approach in tier one, the AGORA-MMS project team opted for a more theory-driven approach. Of course, since theoretical evidence is mixed and very ambiguous, this could only be done by restricting attention to a more limited number of indicators and economic theories. This has resulted in a sector classification system that results in a subset of sectors that are labeled “require further investigation”, “require more investigation at the international level” and “low risk sectors”.

All of these approaches meet the demands of the original project objective of developing a screening tool for market functioning. But given the broad spectrum of available approaches in the literature, the project also provided a set of different and flexible screening tools that can be adapted to the specific needs of the users. Therefore, the project focused in a second tier on specific indicators and / or on detailed methodologies for particular markets. This resulted in two substantial case studies. The first case study focused on the inherent dynamic nature of markets and competition. The Persistence of Profits approach consists of investigating how profitability of companies in a sector evolves over time. The intuitive idea behind this approach is that in very competitive markets, the benefits of positive shocks in profitability erode more quickly than in less competitive markets. The dynamics of profitability serve as a synthetic indicator of all the underlying structural features that determine its functioning like for instance concentration, barriers to entry, international openness and so on. A second case study was developed to study local markets where the functioning is completely determined at the local level of a municipality or region as in the case of many service sectors (e.g. bakeries, travel agencies, …). From the work on the first tier, it emerged that broad screening tools are ill adapted to capture market functioning of such local markets. Therefore, an approach was taken that assesses the impact on profitability of accession of additional competitors on the market. Intuitively, the central idea behind the “entry threshold” methodology is that if market size has to expand more than proportionally when a new entrant comes in, this is an indication of intense competition and good market functioning.

The multi-tier approach of the AGORA-MMS project has resulted in a set of tools that can be used in the future by the FPS Economy to address its objective of screening market functioning at sector level. Many of these tools have been implemented in the FPS Economy software platform (SAS EGuide) and were carefully documented in order to facilitate future use and possible extensions and adaptations. Some other methods have been implemented in specialized dedicated software programs. In those cases, we have developed extensive documentation and the FPS Economy team has been closely involved in validating the procedures in view of possible future incorporation in the FPS software environment. All final results of the detailed indicators and the composite indicators have been made available in the Sectoral Database of the FPS Economy and are therefore ready to be used by FPS Economy collaborators in the future.

Finally, we are aware that the set of tools we developed is only a subset of all the possible tools that are available in the literature. In our choice, we have always tried to strike a balance between scientific rigor and practical usability. At several points in this report, we will make extensive reference to the scientific literature and we regularly review alternative approaches. By doing so, we believe this document can be of important use to the FPS Economy to implement the monitoring tools correctly, to use its results or as a reference document for future research projects to meet its objective of sector and market screening.

This remainder of this document is structured as follows. In Part One, we describe the composite indicators that were developed for this project. We start in section 2 with a brief introduction to the methodology of composite indicators distinguishing between traditional composite indicators (section 2.1) and the Benefit of the Doubt composite indicator (section 2.2). We turn to the data work in section 3 where we discuss all the individual indicators that enter the composite indicator monitoring tool. For each indicator, we provide formulas, intuition, theoretical background and literature references. We also discuss descriptive statistics for each of the indicators. Results of the composite indicator tool are to be found in section 4 in which we discuss separately the results for the traditional composite indicator in section 4.1 and the results for the Benefit of the Doubt indicator in section 4.2.

In Part Two we provide three additional monitoring tools that were developed under the AGORA-MMS contract. Section 5 discusses the decision tree or quick scan sector classification methodology. In section 6 we introduce the methodology aimed at analyzing competition in local markets based on the estimation of entry threshold ratios. Section 7 discusses the methodology based on the persistence of profits approach in order to assess the degree of competition in sectors. All of these additional tools are described in full detail in separate research papers. We compare the different methodologies in section 8 and we provide in section 9 (Part Three) conclusions and suggestions for next steps in the ongoing process of developing monitoring tools for market function.

PART ONE: COMPOSITE INDICATORS

2 Composite Market Performance Indicators

2.1 Traditional Composite Indicators

2.1.1 Introduction

In many policy domains researchers and policy makers are confronted with a multi-facetted reality consisting of a wide variety of performance dimensions. For instance, the World Economic Forum's (WEF) *Global Competitiveness Report* (GCR) is measuring competitiveness of national economies using 12 "pillars" ranging from institutions, macro-economic stability, infrastructure, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market sophistication, technological readiness, market size, business sophistication and innovation, see WEF (2009). The United Nations Development Programme's (UNDP) *Human Development Report* is another example of an international indicator tool covering a large variety of countries' performance variables ranging from GDP per capita to literacy and access to health care, see UNDP (2009).

Monitoring tools have also been constructed to measure market functioning, see for instance Cherchye et al. (2007b) for an evaluation of the performance of the European single market. Recently, market monitoring tools using economic sectors or industries instead of countries as basic units of observation have been developed; see for instance European Commission (2007a,b), Federal Public Service Economy (2008), or Office of Fair Trading OFT (2004). It is in the last category of market indicators that our Market Performance Indicator should be situated.

Most of these monitoring tools or scoreboards try to aggregate the information contained in the detailed indicators into one single number, a so-called *composite indicator*. Based on this composite indicator score, it is common to produce rankings of countries or sectors and to track their progress over time. The construction of composite indicators has almost become a scientific discipline in itself. A valuable resource for information on both methodology and case studies of composite indicators is the European Commissions' Joint Research Center website[2]. This research center has also played an important role, together with OECD, in the writing of a handbook on composite indicator construction, see OECD (2008). The OECD handbook has served as an important input for the text.

This type of aggregation exercises, and the ranking they produce, is of course strongly dependent on how the different individual indicators are aggregated into one single indicator. Very often, there is theoretical and statistical evidence that sub-indicators are linked or correlated. Frequently, negative and positive feedback loops are present such that the final impact depends on the balance of these negative and positive tendencies. Therefore, researchers mostly lack a comprehensive model of the complex reality they want to capture and as a consequence, little can be said *a priori* about appropriate weights for the different sub-indicators in the final composite indicator. Lack of solid theory is often used as an argument to compute a simple unweighted average (i.e. equal weights) of all subindicators. Some composite indicators however, use varying weights by dimension (see for instance the WEF (2009) GCR) based on expert judgment or normative considerations.

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[2] European Commissions' Joint Research Center website. Composite Indicators: An information server on composite indicators, see http://composite-indicators.jrc.ec.europa.eu/

In this section, we give a brief introduction to the construction of composite indicators and the major issues involved. We refer the interested readers to OECD (2008) for a more elaborated introduction to the theme. After reviewing *traditional composite indicator* construction, we will discuss in more detail a more sophisticated aggregation method known as the *Benefit-of-the-Doubt* (BoD) approach.

2.1.2 Arithmetic and Geometric Mean of Indicators

Consider a number of indicators $i = 1, \ldots, m$ which are observed at the sector level $s = 1, \ldots, k$. Examples of such indicators are for instance market concentration, measured for instance by the Herfindahl-Hirschman index, price-cost margins, import penetration and so on[3]. The raw score of a particular sector s on indicator i is denoted by $y_{s,i}$, its normalized score by $y^n_{s,i}$. A first way to define a composite indicator (CI in the sequel) is to compute the weighted sum of normalized indicator values on all individual indicators:

$$CI_s = \sum_{i=1}^{m} w_i \cdot y^n_{s,i} \qquad \forall s \in \{1, 2, \ldots, k\}$$

Although the theoretical framework is in principle flexible, we observe that in many applications, one uses equal weights for every indicator ($w_i = 1/m$) and the same set of weights for all sectors (the w_i's do not depend on s). The composite indicator score is in that case the *arithmetic mean* score of the sector over all indicators. Adopting equal weights is typically done in situations where one has limited, or even no, a priori information or theoretical model that can give guidance about the relative importance of each indicator in the overall picture.

It should be noted however that the linear aggregation formula corresponds to a specific assumption regarding the trade-off, and hence also possible compensation, between indicators. A sector that scores highly on say market concentration can compensate this by a low score in another indicator, say for instance its price-cost margin. With the fixed weights, the marginal impact of an indicator on the composite indicator score is always the same for all sectors ($\partial CI_s / \partial y^n_{s,i} = w_i$ for all s). For a given indicator, it is also independent of the score on the indicator itself and of the values of the other indicators ($\partial^2 CI_s / \partial y^n_{s,i} \partial y^n_{s,j} = 0 \quad \forall i, j$). This implies that the composite indicator is additively separable and therefore the contribution of a particular indicator to the composite indicator does not directly depend on the value of the other indicators. Indirectly however, it can depend on other sectors'

[3] The indicators mentioned here will be explained later in the report when we discuss the different indicators in detail.

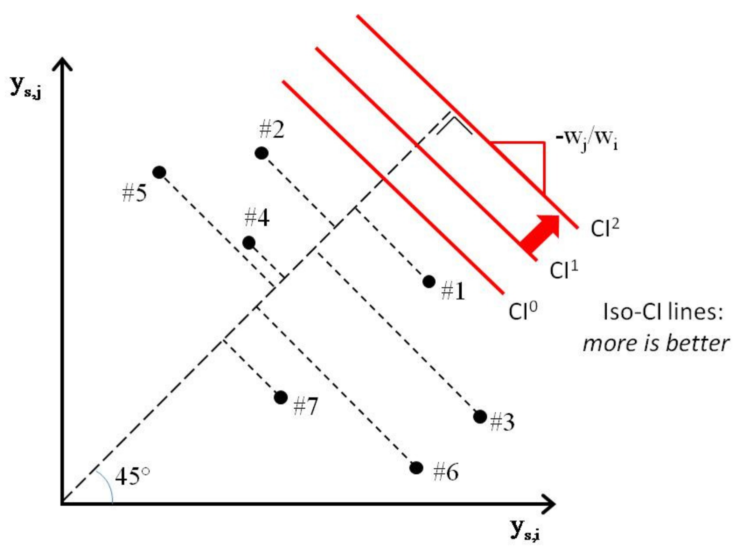
scores on the same indicator through the normalization formula chosen. We will discuss normalization in more detail below.

The ratio of the weights of two indicators i and j in the CI can be interpreted as marginal rate of substitution between the two indicators. It tells us how much of sub-indicator j that has to be given up in order to compensate for an increase in sub-indicator j in order to keep the sector's CI score constant. For instance, if sector s experiences a decrease in concentration by one unit, it has to improve its score on price-cost margin by w_j/w_i units in order to keep its overall CI score constant because:

$$dCI_s = \sum_{i=1}^{m} w_i \cdot dy_{s,i}^n = 0 \qquad \Rightarrow \quad \frac{dy_{s,i}^n}{dy_{s,j}^n} = -\frac{w_j}{w_i}$$

Figure 2 shows how we can represent this type of linear Composite Indicators. On the vertical axis we measure indicator j, on the horizontal axis indicator i. Both indicators are "goods" in the sense that higher scores are deemed better. Every point in the cloud or scatter plot represents one sector s. Given a linear Composite Indicator, we can draw iso-composite indicator lines (iso-CI lines) which comprises of all points that yield the same CI-score. These lines have a slope equal to $-w_j/w_i$ as shown above. In Figure 2 we assume that both indicators have the same weight, hence the slope of the iso-CI lines equals minus one. Using the iso-CI lines we can now easily rank the sectors. Starting at top-right corner, one draws iso-CI lines until one reaches the first point, sector #1. This sector achieves the highest CI score given if we consider only indicators i and j and if we attach equal weight to both indicators. Continuing this argument, we can determine the rank order of the other sectors.

Figure 2: Visual Representation of Traditional Composite Indicators



Another way of aggregating is to use the *geometric mean* of the indicators:

$$CI_s = \prod_{i=1}^{m} \left[y_{s,i}^n \right]^{w_i} \quad \text{or} \quad CI_s = \sum_{i=1}^{m} w_i \log\left(y_{s,i}^n \right) \qquad \forall s \in \{1, 2, \ldots, k\}$$

The geometric mean is the product of the sub-indicators which have been raised to the power w_i. A practical way to compute the geometric mean is to take logarithmic transformations of the sub-indicators and taking the weighted arithmetic average of the transformed values[4]. In this formulation, the marginal impact of one particular sub-indicator for a given sector depends on the weight of that indicator and on the inverse of the sector's score on the sub-indicators since $\partial CI_s / \partial y_{s,i}^n = CI_s \cdot w_i / y_{s,i}^n$. Hence, the marginal impact of a particular indicator is decreasing for the geometric formulation and not constant as in the arithmetic mean case. Intuitively this means that an increases in sector s performance on sub-indicator i leads to a lower increase in the overall CI score if sector s is already doing very well on sub-indicator i. In other words, increasing performance in dimensions one is good at, leads to lower and lower increases of the overall CI score. The marginal rate of substitution between the two sub-indicators for the geometric mean becomes:

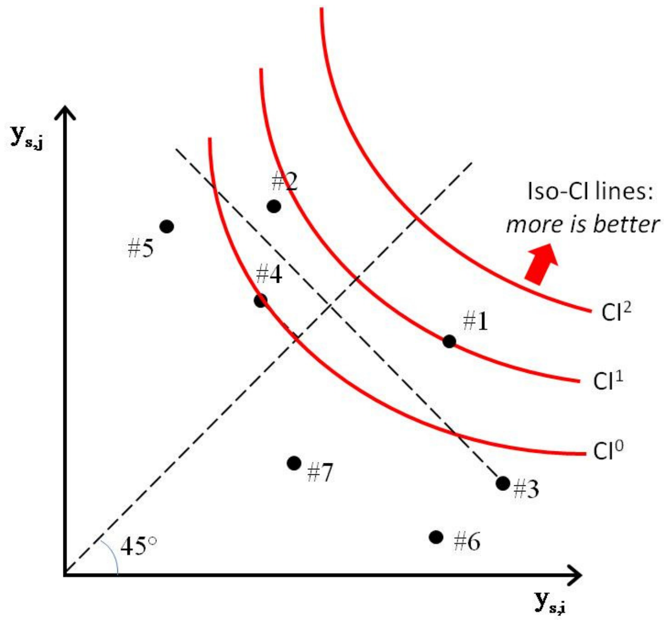
$$\frac{dy_{s,i}^n}{dy_{s,j}^n} = -\frac{w_j}{w_i} \cdot \frac{y_{s,i}^n}{y_{s,j}^n}$$

For instance, if one of the indicators were R&D expenditure (which we consider as "good"), an increase in R&D expenditure will have a relatively stronger impact on the CI score for sectors that are characterized by low R&D expenditure compared to sectors doing very well on that dimension. Doing better in one's weaker dimensions counts for more compared to increases in one's stronger dimensions. Similarly, deteriorating performance in weak dimensions is penalized more than a decrease in strong dimensions. Whether this is a desirable feature of the composite indicator in general depends of course on the indicators one considers and the relevant theoretical and empirical evidence. We only want to point to the important implications of the choice of aggregation formula.

[4] In order for the CI to be well defined, it is of crucial importance that the sub-indicator values are strictly positive before applying the logarithmic transformation.

Graphically, Figure 3 shows that the geometric mean leads to curved iso-CI lines. Compared to the arithmetic mean, this can lead to different rankings of the sectors. For instance, sector #3 ranks 4 under the geometric mean instead of 3 under the arithmetic mean.

Figure 3: Traditional Composite Indicators using Geometric Mean



2.1.3 Normalization of sub-indicators

Not only the way indicators are aggregated, using the arithmetic or geometric mean, has a strong impact on the final composite indicator. Also the way the raw indicator values are normalized plays an important role in the analysis. First, it should be noted that indicators should all point into the same direction (for instance, *high* indicator values are considered *desirable*). This will sometimes require transforming the raw data, for instance by taking the negative or inverse of the original values. Secondly, indicators should be brought onto the same denominator in order to be comparable. Many different normalization formulas appear in the literature. It makes no sense to compare percentage scores with monetary values expressed in thousands of Euro's. We will not review all the possible normalizations here, we will only list the most commonly used and we will mention some general properties of normalizations.

Good versus bad indicators

Typically, some sub-indicators can be considered as "good", i.e. high scores on this sub-indicator are desirable, whereas other indicators are considered "bads" in the sense that high scores are deemed undesirable. For instance, higher R&D expenditures are deemed good whereas high score on a concentration index like the Herfindahl-Hirschman index are considered bad. For the construction of a composite indicator, it is therefore of crucial importance to ensure that all sub-indicators point into the same direction. In order to achieve this, the direction of some indicators will have to be reversed by an appropriate normalization. Typically, there a two dominant normalizations used for this purpose, the reflection and the inverse transformation.

- Reflection transformation: $y^{n}_{s,i} = -y_{s,i} \quad \text{or} \quad y^{n}_{s,i} = 1 + \max_{s}\left\{y_{s,i}\right\} - y_{s,i}$

  In the reflection transformation, the original data is transformed by reversing its sign. Positive numbers become negative and *vice versa*. In some context, one wishes to have strictly positive numbers after the transformation (because one wants to apply a geometric mean through logarithmic transformations afterwards, see before). In order to achieve this, one can add the maximum value of the sub-indicator (plus one to ensure strict positivity). Note that the reflection transformation is a linear transformation in contrast to the next alternative, the inverse transformation.

- Inverse transformation: $y^{n}_{s,i} = \frac{1}{y_{s,i}} \quad \text{for} \quad y_{s,i} \neq 0$

  Under the inverse transformation, bads are transformed into goods by taking the inverse of the sub-indicator values. Of course, one has to be careful to avoid dividing by zero. The inverse transformation is a non-linear transformation. The ranking of sectors can be different after applying the inverse transformation compared to the reflection transformation. This implies that the final CI scores and sector ranking is not neutral for the way bads are transformed into goods.

Different normalizations

After converting all sub-indicators into "goods", the next step involves normalizing the different data series. This is mostly done to bring all series on comparable scales and units. For instance, if we measure concentration by means of the Herfindahl-Hirschman index, the sub-indicator ranges between 0 and 10,000. On the other hand, R&D expenditure is often measured as a ratio of total R&D spending over turnover, hence this sub-indicator ranges between zero and one. Obviously, if both of these sub-indicators are summed to generate a CI, the concentration measure will dominate the R&D sub-indicator in the final result. In order to avoid this, normalization of the indicators is common practice. Below, we summarize some of the most commonly used normalization methods.

- Rank score normalization: $y^{n}_{s,i} = y^{rank}_{s,i}$

In this approach, the original data is transformed by ranking the different sectors for this specific indicator and using their rank order as normalized score in the construction of the composite indicator. This normalization is ordinal in the sense that the relative distance between the scores on a specific indicator of two sectors does not influence the final score. Only its relative position compared to other sectors plays a role. Whether the indicator score of sector x is only slightly higher than that of sector y, or much higher, the impact on the composite indicator is in both cases identical. The advantage of this normalization is that it is insensitive to small measurement errors in the original data. The disadvantage is that a lot of information on the intensity of the sub-indicator is thrown away.

- Categorical normalization:

  $y^n_{s,i} = +1$ if $y_{s,i} > \overline{y}_{s,i} \cdot [1+\alpha]$;

  $y^n_{s,i} = -1$ if $y_{s,i} < \overline{y}_{s,i} \cdot [1-\alpha]$ and

  $y^n_{s,i} = 0$ if $\overline{y}_{s,i} \cdot [1-\alpha] \le y_{s,i} \le \overline{y}_{s,i} \cdot [1+\alpha]$

  with $\overline{y}_{s,i}$ the arithmetic average indicator score over all sectors and α equal to 0.10 or 0.25 for instance.

  In this example, information of the indicators is transformed such that values higher than one plus α times the mean over all sectors get value +1, values lower than one minus α times the mean get -1 and value zero in between. Many other ways to categorize the underlying indicator values are possible, for instance “flagging” the top three or bottom 3 sectors. Or giving value one to all sectors in the top decile and zero to all others and so on. The exact formulations are numerous but they all build on the same idea: categorizing the original data series into a limited number of classes.

- Distance-to-leader normalization: $y^n_{s,i} = \frac{y_{s,i}}{\max_s\{y_{s,i}\}}$

  In the distance-to-leader normalization, the best performing sector on the indicator at hand is used as benchmark to compare all other sectors. Since no information on sectors outside the country is used, this type of normalization can be labeled as *internal benchmarking*.

- Distance-to-mean/median normalization: $y^n_{s,i} = \frac{y_{s,i}}{\overline{y}_{s,i}}$ or $y^n_{s,i} = \frac{y_{s,i}}{y^m_{s,i}}$

  In the distance-to-mean/median normalizations, the mean or median sector is taken as benchmark for all other sectors.

- External benchmarking normalization: $y^n_{s,i} = \frac{y_{s,i}}{y^B_{s,i}}$

In the external benchmarking, a benchmark indicator value from outside the country is chosen as benchmark to compare all sectors. Typical examples are normalizations that compare individual EU member countries' performance to the performance of for instance the OECD or USA average. This type of normalization is chosen used in the European Commission exercises (see European Commission 2007a,b) for instance.

- min-max normalization: $y^n_{s,i} = \frac{y_{s,i} - \min_s\{y_{s,i}\}}{\max_s\{y_{s,i}\} - \min_s\{y_{s,i}\}}$

  The indicator value is rescaled such that it is always confined between zero and one. Sub-indicators in the WEF (2009) GCR are normalized in this way for instance.

- z-score normalization: $y^n_{s,i} = \frac{y_{s,i} - \overline{y}_i}{\sigma_i}$ with σ_i the standard deviation of the indicator. This normalization originally stems from statistics and is for instance used by FPS Economy (2008). The transformed values can be interpreted as how many standard deviations the particular sector under consideration is deviating from the arithmetic mean.

It should be noted that the normalization can have important consequences for the final result but that it is always compromising between different properties. For instance, the attraction of the rank score normalization lies in the fact that it is insensitive to outliers. This is the case for all normalizations that are ordinal in nature (i.e. normalizations such that the sectors' ranking is invariant to monotone transformations). Other normalizations are however very sensitive to outliers, in particular normalizations that use the best (or worst) performer in the sector as benchmark. However, a disadvantage of the rank order normalization is that it makes no use of the relative distances between sectors. That information is simply ignored in the final composite indicator based on rank orders of the different sub-indicators. In other words, some potentially useful information is not exploited in the ordinal transformations.

We will not suggest a particular preferred method to be used in all circumstances. Depending on the research question and available data, different methods can be preferable. We only want to make clear that the normalization is very important as it can have a substantial impact on the final ranking of the sectors. If we denote by $y^n_{s,i} = f\left(y_{s,i}\right)$ the normalization transformation, we can write the marginal rate of substitution between two indicators for the distance-to-mean normalization as follows:

$$\frac{dy^n_{s,i}}{dy^n_{s,j}} = -\frac{w_j}{w_i} \cdot \frac{\frac{df\left(y_{s,i}\right)}{dy_{s,i}}}{\frac{df\left(y_{s,j}\right)}{dy_{s,j}}} = -\frac{w_j}{w_i} \cdot \frac{\overline{y}_{s,i}}{\overline{y}_{s,j}}$$

Hence, in this particular case, the trade-off between the two sub-indicators depends on mean values over all sectors which are possibly biased by the presence of outliers or measurement errors in the data. In our implementation we will therefore provide different possibilities for the user to normalize the data. The user should be aware of the importance of normalization and ideally should test how sensitive his or her results are for the normalization method used.

2.2 Benefit of the Doubt approach (BoD)

So far, we have only reviewed approaches with fixed weights across sectors. However, it is also possible to have weights that are endogenously determined by the data itself and which might differ between sectors. The Benefit of the Doubt (BoD in the sequel) approach is an example of such an approach. The BoD method is rooted in production efficiency measurement, in particular it can be considered as a particular form of the Data Envelopment Analysis (DEA) technique. Intuitively, the BoD approach tries to find for each sector a vector of weights for the different indicators so that the sector performs best compared to its peers. The BoD comprises three distinct steps, see Cherchye et al. (2007a):

(1) Normalization by comparing a sector with one of its peers:

$$\frac{\sum_{i=1}^{m} w_{s,i} \cdot y_{s,i}}{\sum_{i=1}^{m} w_{s,i} \cdot y_{B,i}}$$

Note that the weights are sector dependent and that untransformed subindicator scores are used here. The peer sector (B or Benchmark) score is computed using the weights of sector s. This normalization has a natural interpretation that a sector that scores less than one performs worse than possible.

(2) Benchmarking, i.e. choosing a best-practice peer:

$$\frac{\sum_{i=1}^{m} w_{s,i} \cdot y_{s,i}}{\max_{j \in \{1,2,\ldots,k\}} \left\{ \sum_{i=1}^{m} w_{s,i} \cdot y_{j,i} \right\}}$$

The benchmarking peer is the sector that achieves the highest possible CI score when using the weights of sector s. Note that it might occur that sector s is its own benchmark. In that case, the CI score of sector s is one.

(3) Determining weights as to maximize a sector's score, given that the same weights would be applied to all other sectors.

$$\max_{(w_{s,1},\ldots,w_{s,m})}\left[\frac{\sum_{i=1}^{m} w_{s,i}\cdot y_{s,i}}{\max_{j\in\{1,2,\ldots,n\}}\left\{\sum_{i=1}^{m} w_{s,i}\cdot y_{j,i}\right\}}\right]$$

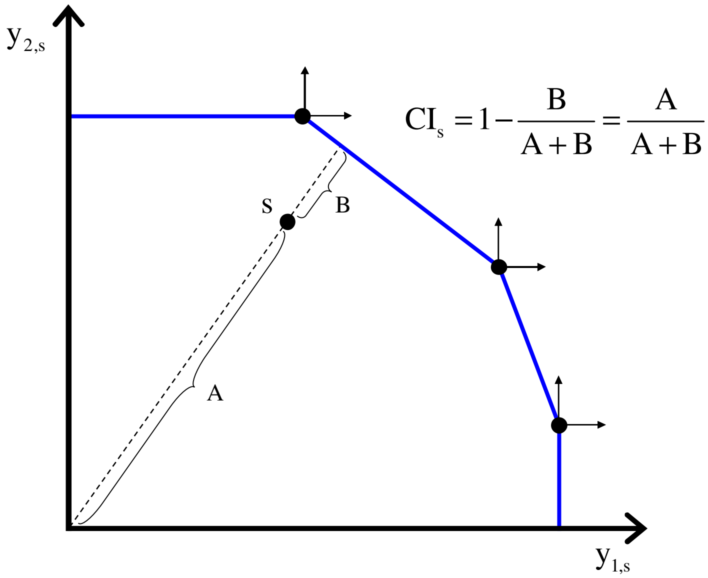
In the final step, weights are chosen as to maximize sector s' overall CI score, given the benchmarking in step (2) and normalization in step (1).

Given the procedure outline above, every other set of weights would lead to a deterioration of sector s position relative to the other sectors. This is exactly the property that led to the terminology Benefit of the Doubt.

Graphically, the approach can be illustrated easily for a composite indicator consisting of only two sub-indicators. In Figure 4, The horizontal axis measures sectors' performance on a first indicator, the vertical axis measures the second performance indicator. Every sector can easily be plotted in this two-dimensional output space using a scatter diagram.

The outer solid line describes a hypothetical best-practice frontier. It consists of the convex hull of the data points, i.e. all undominated sectors, plus all line intervals connecting them. Undominated sectors are sectors for which one cannot find other sectors in the sample that strictly outperform them in at least one output dimension. Graphically, there are no sectors situated to the North-East (top-right) of an undominated sector. Given this particular frontier, every sector is compared to the best practice frontier and an intuitive performance index is to measure its relative shortfall to the best practice frontier. The distance to the frontier is given by B and can be interpreted as a measure of inefficiency. Alternatively, efficiency can be measured as the complement 1 – B/[A+B] = A/[A+B].

Figure 4: Visual Representation of BoD Composite Indicator



In general, the set of weights for the indicators for a given sector s is the solution to the following linear program:

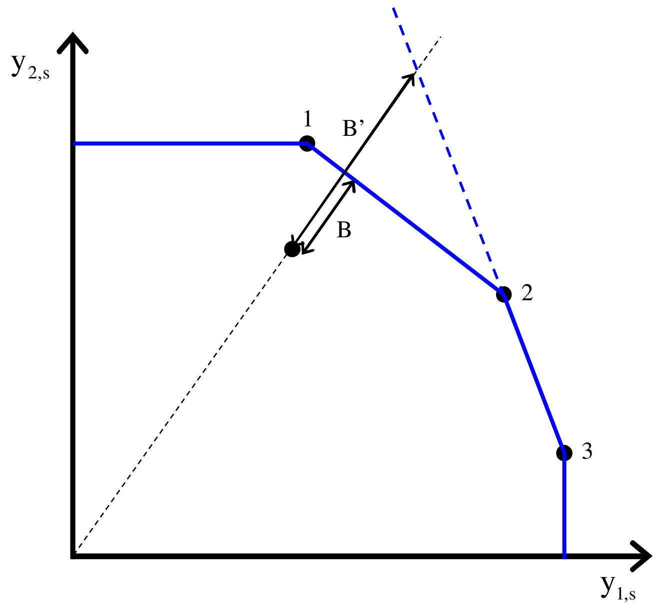
$$CI_s = \max_{\{w_{s,i}\}_{i=1,\dots,m}} \sum_{i=1}^{m} w_{s,i} \cdot y_{s,i}$$

$$\text{s.t.} \begin{cases} \sum_{i=1}^{m} w_{s,i} \cdot y_{s',i} \le 1 & s' = 1,\dots,k \\ \underline{W}_{s,i} \le w_{s,i} \cdot y_{s,i} \le \overline{W}_{s,i} & i = 1,\dots,m \end{cases}$$

Data requirements are observations for all sectors s=1,2,…,k for all the indicators i=1,2,…,m. For each sector, a separate linear program is solved. The objective of the maximization program is to find weights for the indicators such that sector s has a maximal composite indicator score. But the weights are constrained such that no other sector can achieve a score higher than one with weights vector of sector s.

Graphically, in Figure 5, this corresponds to finding a couple of peers such that the score of sector s is maximized. Take for instance sectors 2 and 3 as peers for sector s. The implicit weights of the indicators are given by the slope of the interval connecting points 2 and 3. The resulting distance between sector s and the hypothetical best practice frontier would be B’ which is considerably larger than B in the case we used sectors 1 and 2 as benchmarks for sector s. Hence, sectors 2 and 3 (and the corresponding trade-off between the indicators) cannot be optimal for sector s. The best possible choice of peers and weights for sector s is the couple 1 and 2 as we illustrated before in Figure 4.

Figure 5: BoD Indicator scores with Alternative Peers

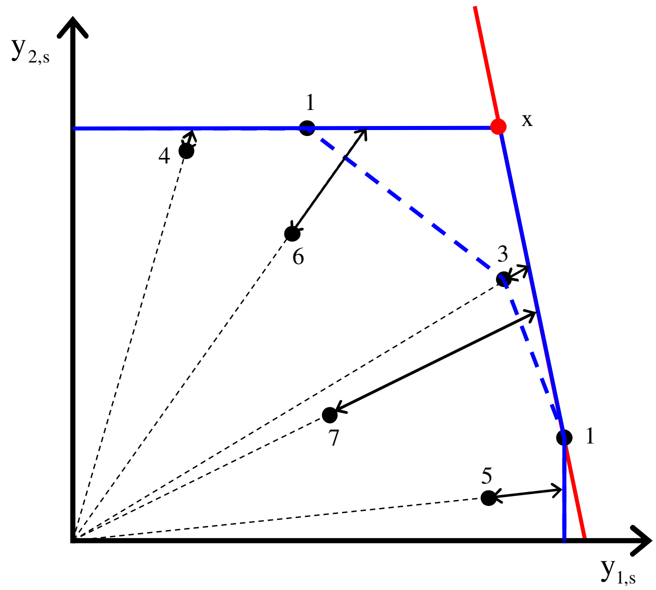


This construction of weights is feasible as long as one has more subjects to compare than indicators (k should be larger than m) and ideally, there are many sectors, and therefore many possible peers, such that the best-practice frontier is nicely convexified.

Restrictions on weights

In many application contexts, there are some exogenous reasons to put lower or upper bounds on the weights of particular subindicators. For instance, the researcher might want to distinguish between three subsets of subindicators and give equal weight to each category in the final composite indicator. Or, from theoretical analysis, the researcher might know that indicator 1 should get a higher weight than indicator 2. Sometimes, restrictions on the weights of different sub-indicators are derived from surveys or some participatory mechanism involving expert users of the data and composite indicator. Graphically, the effect of imposing this restriction is illustrated in Figure 6. In particular, the restriction implies that the slope of the iso-index lines (red line in Figure 6) should exceed a specific value and hence, the iso-index lines should be sufficiently steep. It can be interpreted as if some hypothetical peer (point x) has been added such that the shape of the frontier changes. This might affects the efficiency score of several points in negative direction as illustrated in Figure 6.

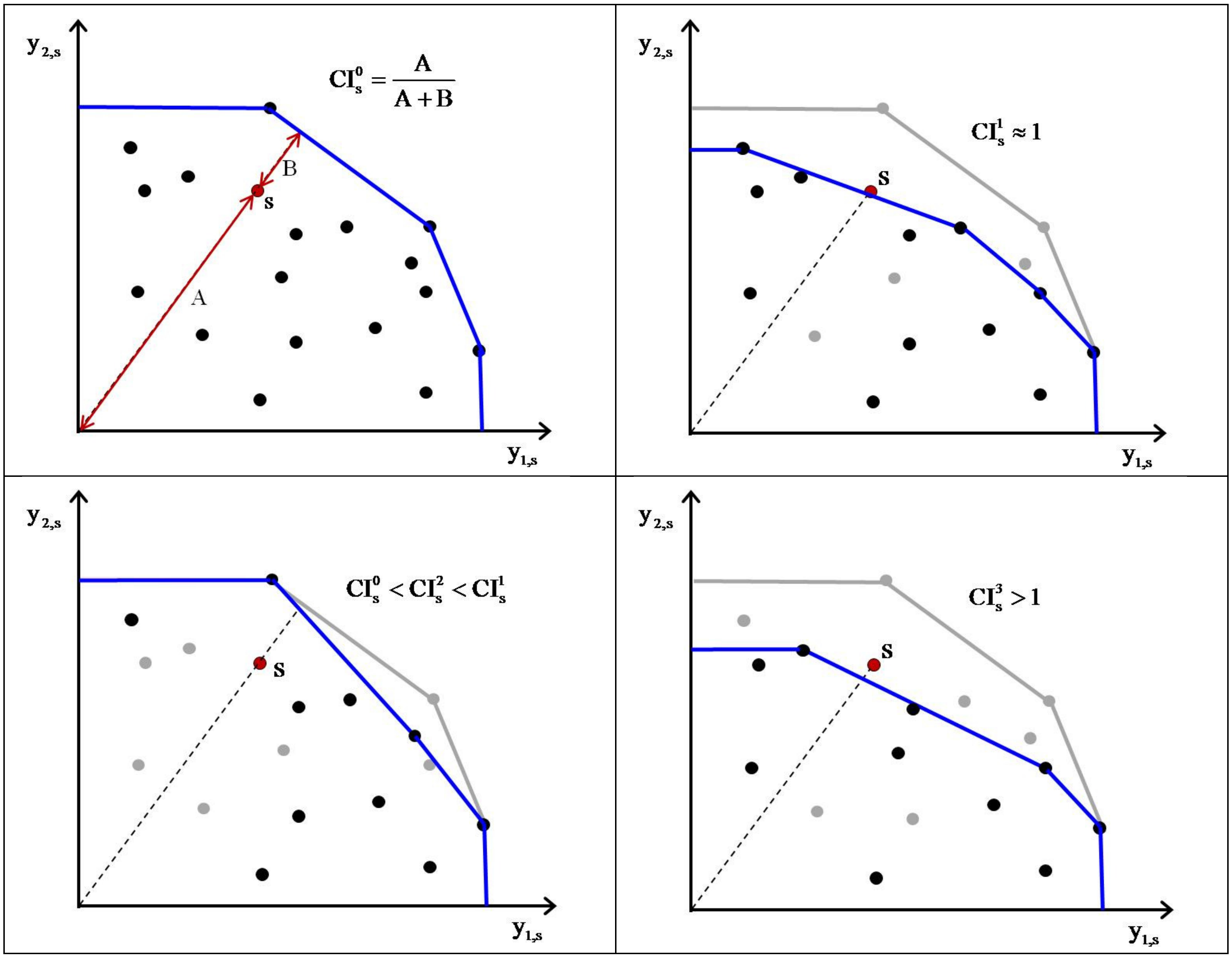
Figure 6: BoD Indicator with Weight Restriction



Robustness

One could object that the final BoD scores are highly dependent on the available peers in the sample. This has been recognized in the literature and therefore, it is common practice to perform robustness analysis on the BoD scores. One way to do this robustness check, is to repeatedly sample a subset of sectors and recompute the BoD score for sector s using the subsamples of sectors and possible peers. The size of the subsamples is very important in this type of analysis and it is commonly known as "order alpha". In the order alpha approach, subsamples of size [1-alpha] m are drawn out of the full sample of sectors (cardinality m). The alpha refers to the share of the population that is disregarded in the sampling. Figure 7 shows how this approach works for a stylized example and only three samples. In reality typically one considers a few thousand of replications of the sampling to construct confidence intervals for the BoD scores.

Figure 7: Robust BoD Scores



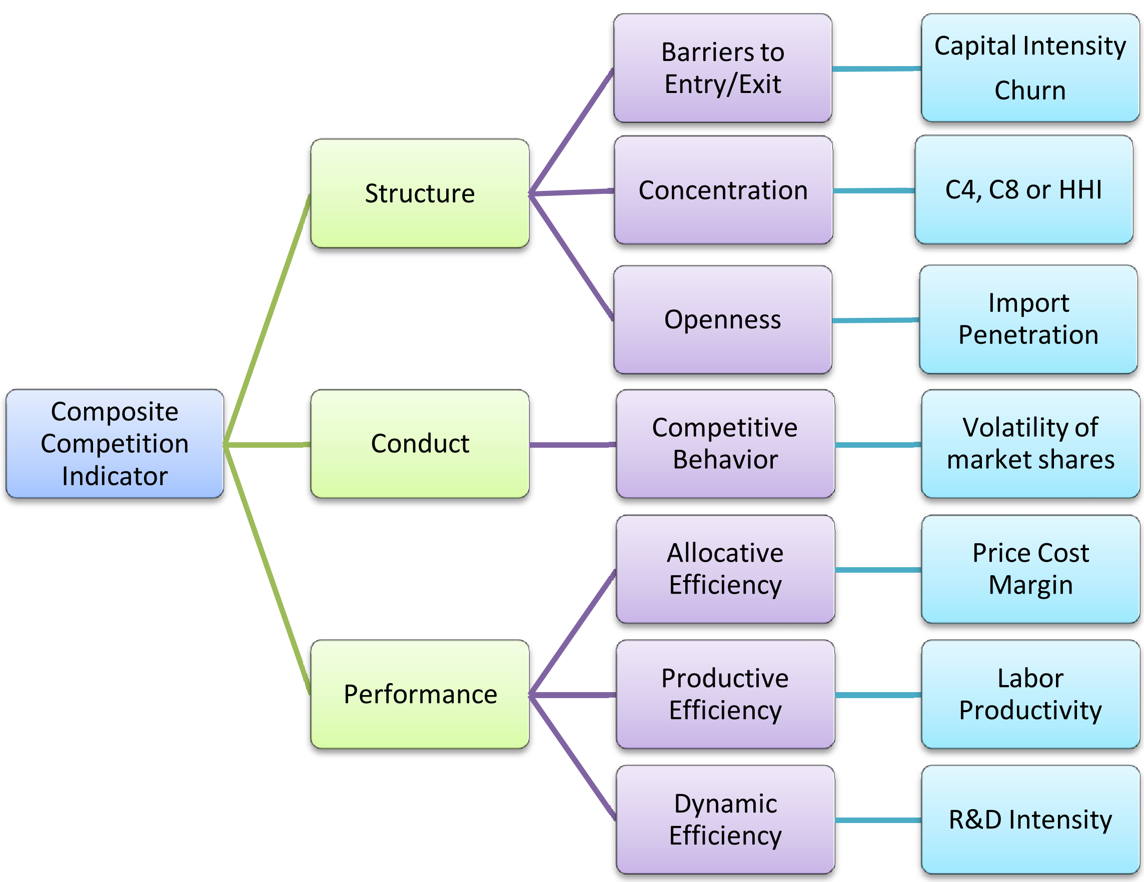
The first panel (top-left) shows how the BoD score for sector s is constructing using the full sample. In the following panel (top-right), five observations are randomly dropped resulting in a new efficiency frontier and hence new BoD score for sector s. As can be seen, sector s becomes a peer as it lies on the frontier. In the next panel (bottom-left) other sectors are randomly dropped resulting another frontier and BoD score. In the last panel (bottom-right) we observe that a sector can end up with an efficiency score exceeding one when it falls outside of the new frontier. This exercise is repeated hundreds of times and gives rise to a dataset of BoD scores for sector s. This dataset can be used to construct empirically confidence intervals (at for instance 10% level). This method is a kind of bootstrapping method as applied in econometrics. See Simar and Wilson (1998, 2000) for more details on bootstrapping efficiency scores.

3 The Components of the Composite Market Functioning Indicator

3.1 Introduction

The composite indicator covers the three traditional dimensions of market functioning as described in the Structure-Conduct-Performance paradigm, see Schmalensee (1989). Figure 8 shows these three dimensions together with the groups of indicators in each dimension. Note that we do not assume any causal relation between the three dimensions as the literature today is very skeptical about the SCP paradigm in the older empirical Industrial Organization literature, see for instance Cabral (2000) or Carlton and Perloff (2005) for a discussion of the SCP debate . The grouping of indicators into three dimensions is primarily done for expositional reasons in the MMS project. For each of the dimensions, we have chosen to operationalize them by means of a fundamental economics concept like efficiency (in different forms), entry barriers or openness of the economy. In a last step, each of these concepts has been linked to an indicator.

Figure 8: Overview of the composite indicator



In the following sections we discuss the precise definition of each indicator and the underlying economic rationale of using it for analyzing the functioning of markets. We also comment on data issues and limitations since this helps to clarify the choices for this particular set of indicators. For the latter reason, the discussion of the economic rationale has been restricted to the proposed indicator only rather than commenting extensively on a range of unavailable alternatives for the proposed indicator.

3.2 Data sources

All data sources, except for R & D data, are available in the Data Warehouse of the FPS Economy using SAS 9.1 as software platform. Data from the so-called Primary Data Sources come from Statistics Belgium own surveys. This is the case for the Structural Business Survey (SBS) (the most important wide scale survey on general "structural" company characteristics) and for Prodcom (detailed monthly product-level survey on industrial production). The other, so-called Secondary Data Sources provide data coming from other institutions: varying form Annual Company Accounts and data on imports and exports (from the National Bank of Belgium), to turnover (from the VAT-administration), employment (from the Social Security offices of Employees - RSZ/ONSS and self-employed - the RSVZ/INASTI) and R&D Data, aggregated on Nace 2-, 3- and 4-digit level (provided by Federal Science Policy).

The basic data used for the computation of the indicators are specified at the level of the individual companies (except for the aggregated data series on R&D and on worked hours of self-employed). For some series (namely imports, exports and Prodcom) the micro data are further specified at product level. For the aggregation of the individual company data to sector totals, the so-called NACENIS nomenclature rev.2 (version 2008) has been used. This is the unique NACEBEL code rev. 2 attributed by Statistics Belgium to each company. In the beginning of 2011 Statistics Belgium finalized a large scale operation of attributing new Nace-codes (version 2008) to two large groups of companies: first, a group of about 750.000 companies that were active at the end of 2007 and secondly another group of also about 750.000 companies that had been active, at least shortly, between 2000 and 2007. For these companies, for which original data series where available, a large scale Nace backcasting procedure was needed in order to produce consistent statistical series from 2000 on. The results of this backcasting operation are sufficiently reliable on aggregate sector 5 digit level for the years 2000 to 2004, but not on individual company level.

Figure 9 gives an overview of the data sources that gradually became available for analysis, and the link with the different analyses that have been done within the scope of this project[5].

[5] Note that at the time this report was written, not all data was yet available in the FPS Data Warehouse. Therefore, some of the proposed indicators are conditional on future data availability. This has been indicated in the text, where applicable.

Figure 9: Relation between data sources and analyses

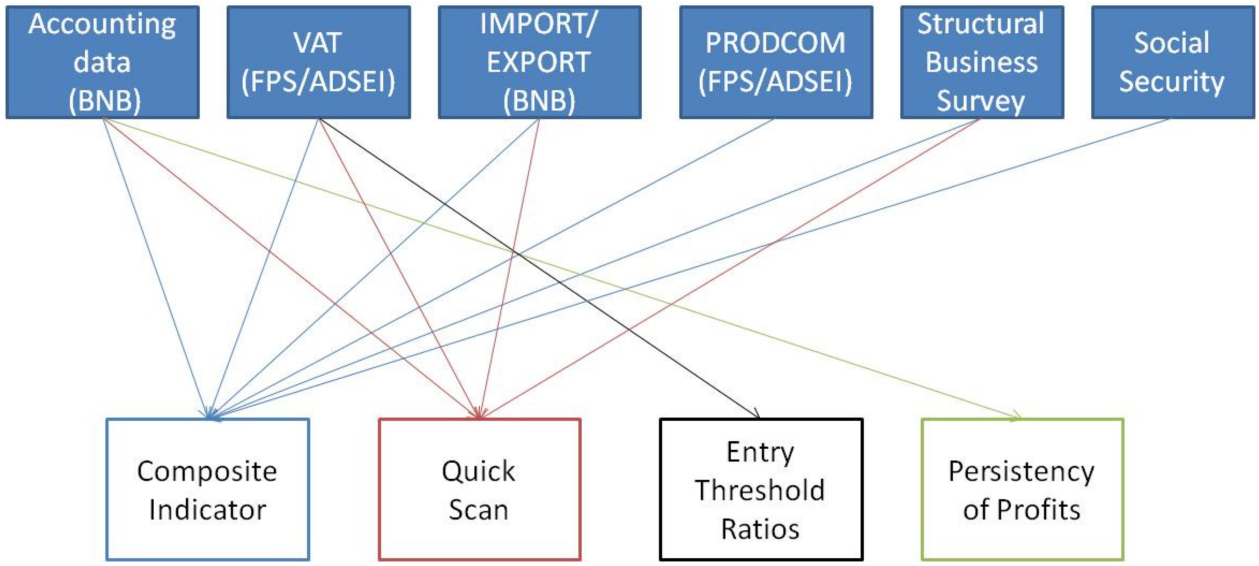


Figure 9 gives a graphic overview of the different data sources used in the AGORA-MMS project. One of the most important basic variables is the turnover on company level. Many sector indicators are derived from this measure. For instance, all the indicators of market concentration (C4, C8 and HHI) use information on market shares, i.e. the companies' shares in total sector turnover. Other indicators, like volatility of market shares and churn are directly based on the turnover. Some indicators use turnover for normalization, for instance capital intensity or R&D intensity. As the turnover is so fundamental for the AGORA-MMS work, a lot of efforts were spent on constructing a reliable measure of turnover with very wide coverage. The problem is that no single data source can provide turnover data with as well broad coverage as high reliability. In principle, turnover is reported in company accounts. But only firms that pass employment (50 persons), sales (7,3 mio Euro) and balance sheet (3,650 mio Euro) tresholds[6] are obliged to provide this information in their public accounts. Smaller companies are not submitted to this obligation, which implies that we would lose many observations on small and medium sized enterprises. In order to correct for this issue, a new turnover indicator was constructed by combining information of company accounts, of VAT declarations and of the Structural Business Survey. Technical details on the construction and validation of this "selected turnover" indicator can be found in a technical note by Luc Mariën (FPS Economy) in appendix. For the other indicators and data sources, more information is given below in the relevant sections for the individual indicators.

3.3 Structure Dimension

[6] Firms are considered as "large" either if they pass at least 2 of the 3 thresholds of if they employ at least 100 persons.

The relevant market to study the market power of firms is the set of products and geographical areas to which the products of the firms belong. In this study, we typically start our analysis at the 3-digit NACE level[7] and cover some important structural features of a sector: 1) the height of entry and exit barriers, 2) the extent to which particular markets are dominated by one or a few large companies, 3) the openness of a sector since Belgium is an open economy where exports account for a substantial part of local production and where imports represent a large part of local consumption.

3.3.1 Barriers to Entry/Exit: Capital Intensity

Formula

$$\text{CAPINT}_i^t = \sum_{i \in S} m_i^t \frac{K_i^t}{y_i^t}$$

where K_i^t stands for firm i's capital stock value in period t, y_i^t for its turnover and $m_i^t = y_i^t / y_s^t$ for its share in total sector turnover[8] (i.e. its market share). The capital intensity for sector s is defined as the weighted sum of the ratio of individual firms' capital stock value over turnover. The weights are typically based on firm's share in the sector total turnover or value added of the sector.

Intuition and motivation for including it in the monitoring tool:

Capital intensity is a measure of *entry barriers*, i.e. structural characteristics of an industry or sector that make it difficult for new companies to start operating in the sector. In particular capital requirements are identified by Bain (1956) as an element of market structure that enables established firms to prevent supra-normal profits from being eroded away by entry. The intuition is that entrants may have trouble finding financing for their investments because of the risk to the creditors or may be prevented from growing as existing players inflict losses on them in the product market in order to reduce their ability to find financing for new investments (Tirole, 1988).

Many empirical studies have tested for the relation between capital intensity and profitability, see for instance Schepherd (1972), or Domowitz, Hubbard and Petersen (1986a,b). Most of the literature finds a significantly positive impact of capital intensity on profitability as confirmed by the survey by Schmalensee (1989) who notes (Stylized Fact 4.7, p.) that: "Measures of scale economies or capital requirements tend to be positively correlated with industry-level accounting profitability". Harris (1986),

[7] Although such a sector-based approach is unlikely to correspond perfectly to economically relevant markets, it is a commonly adopted approximation of markets in this type of empirical work. Note that our analysis defines markets at much more detailed level than has been done in related efforts (Office of Fair Trading, 2004; European Commission, 2007) that were done at the aggregate 2-digit NACE level. Also, our empirical analysis will include robustness checks where results at the 4-digit NACE level are compared with those at higher levels of aggregation.

[8] We will denote the sum of turnover (and other variables) over all firms in a sector s by a subscript s in the sequel: $y_s^t = \sum_{i \in s} y_i^t$.

though, finds negative capital intensity coefficients in structure-performance equations estimated on both line of business and firm-level data for consumer durable and high median efficient scale subsamples. Harris (1988) shows that the firm specific cost of capital seems to explain a substantial part of variation in firm level profitability. He argues that the cost of capital affects the qualitative performance of other variables, most notably of capital intensity and concentration.

General data issues

The major problem in constructing reliable measures of capital intensity is that different firms sometimes use somewhat different accounting rules for depreciation and valuation of their capital stock. This makes it difficult to compare capital intensity over countries and even within one country, between sectors or even individual firms.

In addition, it should be noted that the literature typically uses accounting or book value as a measure of the value of the capital stock of a firm. If a company uses relatively old capital equipment that is depreciated fully in accounting terms, its capital intensity would be low although this is not an accurate reflection of the entry barriers in the sector. This is not much of a problem as long as there is a mixture of relatively young and old firms in the sector. It is an issue however for sectors in which most of the firms were established long ago.

Data issues in the MSS project

For the calculation of the capital intensity, we use National Bank of Belgium data on company accounts. This allows us to have information on turnover and tangible fixed assets. However, since the Belgian accounting law makes a distinction between the extended and abbreviated reporting scheme (depending, basically, on the size of the reporting company), not all of these variables are available for all companies. In particular, smaller companies (using the abbreviated reporting scheme) are not obliged to report turnover or sales (they can but they are not legally obliged to do so). In practice this means that for most small companies, turnover data are lacking from the NBB companies accounts database.

The final calculation makes use of the following fields of the NBB company accounts:

- Tangible fixed assets = code 22/27 = (1) land and buildings, (2) plant, machinery and equipment, (3) furniture and vehicles, (4) leasing and similar rights, (5) other tangible fixed assets and (6) assets under construction and advance payments.
- Turnover (code 70) = sales revenues

The SAS code computes the capital intensity in the following two steps:

1) Calculate for each firm its capital intensity = tangible fixed assets divided by turnover
2) Capital intensity for the sector = sum of all the firms' tangible fixed assets divided by the sum of all firms' turnover

After computing the capital intensity in the way described above, we pooled all observations by year and dropped the top and bottom 5% in order to avoid problems with outliers.

Alternative ways to measure capital intensity and entry barriers

There are different measures of capital intensity in particular, and entry barriers more in general, in the I.O. literature and in the financial economics literature. For instance, in OFT (2003), capital intensity is measured as the ratio of the value of the capital stock over value added (instead of turnover). There are no strong theoretical arguments to prefer one measure over the other and in practice, the choice is mostly driven by data availability considerations. Other publications measure capital intensity as the ratio of the capital stock over total asset (instead of turnover). We have implemented in the MMS project this variation of the capital intensity measure as a robustness check for our calculations. Total assets data (code 20/58) is from NBB company accounts, which includes fixed assets (tangible, intangible fixed assets, and financial fixed assets) and current assets.

In macro-economics one often uses another measure of capital intensity, namely the capital-labor ratio. Capital is measured as fixed assets at historical or replacement costs. Labor is the total number of workers employed or labor expenditure. Lim (1976) argues for a modified version, with capital adjusted for utilization, and labor as the number of production workers on the biggest shift. Unlike the I.O. literature, the macro-economic literature considers only the capital / labor ratio as a measure of capital intensity which is to be distinguished from capital intensity as a capital labor ratio in the strict sense.

Finally, capital intensity, in the I.O. or the financial economics' literature, can also be defined as the ratio of depreciation plus interest expense to total assets (Hecht, 2008). The idea here is to look at flow instead of stock values of the capital requirements in an industry. Conceptually, this can also be considered as a measure of entry barriers in a particular industry but its actual computation is again influenced by accounting standards about depreciation and valuation.

Except for capital intensity, there are numerous alternative measure of entry barriers. We discuss briefly two common measures: Minimal Efficient Scale (MES) and Cost Disadvantage Ratio (CDR). More details can be found in OFT (2004).

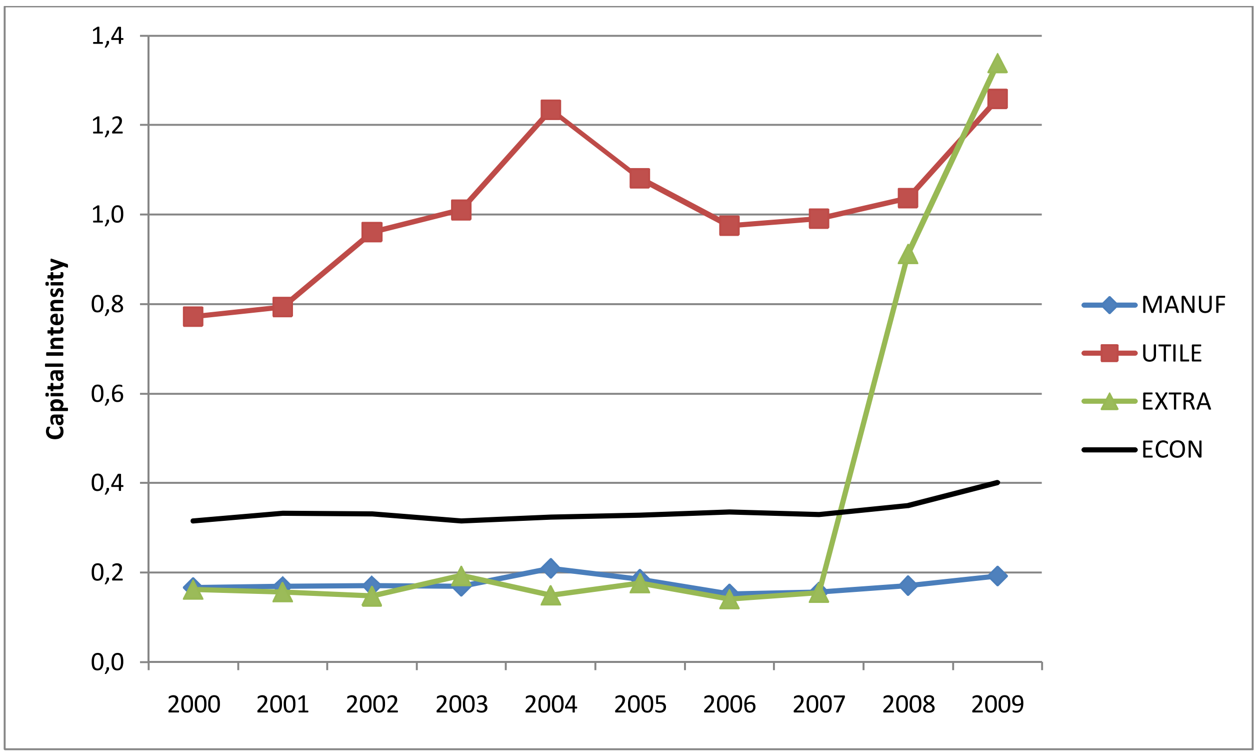
The idea of MES is that in some sectors, the minimal scale to be able to produce efficiently is so high that it is difficult for newcomers to mobilize sufficient resources to start up a new business of this size. Technically, in micro-economics the concept of MES refers to the level of output at which average costs in the long term are minimal. In practices, pragmatic proxy variables have been used to measure MES. For instance, in OFT (2004), the MES is approximated by the ratio of the average firm turnover of the largest firms (accounting for the first 50 per cent of total industry turnover) over total industry turnover. Caves et al. (1975) suggested to measure the extent to which a firm is disadvantaged by operating at a level below the MES by calculating the ratio of value added per worker in the smallest plants (accounting for 50% of market output) over value added per worker in the largest plants (accounting for 50% of market output). If there are significant economies of scale in a sector, this ratio will be less than one because workers in smaller scale and less efficient plants produce typically less value added than their peers in larger scale plants that are more efficient.

Descriptive statistics

In the following sections we will show descriptive statistics of the indicators for broad sector groups, subdivided in Manufacturing and Services. A precise definition of the different groups can be found in Appendix. The scores for each sector group are calculated as the arithmetic average of all the scores of the individual sectors belonging to the group. For the calculation of the sector group scores, the individual sectors are defined at NACE 3-digit level, except when indicated otherwise.

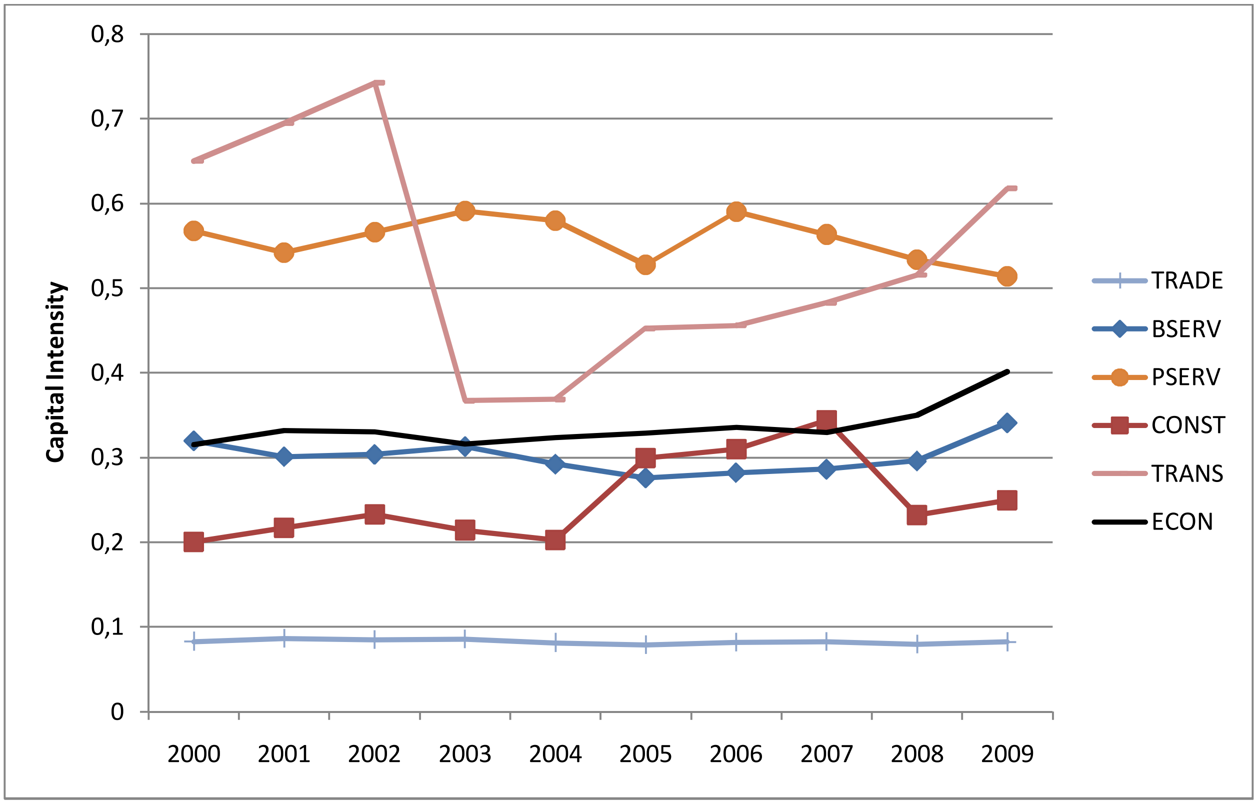
Figure 10 shows the evolution over time of the Capital Intensity indicator for the Manufacturing group of sectors. Capital intensity is very high in the Utilities and Electricity sector where the value of fixed tangible assets is equal to or more than annual turnover. In other manufacturing sectors, the capital intensity ratio is about 20% which is substantially lower than the overall average for the Belgian economy which is close to 40%. Over time, the indicator is very stable for the manufacturing industry but it varies considerably for Utilities and Extraction due to the limited number of companies.

Figure 10: Evolution Capital Intensity in Manufacturing



The evolution of capital intensity in services is shown in Figure 11. There is little variation over time in the Trade, Personal and Business Services sectors. More variation is observed in Construction and Transport. Overall we notice that by the end of the period (2009), Personal services (50%) and Transport (60%) are characterized by substantially higher capital intensity than Business Services (35%) and Construction (25%).

Figure 11: Evolution Capital Intensity in Services



At NACE 3 level, we observe in Table 1 very high capital intensity in network utilities sectors like water supply (360), sewerage (370), manufacture and supply of gas (352) and transport by pipelines (495). Sectors like freight rail transport (492), renting and leasing of motor vehicles (771) and renting and leasing of real estate (682) are characterized by high capital intensity because of their fleet of transport equipment and stock of real estate. Some outliers, like for instance manufacture of irradiation, electromedical and electrotherapeutic equipment (266) are probably caused by lack of sufficient and reliable data.

Table 1: Top 20 sectors Capital Intensity

[redacted]

Table 2: Bottom 20 sectors Capital Intensity

[redacted]

The lowest Capital Intensity we observe in radio broadcasting (601). This is probably due to particular accounting conventions about the valuation of capital equipment in formerly public broadcasting companies. Somewhat surprising also is the fact that passenger air transport (511) ranks low in capital intensity. This is probably due to the fact that in this sector, it is common not to own air planes but to lease them. More in line with intuition is that Capital intensity appears to be low in for instance travel agencies (791) and temporary employment agencies (782).

3.3.2 Barriers to Entry/Exit: Churn rate

Formulas

$$CHURN_s^t = \frac{\sum_{i\in s}\left[EN_i^t + EX_i^t\right]}{\sum_{i\in s} AF_i^t} \qquad WCHURN_s^t = \frac{\sum_{i\in s}\left[EN_i^t \cdot m_i^t + EX_i^t \cdot m_i^t\right]}{\sum_{i\in s} AF_i^t \cdot m_i^t}$$

The churn rate is an indicator that reflects the presence of entry and exit barriers in an industry. Churn is usually defined as the sum of the number of firms that enter and the number of firms that exit the industry over the total number of active firms. In the formula above we use dummy variables to count entering, exiting and active firms during a particular time frame (usually one year). The variables EN_i^t and EX_i^t are dummy variables taking value one if firm i was entering or exiting the industry respectively. AF_i^t takes value one for firms that can be considered active in the industry during the time frame considered. Gross entry and exit rates are defined by the ratio's EN_i^t / AF_i^t and EX_i^t / AF_i^t . Economic churn (or sometimes labeled also turnover rate) is the sum of gross entry and exit rates. The entry, exit and churn indicators can also be weighted by the relative size of the firms entering and exiting in order to take into account the market share, and hence importance, of the entries and exits. The market share weighted entry rate is also called entry penetration. For an overview of different ways to measure churn, see Dunne, Roberts and Samuelson (1988) or Robinson, O'Leary and Rincon (2006).

Intuition and motivation for including it in the monitoring tool:

The relationship between churn and other indicators like productivity, competition, employment or economic growth has been widely recognized in I.O. literature over the years. The starting point has been the contestable market theory that argues that free entry is likely to constrain the market power of incumbent firms in an industry (see Baumol, Panzar and Willig, 1982). With that in mind, deviations from free entry and exit have lead to the concept of entry and exit barriers, which can be summarized in a non-extensive way by economic churn. Therefore we have included churn in the MMS project's monitoring tool. Churn is calculated making use of firm-level data in order to assess the magnitude of entry and exit barriers on an extensive list of Belgian economic sectors.

One important insight of the contestable market theory is that if entry is easy, an incumbent firm would not be able to charge a high margin because large profits would attract competitors into the industry (Bain, 1956). However, in many industries new firms have to bear large fixed and sunk set up costs to enter the industry. Compared to the ideal of a competitive market with free entry and exit, the presence of substantial barriers to entry is likely to result in an inefficient allocation of resources because incumbent firms can maintain prices above marginal production costs.

Entry rates measure the level of entry barriers and market contestability, while exit rates measure the level of exit barriers and indicate the scale and speed of the selection process based on efficiency (EC 2008).

Entry and exit barriers can be structural, strategic or regulatory:

- Structural entry and exit barriers are characteristic to production conditions in the sector or the way services are provided. Possible structural entry barriers are economies of scale, network effects, economies of scope or the presence of specific know how (Hopenhayn, 1992). In the case of exit barriers the presence of high sunk costs is most decisive, which will deter firms to exit the market (Eaton and Lipsey, 1980).
- Strategic barriers are generated by the behavior of incumbent firms for the purpose of deterring entry or the purpose of pushing new entrants out. In this way, strategic barriers should be seen in a dynamic way since incumbent firms can easily adapt their strategic behavior in the short run. Exclusive dealing arrangements, high advertising expenditures, building up overcapacities or the threat of price cuts are a few examples of strategic barriers.
- Regulatory barriers could be strategic in nature depending on whether incumbent firms played a role in creating them by lobbying the government. But since information on lobbying activities is scarce, the literature usually focuses on requirements such as licensing procedures, territorial restrictions, safety or environmental conditions as regulatory barriers.

Data

The data used is an estimation of domestic turnover, based on three sources with their respective priorities: 1° Company Accounts, 2° SBS (Structural Business Survey) and 3° VAT.

From an extensive list of companies registered in Belgium in a given year – present in the Federal Public Service Economy’s Sector Database, we subtract the value of exports from total turnover in order to obtain a measure of domestic turnover.

Next, we define as active firms those with a strictly positive turnover in the analyzed period (any given year), making thus a clear distinction between active and dormant companies (registered but with no apparent activity). Active companies are defined every year between their entry and exit year (see definition below), so that a company might appear to switch from activity to inactivity over different periods. Using the notation in the formula above, $AF_i^t = 1$ if $y_i^t > 0$, where AF_i^t is the dummy for active firm i in year t, and y_i^t is the turnover of firm i in year t.

Further, a firm is considered an entrant/exit only once during 2000-2009 , which is the first/last year they register positive domestic turnover; in years outside the entry/exit period, a company is not taken into consideration (it is neither economically active, nor dormant).

An important remark is that we do not account for firms changing their sector of activity (NACE code) from one year to another due to the inaccuracy of reporting such changes – we cannot distinguish between a real change in activity and a reported (unreal) one. This translates into a slightly underestimated churn rate, which we consider a smaller issue than largely overestimating it by introducing fictive entries/ exits from one sector to another.

We also ignore mergers and acquisitions (M&A) because of lack of reliable data on these activities. If a company acquires another company in the same sector, how will this affect the churn rate? The answer to that question depends on how the acquisition or merger is registered. In some cases, the original companies cease to exist and the jointly establish a new legal entity. In that case we would see two exits and one entry. But in other cases, one of the companies continues to exist and only the acquired company disappears resulting in no entry and only one exit. We are aware of these complications but have no access to specific merger and acquisition databases that could be used to account for M&A in an adequate way.

Alternative definitions of churn

Some authors have made the case that churn should also capture the reallocation of resources within the different establishments of a company, and therefore should be based on plant-level entry and exit decisions. Also, diversifying firms that do not create new production facilities but change their product mix in the existing ones have been considered to have a different impact on competition than completely new entrants by also exhibiting different exit patterns. Dunne et al. (1988) find that diversifying firms that build new plants are usually larger than new firms and also have smaller exit probabilities.

However, for the purpose of our screening exercise, where the goal is to measure the magnitude of barriers to entry and exit of firms, we conclude that a plant-level indicator would capture other effects, such as managerial decisions or social characteristics of the geographical location of plants, which are beyond our purpose. In addition, reliable plant specific activity data are not available in the databases of the FPS Economy.

Churn and concentration

The link between churn and concentration is not one-way: if high concentration levels are a marker of high profitability, this can trigger high entry rates by attracting new firms to the market. On the other hand, possible new entrants may be kept away by strategic entry barriers in highly concentrated markets. In such cases, firms may take up a strategy of incomplete entry, finding strategic niches in highly concentrated markets and thus not competing on the larger market (Geroski and Murfin, 1991).

Churn and productivity

Roberts & Tybout (1997) find – in a study on micro data sets from manufacturing sectors in Columbia, Morocco and Chile – that the amount of new jobs created each year due to entries and exits can be as high as 30% in these countries. This high rate is, however, mostly due to movements within the same industry, rather than across-industry shifts. Furthermore, they find that entering plants are not much more productive than the ones they replace on the market, which have a decline in productivity towards the end of their life, but the ones that do survive become more productive as they age. Also, a key finding is that most of the plant turnover is due to plants with relatively small market shares.

A slightly different finding comes from Foster et al. (2002), who examine the US retail trade sector in the '90s. Their results show that the sector's productivity growth comes especially from more productive plants taking the place of "much less productive existing establishments". They also find that this reallocation of resources is prominently a within-firm phenomenon, rather than a between-firm one.

Baldwin and Gu (2002) examine the effect of churn on labor productivity in Canadian manufacturing, concluding that new plants contribute around 15% to 25% to productivity growth, the rest being attributed to existing plants becoming more productive. The largest contribution to productivity growth from new plants comes from foreign-controlled firms or multi-plant firms, whereas brand new firms tend to be smaller and less productive in their first years.

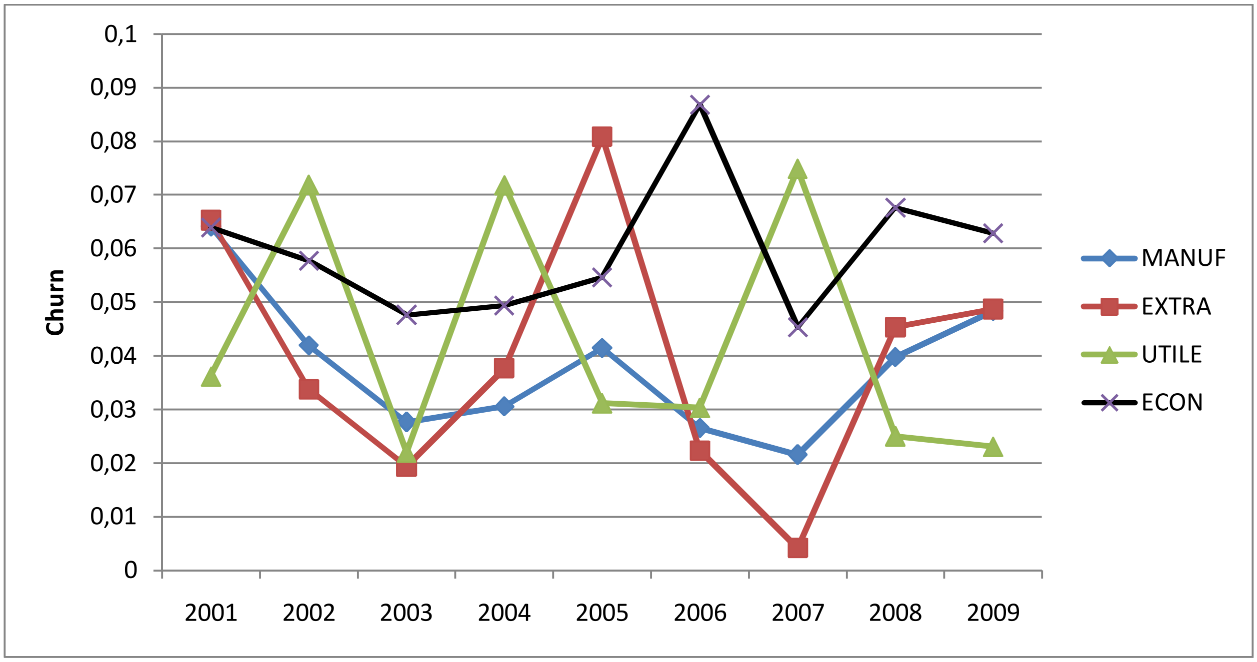
Churn and market size

The link between entry and exit, on the one hand, and market size on the other, has been the subject of a lot of empirical research. Asplund and Nocke (2002) for instance show that entry and exit rates are increasing over time in market size, an effect due to smaller price-cost margins – as entry barriers – on larger markets. However, their study is empirically tested only on one geographically concentrated market.

Descriptive statistics

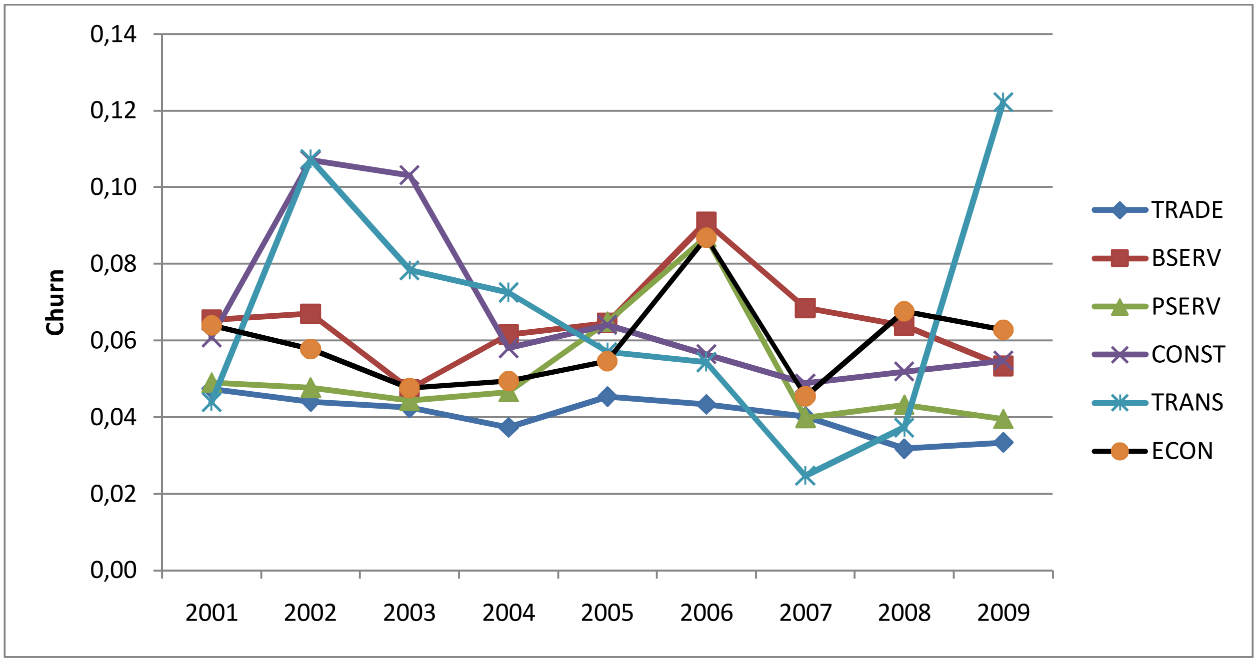
When interpreting the evolution of Churn over time, it is important to keep in mind that sectors with a large number of companies will show up as more stable than sectors with only a limited number of firms. For instance, entry and exit of a few firms in the Utilities and Electricity sector leads to strong fluctuations in the Churn rate of that sector. The pattern for the Manufacturing sector is much more stable. In addition, it is to be noted that we are looking at Churn, weighted by turnover. So, the numbers refer to the combined market shares of the firms that enter and exit the market. In many sectors we observe that single events, like the entry of exit of one or two major players, leads to a temporary peak in the Churn indicator.

Figure 12: Evolution of Churn in Manufacturing



Economic Churn seems to be relatively low in the Manufacturing and Extraction sectors according to Figure 12. It is more variable in the Utilities and Electricity, probably because in this sector, relatively big companies are active such that the combined market shares of firms entering and exiting the market can be rather high. Among the Services sectors (see Figure 13), Churn is relatively low and stable in the Trade sector but more variable and sometimes high in the Construction and Transport sectors.

Figure 13: Evolution of Churn in Services



According to Table 3 Churn rates are very high is sectors with only very limited number of companies as for instance in the sector of military vehicles (304) or sea and coastal passenger water transport (501). More in line with intuition is that we find the sector of bars (563) among the top 20 sectors in terms of Churn.

Table 3: Top 20 sectors Churn

[redacted]

Table 4: Bottom 20 sectors Churn

[redacted]

Low Churn is expected (and observed in Table 4) in the wireless telecom sector (612), manufacture of pesticides and agrochemicals (202), prepared animal feeds (109), grain mill products (106) and refineries (192).

3.3.3 Concentration

Formula

$$HHI_i^t = \sum_{i \in s} \left[m_i^t \right]^2$$

The Herfindahl-Hirschman Index (HHI) is a traditional indicator for measuring market concentration. The HHI is calculated as the sum of squared market shares of all firms in the sector or market. Non-aggregated data on a measure of economic activity, for instance production in physical units or turnover, of all firms in the sector is needed to compute the market shares.

Typically, the sectors are defined on the basis of standard industry classification schemes (for instance SIC in the USA or NACE in Europe) although it is well known that this need not match well with the boundaries of the relevant market. Pepall, Richards and Norman (2011) discuss in detail the difficulty of defining the relevant market pointing towards problems like the mismatch between industry classification codes and actual consumption activities. For instance, cigarettes are sold in specialised shops (a sector with a specific NACE code) but also in supermarkets (which have a different NACE code). Hence, measures of concentration in the tabacco stores sector ignore an important competitor for this stores. Also the fact that many firms produce multiple outputs (but are classified under one main NACE activity) or export a large part of their production is not properly accounted for in traditional concentration measures.

Motivation

Economists are very interested in the HHI of concentration because of its theoretical and empirical link to market power. Theoretically, it can be shown that for a given market or sector characterized by Cournot competition, the Lerner index equals the HHI divided by the absolute value of the price elasticity of demand (see for instance Carlton and Perloff, 2005 p. 283 for a formal derivation):

$$L_s = \frac{HHI_s}{|\varepsilon_s|}$$

Hence, the higher the concentration, the higher market power as measured by the Lerner index. This theoretical relationship has been frequently tested empirically also for Belgium, see for instance Jacquemin, Ghellinck, & Huveneers (1980). Schmalensee (1989) offers a survey of these empirical studies and concludes (Stylized Fact 4.5, p. 976): “The relation, if any, between seller concentration and profitability is weak statistically, and the estimated concentration effect is usually small. The estimated relation is unstable over time and space and vanishes is many multivariate studies.” Cabral (2000) discusses possible explainations for the mixed results. For instance, it has been observed that the link between concentration and market power is in reality much more complex because of endogenous market structure. If prices rise, the long-term equilibrium number of firms increases leading to lower concentration. However, at the same time increasing prices lead to higher Lerner index and hence market power (Cabral, 2000). We can conclude that, when market structure is endogenous, the correlation between market power and concentration might be negative instead of positive.

Nevertheless, concentration measures like HHI are often used in market analysis, regulation and and competition policy. For instance, the Horizontal Mergers Guidelines of the antitrust division of the US Department of Justice (see http://www.justice.gov/atr/public/guidelines/hmg.htm#15) classifies markets according to the Herfindahl index. A HHI less than 1000 represents an unconcentrated market, an HHI between 1000 and 1800 is said to be moderately concentrated. Markets with an HHI more than 1800 are considered to be highly concentrated. When evaluating the effects of mergers, the US DOJ considers an increase in the HHI of 100 or more as a serious warning signal in moderately or highly concentrated markets.

In small open economies, it is important to correct concentration measures for exports. The market share of a leading firm based on total turnover is a misleading indicator of the local market power of such a firm, if it exports a large proportion of its total production. The part of production that is exported does not enter the domestic market and hence should not be taken into account when measuring concentration. In the MMS project, we therefore compute the HHI based on domestic turnover, i.e. total turnover minus value of exports, as suggested by for instance Sleuwaegen and Van Cayseele (1998).

Data issues in the MSS project

For the calculation of the HHI, we compute the firms' market shares by using their domestic turnover which is an estimation of the total turnover in Belgium, based on three sources with their respective priorities: (1) Company Accounts from the National Bank of Belgium (NBB), (2) Structural Business Survey, and (3) the VAT Declarations. From its domestic turnover we deduct the firm's total exports which are based on data from the NBB.

The SAS code computes the HHI in four steps:

1. Take out the observations with negative or zero turnover.
2. Calculate the market share of each firm in the sector, which is equal to the firm's turnover divided by the total turnover of the sector.
3. Square the market share of each firm in the sector.
4. The HHI for a sector equals the sum of the squared market shares of all firms in the sector.

Alternative ways to measure concentration

Many different measures of market concentration are used in the literature, see for instance Chapter 8 in Lipczynski, Wilson and Goddard (2009). In the MMS project we have chosen to implement, in addition to the HHI, the widely used C4 and C8 measures. These measures sum the market shares of the 4 and 8 biggest firms in the sector respectively. According to many scholars, the HHI provides a more complete picture of industry concentration than does the C4 or the C8 concentration ratio since it takes into account the market shares of all firms in the industry. As a consequence, the HHI is also sensitive to changes in market shares of other firms than largest 4 or 8.

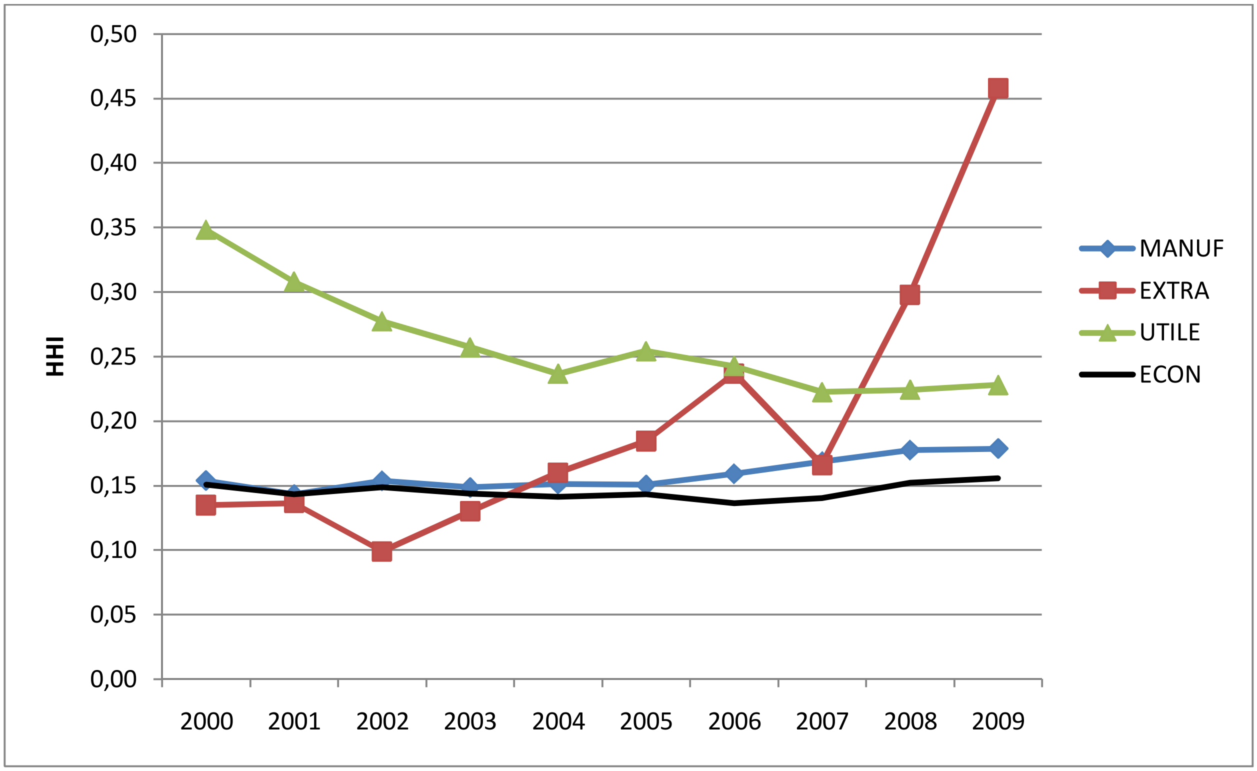
The SAS code computes the C4 (C8) in three steps:

1. Rank each firm in each sector according to its market share based on domestic turnover
2. Pick the top 4 (top8) firms with the highest market shares in each sector
3. C4 (C8) is the total market shares of the 4 (8) largest firms in the sector

Descriptive statistics

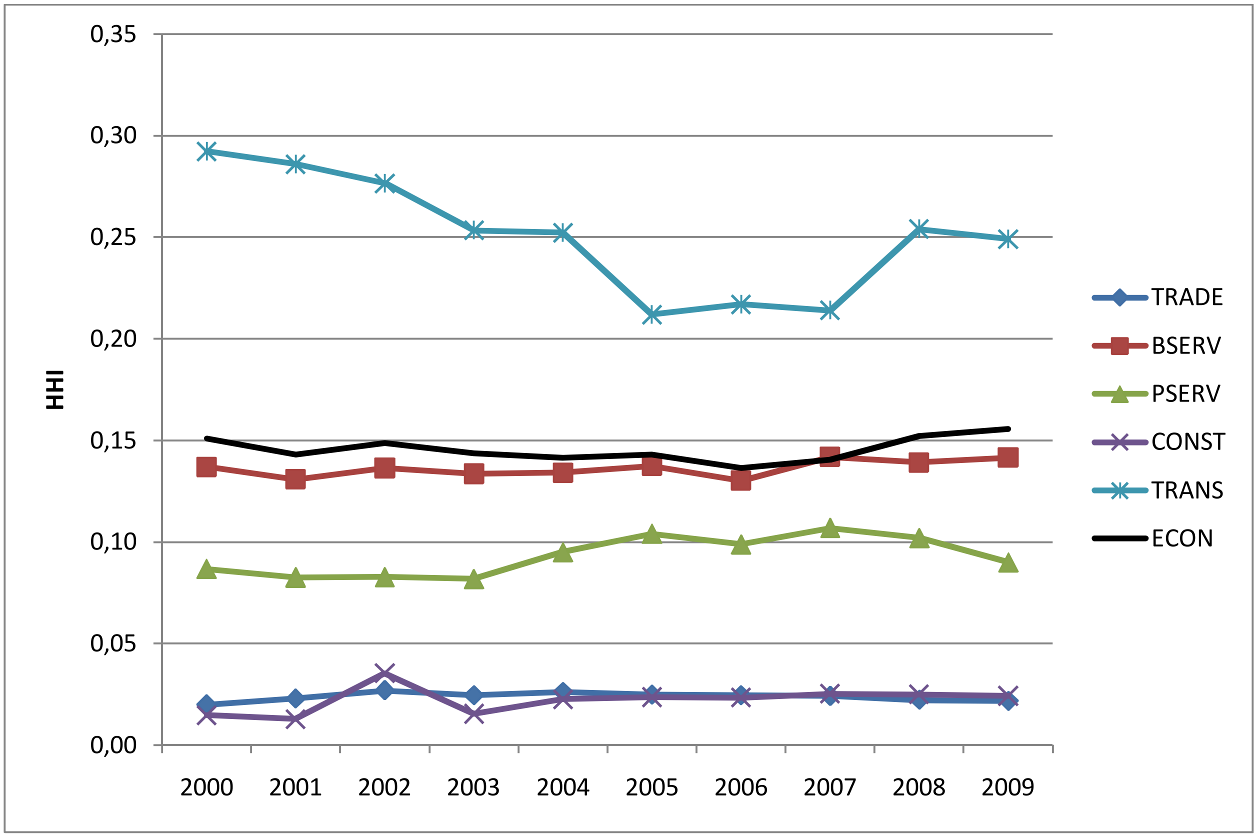
Figure 14 shows the evolution of concentration (HHI) in the Manufacturing group of sectors. Concentration in Utilities and Electricity was very high in the early 2000s, but has steadily decreased since then. Concentration in the Extraction sector has gone up spectacularly but this is again due to the relatively small size of this sector compared to the others.

Figure 14: Evolution of Concentration (HHI) in Manufacturing



Except for the Transport sector, concentration is below the economy wide average in the Services sectors, see Figure 15. Especially in Trade and Transport, and to a lesser extent in Personal Services, we observe very low concentration ratios.

Figure 15: Evolution of Concentration (HHI) in Services



According to Table 5, the top 3 sectors are to be considered as outliers as these are relatively young sectors in the Belgian economy and therefore high concentration is not unusual initially. Postal activities (531) and cokes (191) on the other hand are long established sectors with a (natural) monopoly. For some sectors, the effects of deregulation are very visible. For instance, in sector of freight rail transport (492), we clearly recognize the year (2005) when the monopoly of the former state owned railway company was lifted.

Table 5: Top 20 sectors Concentration (HHI)

[redacted]

Table 6 shows the bottom end of the ranking of sectors according to concentration (HHI). Concentration is very low in the accounting and tax consultancy sector (692), renting and leasing of real estate (682 and 683) and treatment of metals (256). Typical low concentration sectors are also found in construction (412 construction of residential and non-residential buildings, 432 electrical and plumbing activities and 433 building completion and finishing) and road transport and logistics (494 freight transport by road).

Table 6: Bottom 20 sectors Concentration (HHI)

[redacted]

3.3.4 Import Penetration or Openness

Formula

The import penetration indicator for a given sector and a given year is computed by dividing the imports (based on product data) into that sector by the sum of imports and domestic turnover (based on company data) in the sector. The formula for the import penetration of sector s is given by:

$$IP_s^t = \frac{\sum_{p \in s} IMP_p^t}{\sum_{i \in s} \left[y_i^t - EXP_i^t \right] + \sum_{p \in s} IMP_p^t}$$

where i denotes a firm in sector s, p the product(s) in the corresponding sector and t the time period.

Intuition and motivation for including import penetration in the monitoring tool:

In the industrial economics S-C-P framework, import penetration is included as a structural construct in the estimation of profitability or productivity.

The other indicators used in our S-C-P framework were mainly focused on Belgium specifically, which could be considered as a weakness of the analysis. However, by introducing this indicator of import penetration, we take into account the openness of the Belgian economy. An important issue for policymakers at national competition authorities is, as a matter of fact, to address the tension between the scope of data availability and policy, which is often national, and the relevant market under study, which for an economy as the Belgian one often involves multiple countries (Massey, 2000). This problem is particularly important for the indicator of import penetration.

Industries that experience excessive import penetration might experience a lot of company exits. In line with Clerides, Lach, Tybout (1998), Raff, Wagner (2010) found that in cases where import penetration is excessive, this may lead to excessive competition which may lead to companies going out of business.

The intuition for the inclusion of important penetration in the composite indicator is that if import penetration is high, there is a high level of competitiveness on the domestic market and domestic firms are expected to have lower profitability. Import competition limits the prices that domestic producers can charge in their domestic markets. This so-called ‘imports-as-market-discipline’ hypothesis has been analyzed in the I.O. literature theoretically (Caves, 1985), Jacquemin (1992) and empirically (e.g. Turner, 1980, Bertschek, 1995 .

There is some literature that makes the distinction between horizontal and vertical import penetration (Altomonte et al. , 2008), but we focused on horizontal import penetration.

Source of the data

The imports and export data used are retrieved from the FPS Economy's Sectoral Database which are a compilation of National Bank of Belgium external trade figures. Trade data are at product level, and the nomenclatures used are CN8 codes for imports and exports. The CN8 codes have been transformed to CPA codes in order to achieve a 1-1 correspondence with NACE sectors (2, 3 and 4 digits). All codes have been transformed to NACE v.2 sectors, so that the results are comparable to the other indicators. The domestic turnover is based on the "selected turnover" variable available in the Sectoral Database of the FPS Economy. This turnover estimate is based on company level information, not product level.

General data issues

A possible issue with the indicator is that there is a different coverage for import and export data between EU countries and import and export data with extra-EU countries. For extra-EU flows, companies must declare everything and, therefore, we know the data are complete. For intra-EU flows, however, there is a threshold underneath which imports and exports do not need to be declared. The National Bank of Belgium estimates that between 2-5% of intra EU trade is thus not included in the database and hence the divergence is not significant.

Alternative ways to measure import penetration

Several proxies have been described in the literature for the measurement of import competition. We will describe them here and discuss whether we used them as robustness checks or provide the reasons why we did not use them.

Ratio of imports over the sum of sales plus imports minus exports

$$IP_s^t = \frac{\sum_{p \in s} IMP_p^t}{\sum_{p \in s} \left[y_p^t + IMP_p^t - EXP_p^t \right]}$$

Instead of using the ratio of imports over turnover, a part of the literature uses the imported proportion of the domestic market as a measurement for import penetration. It is defined as the ratio between the total volume of imports over domestic consumption. Domestic consumption is then defined as domestic production plus imports minus exports (Turner 1980), (Altomonte, Barattieri, Rungi (2008) for their horizontal import penetration)). In this formula, all variables are based on product level data.

In the MMS project, considerable efforts were dedicated to the construction of this type of measurement. There were, however, constraints to be able to use this measurement for import penetration. Production data and exports and imports data came from two different databases with different coverage (one is exhaustive, the other is survey based) and the data could not be correctly linked. Production data are available at product level from the PRODCOM surveys. The exports and imports data from the NBB database are derived from customs declarations (exhaustive coverage) and are available at product level.

Another problem with all types of import penetration measures is that the coverage of imports and exports data for services is only about 20%. Hence, we often excluded import penetration as an indicator in the composite indicator tool when focusing on service industries.

Imports / production

This is the measurement used in e.g. OFT (2004). This is an alternative to our approach.

Imports /(exports plus imports)

Ratio of imports divided by the sum of shipment values (exports) plus total imports
Clark, Kaserman, Mayo (1990) in their study of the microeconomic determinants of import penetration of the US manufacturing industries use this measurement.
They come to the conclusion that the impact of import penetration on industry profitability largely differs between industries. For US manufacturing industries over the 1980-1984 period, product differentiation, non-tariff barriers and high transportation costs insulated domestic industries from import share changes. On the other hand, economies of scale and the percent of industry output going to final consumer demand acted to increase the vulnerability of domestic industries to imported goods' market share penetration.

Relationship between import penetration and other indicators

Turner (1980) shows that import competition has only an effect on profitability, in the case that domestic seller concentration is already high. Imports (and inward foreign direct investment) raise competition in the domestic market and can stimulate domestic firms to perform more efficiently to maintain their market position. As a response to increased import competition, domestic firms have to perform more efficiently to maintain their market position.
Bertschek (1995) shows that one possible manner in which domestic firms react to enhanced competition in order to remain competitive is by increasing innovative activity in terms of process and product innovation.

Descriptive statistics

According to Figure 16, Import Penetration is low in Utilities and Electricity (less than 10%) and Extraction. In the Services sectors, see Figure 17, it is extremely low but that is probably more due to the fact that Services sector are not covered well in the traditional trade statistics.

Figure 16: Evolution of Import Penetration in Manufacturing

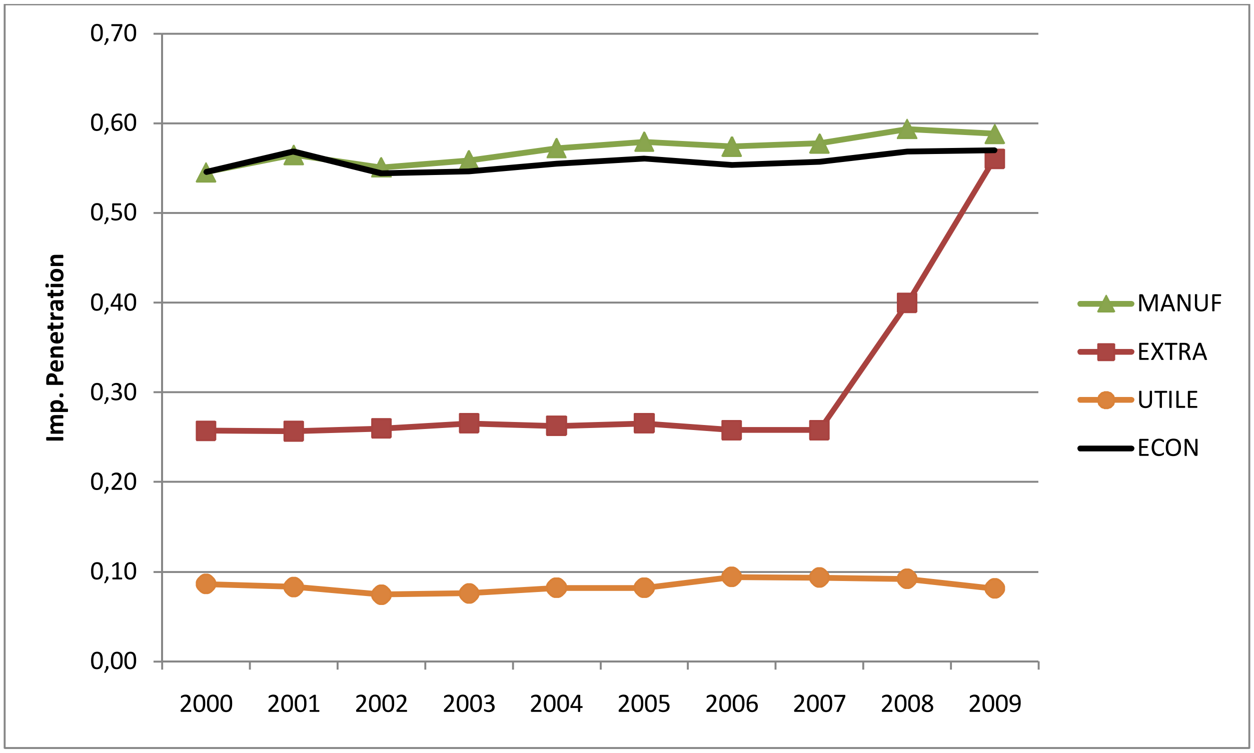


Figure 17: Evolution of Import Penetration in Services

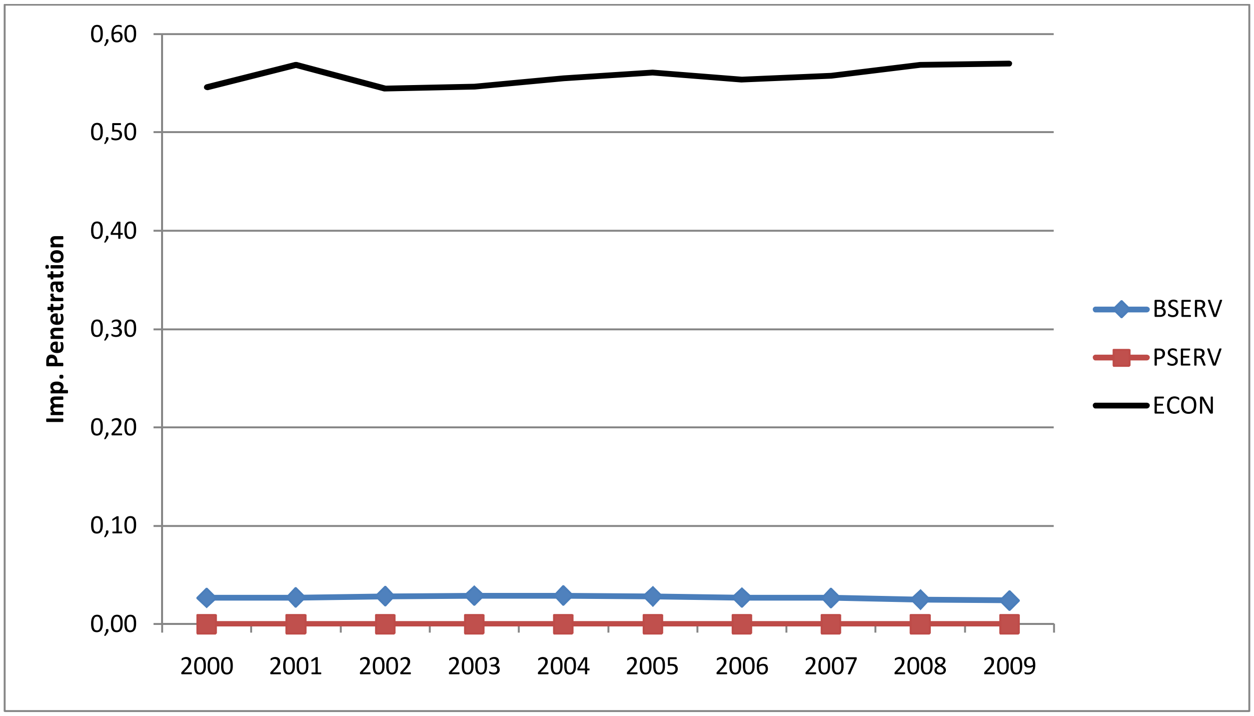


Table 7 contains Import Penetration numbers for the top ranked sectors. Import Penetration is very high in some textile sectors, for instance in knitted and crocheted apparel (143), footware (152) and sport goods (323). Also in computer equipment (262) and optical instruments and photographic equipment (267) Import Penetration exceeds 90%.

Table 7: Top 20 sectors Import Penetration

[redacted]

According to Table 8, Import Penetration is very low in some Utilities sectors like electric power generation (351), manufacture and supply of gas (352), waste treatment and disposal (382 and 383) or sewerage (370). Also is some traditional manufacture sectors like cement (235 and 236), low import penetration prevails.

Table 8: Bottom 20 sectors Import Penetration

[redacted]

3.4 Conduct Dimension

3.4.1 Volatility of market shares

Volatility of market shares in sector s in year t is measured as the average of the changes in market shares of the companies that belong to the top four of sector s in period t.

Formula

$$VOLAT_s^t = \frac{1}{\sum_{i \in S} \delta_i^t} \sum_{i \in S} \delta_i^t \frac{\left| m_i^t - m_i^{t-1} \right|}{\left[\frac{m_i^t + m_i^{t-1}}{2} \right]}$$

Where m_i^t is the share of company i in the sector turnover in period t and δ_i^t is a dummy variable taking value one for company i if this company belongs to the top 4 in sector s in year t. The indicator is normalized by taking into account the average market share of the companies in the top four. Note that there can be less than four companies in the top four in sectors with less than four companies in total.

The volatility of market shares (VMS) is an index of relative market share instability (Caves and Porter, 1978; Sakakibara and Porter, 2001) measured by the average relative changes in market share of the leading firms in an industry over the observation period. The relative change in market share of a leading firm is measured by the absolute value of the annual market share change, divided by the average market share of that firm during the observation period. When we observe this relative change in market share for each leading firm and every year of the observation period, we calculate the average per industry, through diving by the number of leading firms in that industry. A firm is selected as a leading firm in an industry when it belongs to the top four largest firms based on domestic market shares, in the analysis year *t*. VMS, which is directly related to market conduct, can detect possible dominance of one single player or a selected group of players when this indicator reflects a low value.

Intuition and motivation for including it in the monitoring tool:

Although concentration measures offer policy makers a snapshot of the degree of competition at a certain time, the need for a more dynamic perspective arises in order to assess the effectiveness of competition.

Even in markets where concentration does not substantively change over time, it can be the case that market leaders engage in competitive behavior, leading to changes in their market shares across different periods. This kind of behavior shows that even when looking at concentration from a dynamic perspective, aggregation might still lead to discrepancies between actual events and conceptual indicators (Mueller and Hamm, 1974). Similarly, Davies and Geroski (1997) state that volatile markets are not inconsistent with stable concentration levels, as gains/losses may be part of a zero-sum game between market leaders. Consequently, as market share stability becomes greater, the likelihood of cooperation among market leaders rises, and so the need for a more in-depth analysis of the reasons for such stability becomes evident (Sakakibara and Porter, 2001).

Carlton and Perloff (1995) analyze different circumstances in which firms can generate long-term profits by cooperating. Of these circumstances, a stable market environment and high concentration are foremost. Concentration eases cooperation due to the fact that fewer actors are powerful enough to sustain cooperation, while stability of the market allows cooperating firms to detect deviations by any of their peers. To summarize, stability creates the setting for detecting deviations from cooperation behavior, while concentration ensures that punishment for deterrence is credible. Reciprocally, volatile market environments make it harder to detect un-cooperating actors, while low concentration levels render implausible the threat of punishment.

Data

The data used to compute volatility of market shares at sector level comes from the Sectoral Database of the Federal Public Service Economy, SMEs, self-employed and Energy, and has at the basis domestic turnover results from three sources: NBB company accounts, the Structural Business Survey and VAT declarations. The domestic turnover, measured as total turnover minus exports, has been aggregated at sector-level in order to compute market shares for each company, which have been used to calculate the volatility of market shares as explained in the formula above.

Alternative definitions of volatility

As an alternative measure of volatility, the EC (2008) measures market turbulence by the "total number of different firms index" (TNF), which is the ratio between the total number of firms within the 8 largest in a given period over the maximum number of different firms that can possibly belong to that group given that period. As alternative measures, the study mentions entry and exit rates and volatility of market shares; however, it finds the use of such measures cumbersome due to data constraints.

Cable (1997) proposes as a measure of market share mobility the squared difference in market shares across two periods, which translates into a linear dependency of mobility and concentration change.

Baldwin and Gorecki (1994) use mobility indices to capture the transfer of market power from *"losers to winners"* (Baldwin and Gorecki, 1994: p.95). Their intuition is that competitive processes will turn up in mobility between top firms. To capture mobility, they use two measures: the instability index, as a linear relationship between aggregate market shares of entrants, exiting firms, and incumbents on the market; the second measure captures the pattern of market share change, and is expressed by the correlation and by the regression coefficient relating firms' market share in two distant periods.

Joskow (1960) proposes the use of rank correlation coefficients as a measure of market turnover, while Kato and Honjo (2006) define absolute market share instability as the firm-level differences in market shares between two periods for the top 3 competitors, summed across sectors. Moreover, relative instability sums the differences in market shares from period *t* to *t+1* relative to period *t*.

Volatility and concentration

Davies and Geroski (1997) report positive correlations between turbulence of market shares and concentration rates and negative ones with changes in concentration levels of the top 5 firms in a sector, although the second correlation is weaker. In an earlier article, Baldwin and Gorecki (1994) assess the complementarities between market mobility and concentration indexes, stating that the two measures expose different features of competition within markets.

Cable (1997) shows that market share mobility captures aspects of concentration levels and changes in concentration by its definition, which incorporates differences in Herfindahl indices.

Volatility and R&D

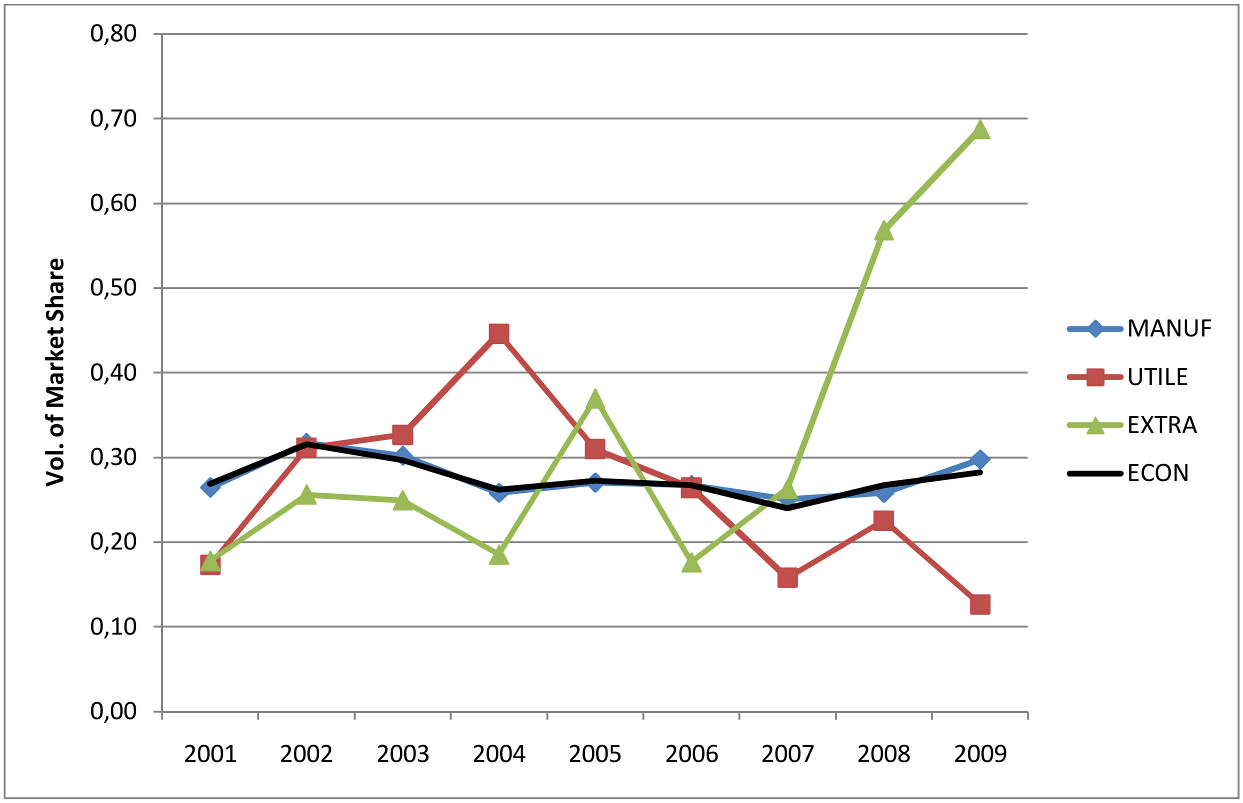
In Davies and Geroski (1997), R&D to sales ratio is used as a proxy for scale economies or sunk costs in a model capturing the determinants of market share changes at firm level. However, their results show negative, but insignificant effects of R&D to sales on market share changes, implying that, at the time of the study, there was no direct effect on turbulence by investments in R&D. Nevertheless, this study captures market dynamics from the 1979-1986 period, and recent datasets might show different results.

Kato and Honjo (2006) state that the impact of R&D intensity on market share instability might be mitigated by a time lag, which could be one of the reasons similar studies did not find any significant direct effect of this variable.

Davies and Geroski (1997) do find that innovation affects mobility by influencing firm growth, thus having a possible positive effect on market share instability.

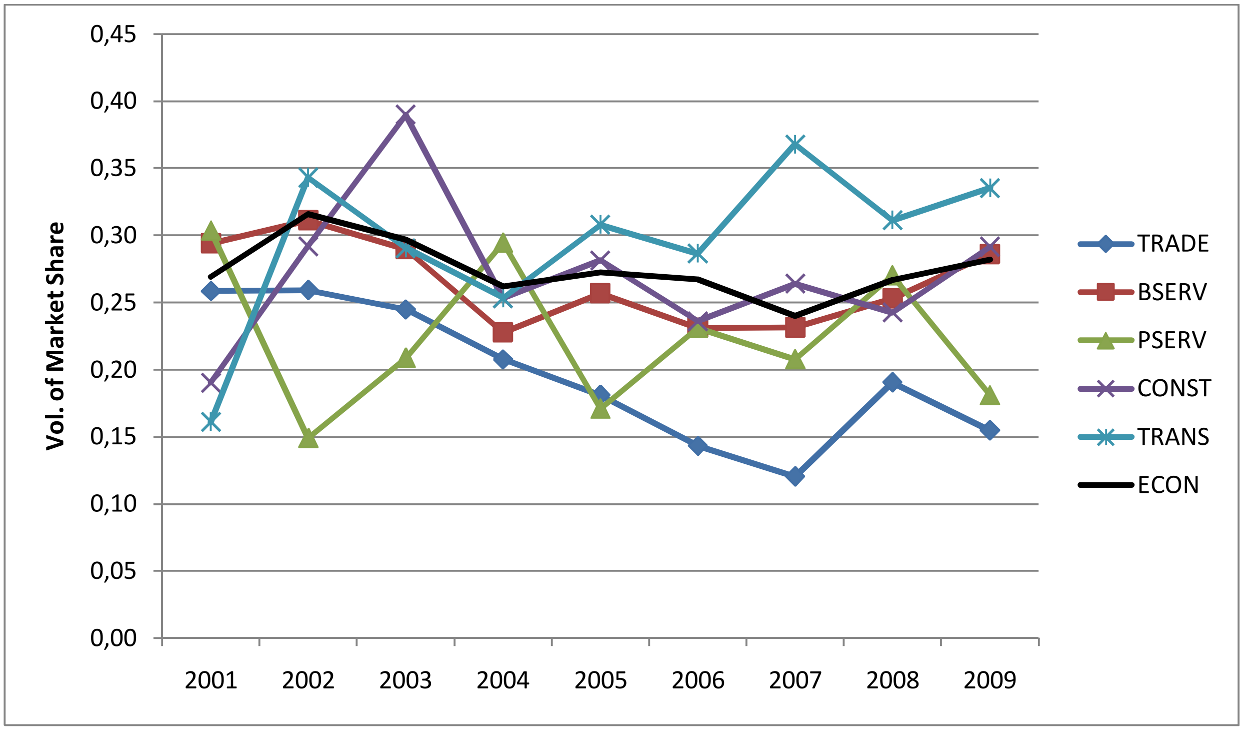
Descriptive statistics

Figure 18: Evolution of Volatility of Market Shares in Manufacturing



On average, the year-by-year change in market shares of the four biggest firms in a sector is about 30% and this value is rather stable over time. In Extraction and Utilities and Electricity, the volatility is more variable over time due to the more limited number of companies in these sectors compared to Manufacturing industries. Volatility of market shares is decreasing substantially in the Utilities and Electricity sector over the period of observation 2001-2009. In the group of Services sectors, see Figure 19, we observe decreasing volatility of market shares for the Trade group of sectors and increasing volatility in the Transport sector.

Figure 19: Evolution of Volatility of Market Shares in Services



In accordance with intuition, volatility of market share is very high in the beverage serving sector (i.e. bars, 563), passenger air transport (511), software publishing (582), buying and selling of real estate (681) and architects and technical engineering (711).

Table 9: Top 20 sectors Volatility of Market Shares

[redacted]

Table 10: Bottom 20 sectors Volatility of Market Shares

[redacted]

We observe low volatility of market shares in, among others, the publishing business (581), advertising (731), water supply (360), mail courier services (532), and in some food related sectors (dairy products 105, animal feed 109 and beverage 110). The temporary employment agencies sector (782) and non-specialized retail sector (471) are characterized by the lowest levels of volatility of market shares.

3.5 Performance Dimension

In the performance dimension the "well-functioning" of markets is operationalized by the concept of efficiency. More specifically, one can distinguish between three types of efficiency: allocative, productive and dynamic efficiency. We briefly explain each of them and the indicator that is proposed to capture that type of efficiency.

3.5.1 Allocative efficiency: Price Cost Margin

Formula

The "price-cost margin" for a single firm (index j) is generally defined (see for instance Lerner 1934 or Carlton and Perloff 2005) as the gap between the output price and marginal production cost, relative to output price[9]:

[9] Note that in some sources the terms "markup" and "price-cost margin" are used interchangeably. We have chosen to use the term "price-cost margin" for the Lerner index.

$$L_i = \frac{p_i - MC_i}{p_i} \quad \text{for firm i}$$

The Lerner index measures the degree to which the price charged by the firm exceeds its marginal costs (relative to the price). When considering an entire industry or sector, the individual firms' margins are aggregated using output or turnover shares. The resulting weighted average price-cost margin is generally referred to as the sector (index S) Lerner index:

$$L_S = \sum_{i \in s} w_i \frac{p_i - MC_i}{p_i} \quad \text{for sector s with} \quad w_i = \frac{q_i}{\sum_{k \in s} q_k} = \frac{q_i}{q_S}$$

Intuition and motivation for including it in the monitoring tool

From micro economic theory, it follows that in perfectly competitive markets, competition among firms causes output prices to be equal to marginal production costs and therefore, the Lerner index tends to zero. For that reason, it is argued that if the Lerner index exceeds zero, this can be interpreted as a sign of market power in the sense that the firm is able to influence the market price to its advantage.

From the solution to the general profit maximization problem of an individual firm, it follows that a firm should choose an output level as to equate its individual Lerner index to the inverse of the price elasticity of demand (in absolute value) for its output.

$$\max_{q_i} \quad p(q_s) \cdot q_i - C_i(q_i) \quad \Rightarrow \quad p + q_i \cdot \frac{\partial p}{\partial q_i} - MC_i = 0$$

$$\Rightarrow L_i = \frac{p - MC_i}{p} = \frac{q_i}{p} \cdot \frac{-1}{\frac{dq_i}{dp}} = \frac{q_i}{q_S} \cdot \frac{-1}{\frac{dq_s}{dp} \cdot \frac{p}{q_S}} = \frac{w_i}{|\varepsilon_S|}$$

From this formula it can be seen that price-cost margins tend to be high for big firms (with high market share w_i) in sectors with low price elasticity of demand in absolute value (low ε_s). Intuitively speaking, firms can charge high prices when consumers are relatively insensitive to the price. Another interpretation is that the price-cost margin, and therefore market power, is always limited by price sensitivity of demand. Firms cannot charge too high a markup because consumers would switch to products of competitors or would simply stop buying the good.

From this discussion it follows that, *ceteris paribus*, a high value of the price-cost margin is to be interpreted as a signal of potential market malfunctioning. For that reason, we believe the price-cost margin is a very useful indicator to include in a market functioning indicator tool. It is an indicator focusing on the final outcome of competition, not on ex ante market conditions.

General data issues

Measuring price-cost margins is complicated because ideally, it requires data on individual firms' output prices and marginal production costs. Neither of these ideal conditions is fulfilled in practice and therefore proxies have to be used. In particular, marginal production costs are not reported in company accounts and are very difficult to estimate using publicly available data. It is therefore common to use a proxy formula based on accounting information on sales (i.e. turnover or y_i in our notation) and variable costs, see for instance Church and Ware (2000) or Carlton and Perloff (2005). Accounting systems typically do not distinguish between fixed and variable costs and therefore, a further assumption is made that variable costs can be approximated by materials costs and labor costs. Assuming that variable costs are linear in production volume, it can be shown that this formula yields the price-cost margin:

$$\frac{y_i - VC_i}{y_i} = \frac{p_i \cdot q_i - c_i \cdot q_i}{p_i \cdot q_i} = \frac{p_i - c_i}{p_i} \approx L_i$$

The approximation works only if several conditions are fulfilled. First, variable costs should be a linear function of output. In other words, the firm produces under constant returns to scale conditions (i.e. an increase in all inputs by the same percentage, leads to an equiproportional change in output). Moreover, it should hold that all material and labor costs can be considered as the only variable costs components. This assumption is clearly heroic and has often been criticized; see for instance Church and Ware (2000). In particular the fact that no capital costs are not accounted for in variable costs can lead to serious bias in cross sector comparisons if those capital costs differ significantly between sectors.

Data issues in the MSS project

For the calculation of the price cost margin, we use National Bank of Belgium data on company accounts. This allows us to have information on turnover and labor and material costs. However, since the Belgian accounting law makes a distinction between the extended and abbreviated reporting scheme (depending, basically, on the size of the reporting company), not all of these variables are available for all companies. In particular, smaller companies (using the abbreviated reporting scheme) are not obliged to report turnover or sales (they can but they are not legally obliged to do so). In practice this means that for most small companies, turnover data are lacking from the NBB companies accounts database.

The final calculation makes use of the following fields of the NBB company accounts:

- Raw materials (code 60/61, 60, 61) = raw materials, consumables, services and other goods
- Labor costs (code 62) = remuneration, social security costs and pensions
- Turnover (code 70) = sales revenues

The SAS code computes the Price Cost margin in three steps:

1. Calculate for each firm its variable cost = raw materials + social security

2. code 60 + code 61 or code 60/61 depending on what data is available
3. Calculate for each firm its profits = turnover minus variable costs
4. code 70 minus variable costs from step 1.
5. PCM for sector = sum(each firm's profit in the sector) divided by the sum (each firm's turnover in the sector)

After computing the PCM in the way described above, we pooled all observations by year and dropped the top and bottom 5% in order to avoid problems with outliers.

Alternative ways to measure or estimate PCM

ROCE and COC (UK 2004) or IRR (UK 2003)

Instead of using price cost margin, some other studies have employed alternative measures of firms' economic performance. For instance, the UK Office of Fair Trading (2004) uses the average ?difference? between Return of Capital Employed (ROCE) and Cost of Capital within a 4 digit SIC code as an indicator to measure market power and degree of competition in terms of firms' ability to raise price consistently and profitably above competitive level. The ROCE is usually a measure of a company's earning before interest and taxes (EBIT) in a given period (usually a year), divided by the capital employed in that period. The OFT (2004) uses the company level data from FAME and is SIC compatible. The limitation of their approach is that high profitable relevant markets may be missed because of averaging across firms. Difficulties in the measurement of economic capital imply that the results need to be interpreted with caution.

Another example is the OFT (2003) study that uses the Internal Rate of Return (IRR) measure to assess profitability in competition policy analysis. A profitability assessment refers to the measurement of the rate of return made on investments in a line of business, company or industry over a time period; and comparing it against an appropriate benchmark. If the estimated returns are higher than the benchmark, the investment can be said to be profitable; if lower than the benchmark, the investment is unprofitable. The profitability of an activity can be defined in terms of net increases in value resulting from that activity over time, and reflect the economic principle of time preference of money. The IRR can be estimated for ongoing activities for which information is available over a truncated period of time by using accounting data. The data required for the truncated IRR methodology is cash flow data for the activity in question over a reasonable length of time and estimates of the value of asset employed in that activity at the start and end of the truncated period. Asset values should be based on, either the cost of replacing the asset (specifically on the "modern equivalent asset", or MEA, basis), the present value (PV) of future earnings, or the value derived from selling it (its net realizable value, or NRV). With good cash flow and MEA data, the indicator is likely to hold in established industries with historical data over long periods (e.g. retailing, manufacturing, utilities, pharmaceuticals and banks); but it may not hold for new product lines in established industries.

Key area of difficulty is the valuation of opening and closing assets. The estimated IRR needs to be compared against an appropriate, competitive benchmark. In competitive markets, characterized by free entry and exit, companies are expected in the long run to make profits that equal the minimum returns required by investors (the opportunity cost of capital). Profits above the cost of capital would invite entry by new competitors, and profits below would induce exit. Hence, returns that are persistently in excess of the cost of capital can be an indication of market power or of a lack of competition in the market. The limitation of using IRR to measure competition is that profits could diverge from the cost of capital for a variety of reasons, not all of which are necessarily related to market power or anti-competitive practices (e.g. economic cycles, windfall gains that are not related to a company's main operations, or temporarily high profits in dynamic, innovative markets).

Boone indicator

Boone (2004) suggested Relative Profit Differences (RPD) as a new measure for competition. The intuition for RPD is related to the relative profits measure (π (e')/ π (e) is increasing in intensity of competition for e' > e where e denotes some measure of efficiency). The intuition for the relative profits measure is that in a more competitive industry, firms are punished more harshly for being inefficient. RPD has a robust theoretical foundation as a measure of competition. It is monotone in competition both when competition becomes more intense through more aggressive interaction between firms and when entry barriers are reduced. Also, the data requirements to estimate RPD are the same as the requirements to estimate markup ratio. That implies that any firm (or plant) level data set which allows a researcher to estimate markup ratio should also allow for the estimation of RPD. The limitation for the RPD measure is that we need to rank firms according to their efficiency level. Assuming that marginal costs are constant clearly makes it possible to rank firms in terms of efficiency in a simple way but can be criticized as an unrealistic assumption in many sectors.

Closely related to the Relative Profit Differences approach is the Profit Elasticity measure by Boone (2000). Intuitively, the idea behind the PE measure is that a percent increase in production costs leads to a stronger fall in profits in a more competitive industry compared to a less competitive sector. An empirical application for Belgium of Boone's PE indicator of profit elasticity can be found in Braila, Rayp and Sanyal (2010).

Persistence of Profits POP

Up till now we have only looked at static measures of competition. In a number of cases however, more dynamic indicators are preferred. For example, in Schumpeter's creative destruction model, successful firms are able to realize substantial profits in a single period, but they lose their dominant position once a competitor takes over the market with a new innovation. Computing static competition measures in such markets will erroneously point to a lack of competition intensity since in each period there is one firm having substantial market power. A solution is to look at the competitive dynamics and examine the degree of profits persistency. The general idea is that in an efficient market economy, supra-normal profits should quickly disappear as they attract new entrants or imitators. The increase in competitors erodes profits earned by the initially successful incumbent. However, when firms operate in a less competitive environment, profits may be persistent and do not fall back to their competitive level.

In order to measure the persistency of profits, typically an equation like the following is estimated:

$$P_{it} = \alpha_i + \lambda_i P_{it-1} + \varepsilon_{it}$$

Where P_{it} is profitability of firm i in period t. The coefficient λ_i measures the persistence of profits. The parameter is expected to lie between 0 and 1 and high values indicate high persistency. Note that in general, firm specific measures for persistency are computed which are afterwards aggregated to the sector level. The measure has been introduced by Mueller (1986) and among others subsequently applied by Geroski and Jacquemin (1988), Goddard and Wilson (1999) to industrialized countries and by Glen et al. (2001, 2003) to emerging economies.

In the framework of the MSS project, we did analyze the persistence of profits in Belgium, using company accounts data on about 200,000 firms between 1999 and 2008. The methodology used and results for the Belgian economy have been written down in a separate paper Cheung and Vanormelingen (2011).

Econometric estimation of mark up

Over the last decades, alternative ways have been suggested to estimate econometrically the price-cost margin instead of computing it using accounting cost data. In his seminal work, Hall (1988) showed how price-cost margins can be inferred using readily available production data. The key insight of Hall (1988) was that imperfect competition drives a wedge between the factor output elasticity and the factor cost share in total revenue. It can easily be shown that a cost minimizing firm will choose its output such that the markup adjusted factor cost shares equal the output elasticity of the respective input factor, for example for labor this implies $\mu \frac{WL}{PQ} = \frac{\partial Q}{\partial L} \frac{L}{Q}$ where subscripts are omitted, μ represents the markup (price over marginal cost), and W and L wage and labor stock respectively. Plugging in this expression in a production function framework, renders the following equation that can be estimated:

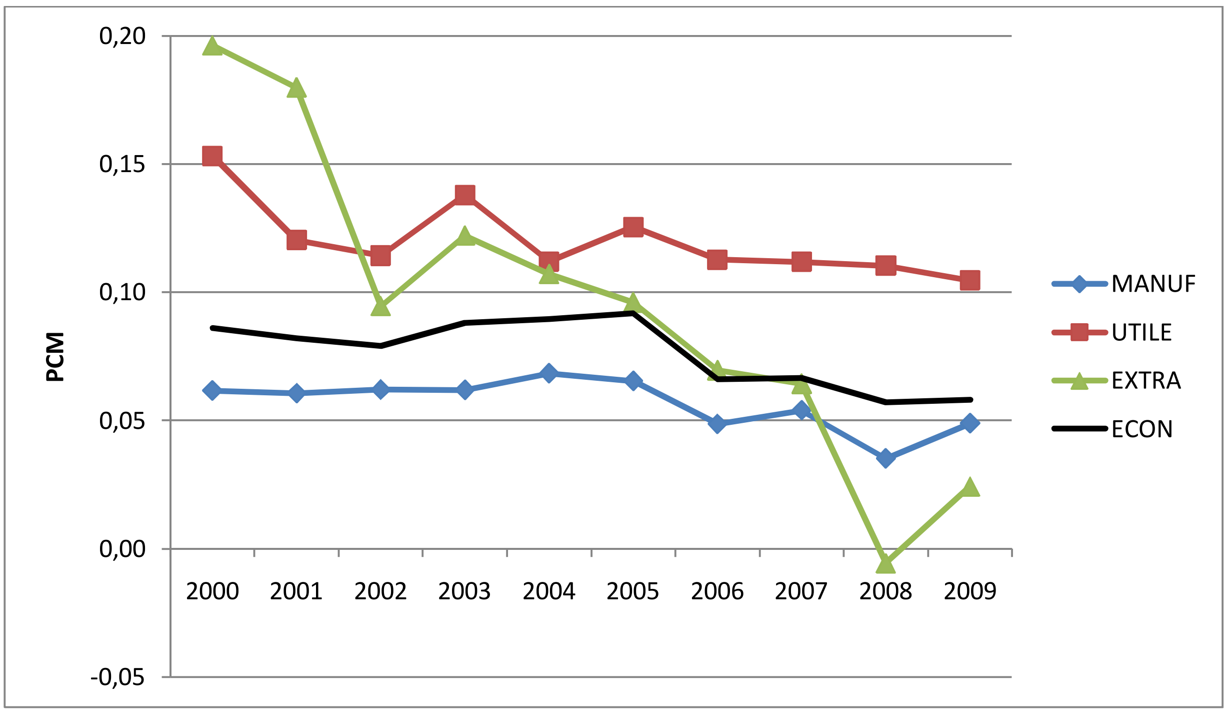
$$\Delta q_{it} = \mu(\alpha_L \Delta l_{it} + \alpha_K \Delta k_{it}) + a_{it}$$

Where a_{it} represents total factor productivity growth, α_X is the input cost share of factor X and lower case variables indicate natural logarithms. In principal, the researcher does not observe the user cost of capital and the markup is identified using variable inputs labor and materials . The seminal work by Hall (1988) triggered an entire line of research estimating markups (price-cost margins) and linking them to various institutions, policy actions, etc… Originally the framework was applied to industry level datasets but over time more and more firm level datasets were used. For example Levinsohn (1993) used the methodology to test the impact of trade liberalization on price-cost margins. Konings et al. (2001) looked at price-cost margins before and after the introduction of a competition authority in Belgium and The Netherlands. The main issue with the methodology is endogeneity of variable inputs which are likely to be correlated with the productivity shock. To solve for this issue Roeger (1995) shows how the dual cost function can be used to substitute out the productivity shock. However, in order to get the methodology, one has to assume constant returns to scale and observe as well the user cost of capital[10]. Recently, insights from the productivity literature to consistently estimate production functions have been used to solve for the endogeneity problem and retrieve unbiased estimates for price-cost margins (De Loecker, 2011). Applications of this approach for Belgium can be found in among others Dobbelaere (2004) and Christopoulou, R. and Vermeulen, P. (2008).

Descriptive statistics

Over time, we observe in Figure 20 a slight erosion of PCM in the entire Belgian economy. The tendency is much more pronounced in the Extraction sector, but again, the higher volatility is due to the limited number of companies in this industry. Overall, PCM is below average in Manufacturing and above average for the Utilities and Electricity sector.

Figure 20: Evolution of Price Cost Margin in Manufacturing



[10] Moreover to identify the markup, there can be no other factors driving a wedge between the output elasticities and input cost shares. For example capital stock is likely to face substantial adjustment costs. Also the presence of unions in the labor market can break the equality between output elasticities and input cost shares. By putting more structure on the nature of these imperfections, one can infer both output and input market imperfections, cf. Abraham et al. (2009) for an application.

[10] Note that with constant returns to scale and observability of the user cost of capital, we could as well consistently compute the price cost margins as explained in the beginning of this document.

PCM is particularly low in the Trade sector, see Figure 21, and above average in the Business Services industry. PCM for the Construction sector follow closely the economy wide average.

Figure 21: Evolution of Price Cost Margin in Services

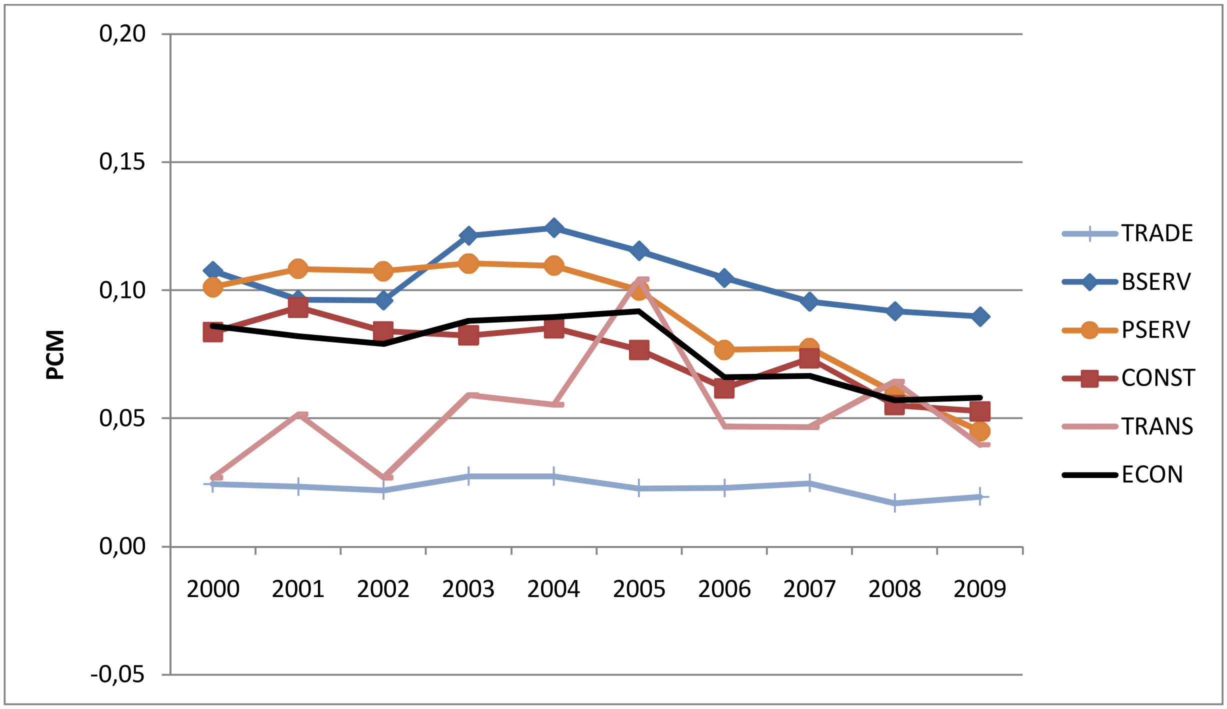


Table 11: Top 20 sectors Price Cost Margin

[redacted]

According to Table 11, Price Cost Margins are high in the real estate sector (682 renting and leasing of own real estate), the financial sector (663 fund management and 643 trusts and funds) and some telecom sectors (611 wired and 613 satellite communication). The table also reveals the strong impact of the recent crisis in the financial sector, the PCM in 643 (fund management) decreased from about 60% in 2003 and 2004 to 3% in 2009.

Table 12: Bottom 20 sectors Price Cost Margin

[redacted]

In some service oriented sectors, competition is so strong that PCMs are completely eroded away. A notable example in this respect is the sector of travel agencies (791) and retail in non-specialized stores (471). Very striking is the absolute bottom sector, freight rail transport (492) whose PCM was lower than minus 25% before 2005. After the deregulation, the situation improved but still, overall PCM remains negative in that industry.

3.5.2 Productive efficiency: Labor Productivity

Formula

Labor productivity LP_s in sector s at time t is calculated as the sum of the value-added VA_j (Euros/hour) of each firm j in the sector at time t over the total number of hours worked H_s in the sector at time t, including both employees and independents[11,12]:

[11] Other possible input measures are, for example, the number of jobs or the number of workers (Bartelsman & Doms, 2000). Number of hours worked is considered as a more accurate measure of labor input, e.g. due to part-time jobs (OECD, 2001). Note that the measurement of hours worked typically differs across countries, which hinders international comparison (OECD, 2008).

[12] The number of hours worked H_s is defined at the sector level due to the fact that the number of hours worked for independent workers is only available at the sector level. The resulting definition of labor productivity is equivalent to the sector-level labor productivity obtained by the sum of firm-level labor productivities using labor weights: $LP_{st} = \sum_{j \in s_t} \left(\frac{H_{jt}}{\sum_{j \in s_t} H_{jt}} \right) \frac{VA_{jt}}{H_{jt}} = \frac{\sum_{j \in s_t} VA_{jt}}{H_{st}}$. Note that the use of different weights, e.g. output shares instead of labor weights, results in different aggregate productivity levels (Van Biesebroeck, 2008).

$$LP_{st} = \frac{\sum_{j \in s_t} VA_{jt}}{H_{st}}$$

In order to allow for increased comparability across heterogeneous sectors, growth in labor productivity $\Delta LP_{st} = (LP_{st} - LP_{s,t-1})/LP_{s,t-1}$ is preferred as a measure over absolute levels. Besides the labor productivity in nominal terms, the indicator is also calculated in real terms by using price deflators (see infra).

Intuition and motivation for including it in the monitoring tool

The choice between productivity measures[13] is determined first and foremost by the ultimate purpose. A primary motivation for analyzing (changes in) productivity is to identify changes in efficiency, which is of key interest when assessing the functioning of markets[14]. Low levels of productive efficiency suggest a lack of competition in the market since the absence of competition as a disciplining factor allows managers to pursue other objectives besides maximizing the firm's value. Stronger competition reduces such managerial slack i.e. it increases productive efficiency (Hart, 1983). With respect to allocative efficiency, competition implies a Darwinian survival process with the more efficient firms pushing the lesser efficient firms out of the market (Jovanovic, 1982). At the aggregate level, this selection effect increases productivity of a whole sector due to a process of entry (of more efficient firms) and exit (of lesser efficient firms).

At the industry level, increases in labor productivity captures improved productive efficiency within the firms that make up the industry and/or a shift of production towards more efficient firms (OECD, 2001).

The second main motivation underlying the choice for labor productivity as an indicator is that it is a single-factor productivity measure and therefore has relatively modest data requirements. While data needs are quite humble, the interpretation of the indicator is constrained by the fact that changes in 'labor' productivity may reflect a variety of underlying sources (changes in capacity utilization, learning-by-doing, economies of scale, technical change, measurement error…). In other words, the relation between output and labor input depends to a large extent on the presence of other inputs[15]. In the absence of a multi-factor productivity measure, labor productivity should therefore be considered jointly with other indicators like capital intensity in cross-sector analyses.

[13] See the overview of commonly used productivity measures in Table 1 of the OECD manual on measuring productivity (OECD, 2001).

[14] Although an indicator like the KLEMS multifactor productivity (O'Mahony & Timmer, 2009; Timmer et al., 2007) allows the analysis of other important issues like industry-level technical change, it is insufficiently detailed for the purpose of monitoring sectors at a disaggregate level.

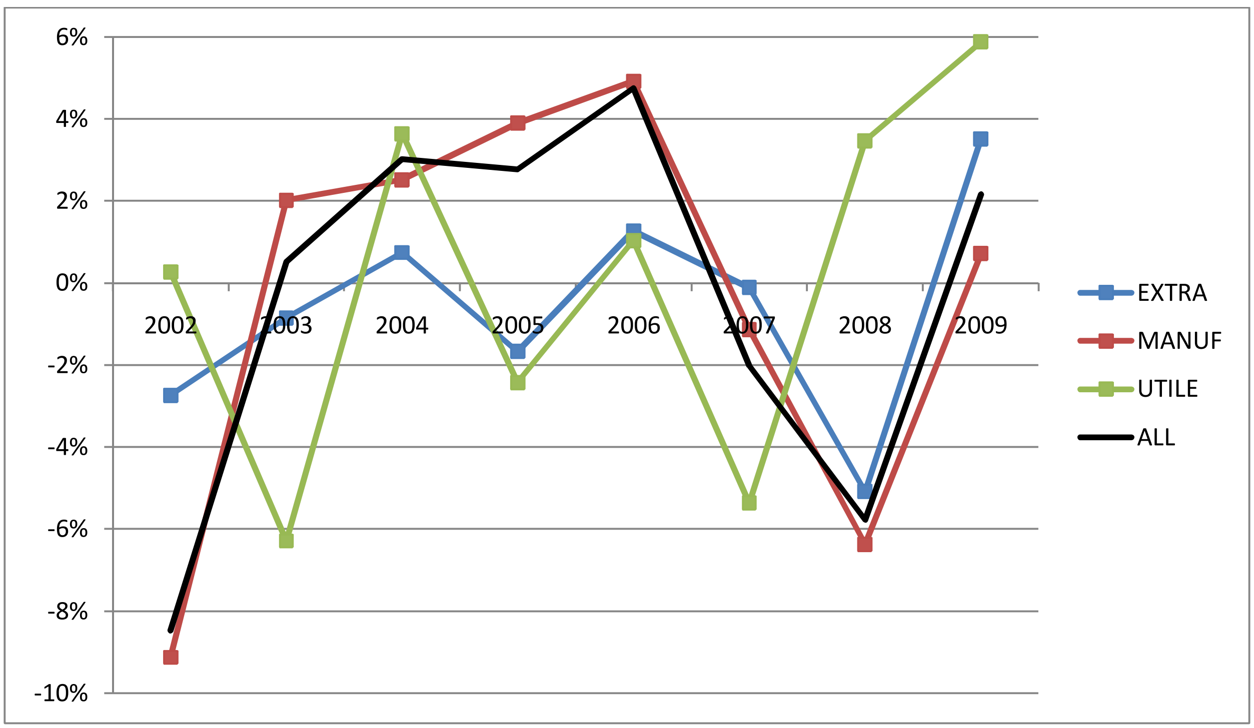
[15] Note that, in comparison with labor productivity based on gross output, the growth rate of labor productivity based on value added is less dependent on any change in the ratio between intermediate inputs and labor, for example in the case of outsourcing (since both labor input and value added decrease).

An important caveat[16] of labor productivity measures in nominal terms is the confounding of productivity and market power. Therefore, nominal output variables are typically deflated at the sectoral level (Bartelsman & Doms, 2000). This approach has also been adopted here, viz. nominal labor productivity was aggregated up to two-digit sector level and subsequently deflated with the corresponding price index[17] so the evolution of labor productivity can be analyzed in real terms at this level of aggregation[18].

Descriptive statistics

In Figure 22 we see the evolution over the period 2001-2009 of the annual rate of change in labor productivity in real terms. In order to compute this indicator, we had to revert to NACE 2 level because currently, no reliable production price indices are available at lower level of aggregation. Overall, labor productivity in real terms increased in 2003 to 2006, decreased in 2007 and 2008, and is increasing again in 2009. The overall average is close to the average for the Manufacturing group of sectors because these sectors are most strongly presented in the production price surveys used in the calculation.

Figure 22: Labor Productivity rate of Change (real terms, based on NACE 2 level data)



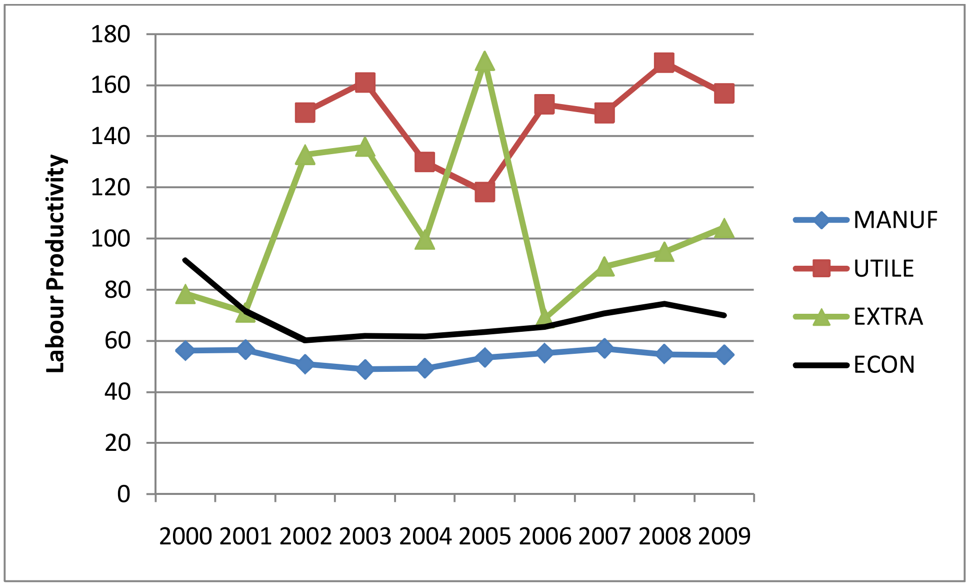
[16] A full discussion of all methodological issues involved in calculating labor productivity measures goes beyond the scope of this factsheet. Well-known sources such as the OECD Manual (2001) on measuring productivity contain extensive detail on theoretical foundations, implementation and measurement issues.

[17] Deflators at more disaggregate sector levels were not available at the time of construction of the indicator.

[18] Note that using deflated production to measure productivity has the drawback that any quality improvement in output that is not reflected in the deflator will result in a downward bias in productivity.

If we want to see more sector detail, at NACE 3 level for instance, we have to use estimates of labor productivity in nominal terms because of the lack of appropriate production price indices at the level of aggregation. Figure 23 and Figure 24 show the evolution over the period 2001-2009 of labor productivity in nominal terms based on NACE 3 level data for the groups of Manufacturing and Services sectors respectively. Labor productivity in Utilities and Electricity is substantially above the economy-wide average, in Trade and Personal services it is below average.

Figure 23: Evolution of Labor Productivity in Manufacturing (levels)



(Note: the first two years were dropped for the Utilities and Electricity sector because of extreme outlier values)

Figure 24: Evolution of Labor Productivity in Services (levels)

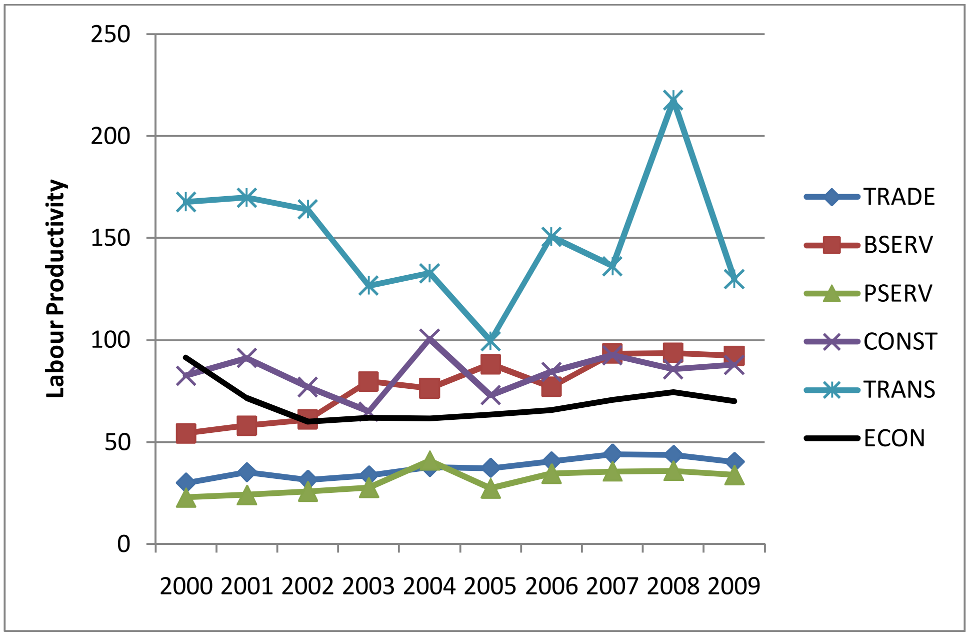
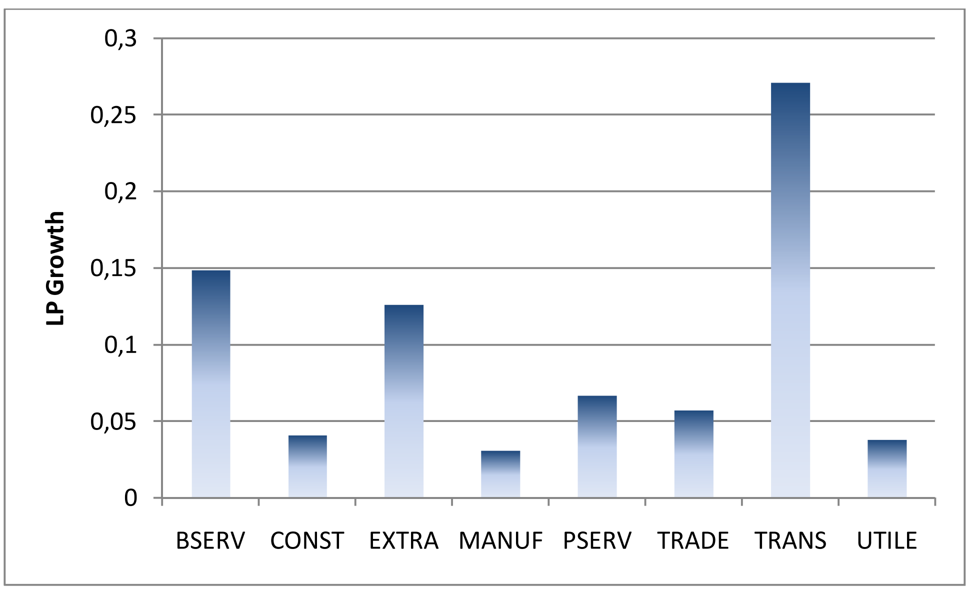


Figure 25: Average Labor Productivity Growth Rate (annual rate of change)



Looking in Figure 25 at the average over the period 2001-2009 of the growth rate of labor productivity (in nominal terms based on NACE 3 level data), we observe that the largest growth is recorded in the Transport sector, Extraction and Business Services. In Construction, Manufacturing and Utilities and Electricity, the average annual labor productivity growth is very low.

Table 13: Top 20 sectors Labor Productivity (in levels)

[redacted]

We observe very high labor productivity levels in some Utilities sectors like steam and air conditioning supply (353), manufacture and supply of gas (352) and generation of electricity (351). Also some financial sectors (643 trusts and funds activities and 663 fund management), real estate (681 buying and selling of own real estate) and renting and leasing (771 motor vehicles and 773 machinery and equipment).

Table 14: Bottom 20 sectors Labor Productivity (in levels)

[redacted]

We observe very low levels of labor productivity in the insurance (651 and 652) and pension funds (653) sectors, in financial intermediation (641) and in several retail subsectors (472, 476, 477, 478, 479). Also in the travel agencies (791) and employment placement agencies (781), labor productivity is low.

3.5.3 Dynamic efficiency: R&D Intensity

Formula

The R&D intensity for sector s at time t is defined as the R&D expenditures of the firms j in the sector divided by total turnover of the firms in the sector at time t[19]:

$$RD_{st} = \frac{\sum_{j \in s_t} \left(RD_{jt}^{intra} + RD_{jt}^{extra} \right)}{y_{st}}$$

The sum of intramural and extramural R&D expenditures is used to obtain a comprehensive measure of the importance of R&D in the sector. The concepts of intramural and extramural R&D expenditures are defined in the Frascati manual (OECD, 2002).

Intuition and motivation for including it in the monitoring tool

Research and development (R&D) has a direct effect on innovation (TFP growth) and helps firms in imitating others' discoveries i.e. it facilitates the transfer of tacit knowledge between firms (e.g. Crépon et al., 1998; Griffith et al., 2004; for a survey of the empirical literature on the impact of R&DF on productivity, see Wieser (2005)). At a more aggregate level, technological change driven by R&D investments is an important driver of economic growth (Romer, 1990; Aghion & Howitt, 1992) and hence R&D intensity is a relevant indicator to measure the dynamic efficiency of a sector. Further, R&D intensity may act as a critical complement to other sectoral indicators when the purpose is to obtain a comprehensive characterization of sectors, in particular for concentrated sectors characterized by large scale economies in R&D.

It should be noted that R&D captures firms' efforts on *technological* innovation. Innovation is more broadly defined in the 3rd edition of the Oslo Manual (OECD, 2005) as "all those scientific, technological, organizational, financial and commercial steps, including investment in new knowledge, which actually lead to, or are intended to lead to, the implementation of innovations". Thus, besides product- and process innovation, organizational and marketing innovation were introduced as non-technological types of innovation. While a higher R&D intensity is associated with efforts for technological innovation, it may not capture organizational and marketing innovation. Therefore, it is recommended to complement R&D intensity with other indicators of non-technological innovation when comparing sectors' innovation performance. Note that although the importance of formal R&D varies over sectors, R&D intensity is still a more general (input) measure of innovation than other innovation indicators like patents, which are relevant for a very restricted subset of sectors only.

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[19] The firm R&D intensities are weighted by the firm's share in sector turnover:

$$RD_{st} = \sum_{j \in s_t} \left(\frac{y_{jt}}{\sum_{j \in s_t} y_{jt}} \right) \frac{RD_{jt}^{intra} + RD_{jt}^{extra}}{y_{jt}} = \frac{\sum_{j \in s_t} \left(RD_{jt}^{intra} + RD_{jt}^{extra} \right)}{y_{st}}.$$

More technical information on the available data and the compatibility of the R&D surveys with the NACE framework are provided in a separate technical note by Stijn Kelchtermans (HUBrussel) in appendix.

Descriptive statistics

Overall, R&D Intensity is low (about 3% in the last year of observation) in the Belgian economy. As we can see in Figure 26, Extraction and Utilities and Electricity spend even less than half a percent of turnover intramuros and extramuros R&D. The R&D Intensity in manufacturing is rather close to the economy wide average. In the Services sectors, see Figure 27, R&D Intensity is very low in Trade and Transport. Only Business Services has an R&D Intensity comparable to the economy wide average. It should be noted however, that the coverage of the R&D survey for the Services is very incomplete and hence, these numbers are to be interpreted with great caution.

Figure 26: Evolution R&D Intensity in Manufacturing

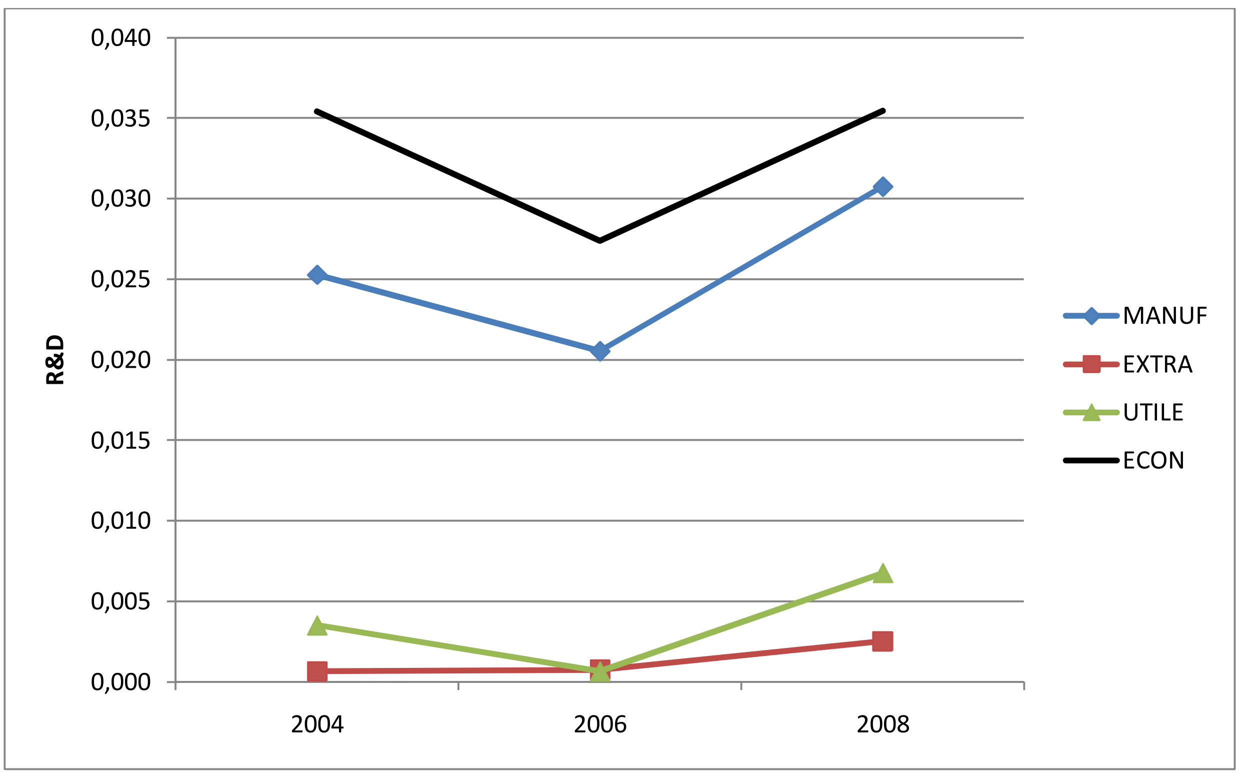
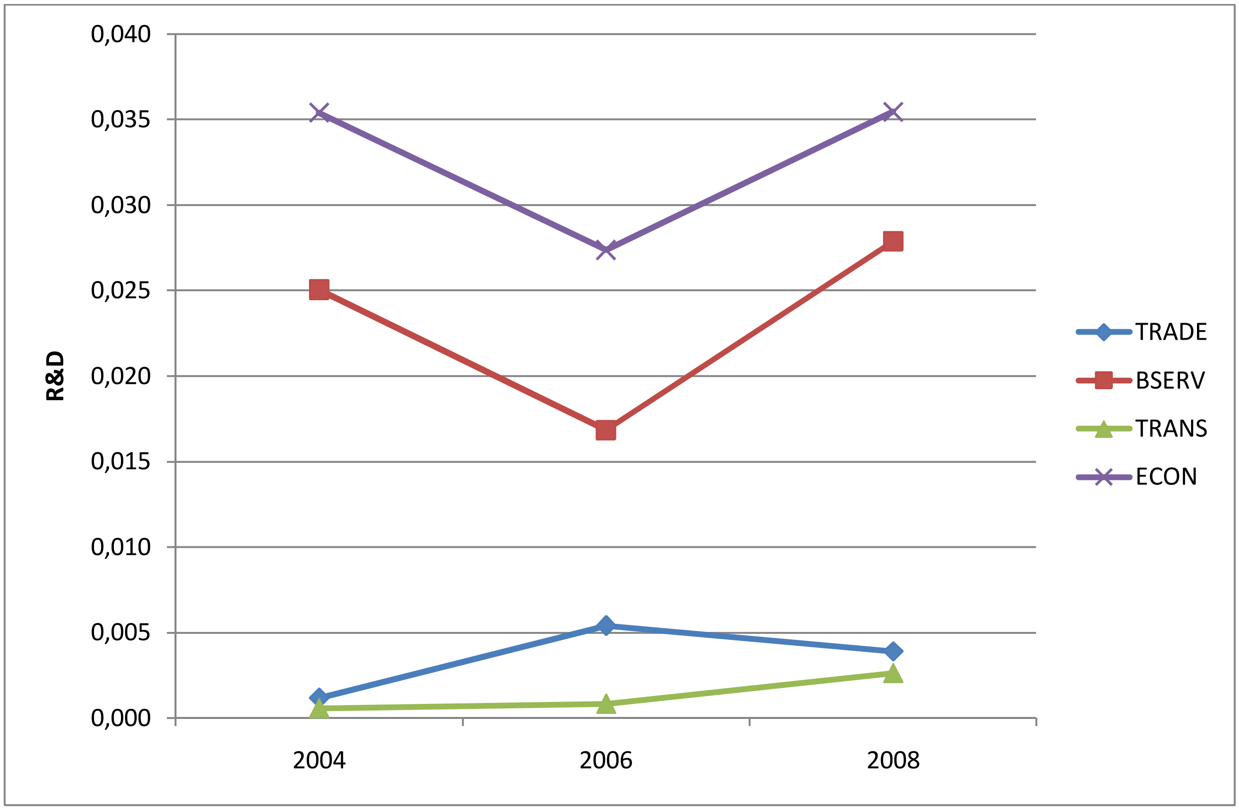


Figure 27: Evolution R&D Intensity in Services



There are two dedicated research sectors in the NACE 3 sector coding: research and experimental development on natural sciences and engineering 722 and on social sciences and humanities 721. Obviously, these sectors are top ranked. Also the top position the pharmaceutical sectors 211 (basic pharmaceutical products) and 212 (preparations), chemical industry (for instance 202 pesticides and agrochemicals) electronics (for instance 261 and 264) is not surprising.

Table 15: Top 20 sectors R&D Intensity

[redacted]

Table 16: Bottom 20 sectors R&D Intensity

[redacted]

3.6 Data coverage

All of the indicators were calculated for a broad set of sectors and for many we could access data from 2000 to 2009. However, at present, data coverage is unevenly distributed across indicators and sectors. Table 17 provides an overview of the coverage of the data across indicators (columns), sectors (rows) and years. For the sectors, shown in the table, all indicators have been calculated at Nace 2-, 3- and 4-digit level except for Labor Productivity, as is indicated in the table. Labor Productivity Growth (LPG) is calculated on the one hand in nominal terms for the entire range of Nace 3- and Nace 4 sectors and on the other hand, in real terms at Nace 2-digit level for only the extracting and manufacturing sectors, since reliable deflator series are only available at Nace-2-digit level for those sectors. The years are referred to by the number of years for which we have observations. This is maximally 10 (2000-2009) and those indicator – sector combinations are marked by green cells in the table. Some indicators like churn, volatility or labor productivity growth are based on annual changes meaning that we lose the starting year. For churn and volatility (starting year 2000) we have 9 years of data (yellow cells),for labor productivity growth (starting year 2001) 8 years (yellow cells).

Most important to note is that for some indicators, we currently have only partial sector coverage. This is most outspoken for the import penetration, labor productivity growth at Nace-2-digits level and R&D intensity. In particular, we lack observations for many services industries for these indicators (zero available observations are marked as red cells). In many of our analyses we will therefore split the sectors in two groups (manufacturing and services) and consider different sets of indicators for these groups.

A final point relates to R&D intensity. This indicator is based on surveys that are organized only once every two or three years. We did use the results of the surveys also for other years by filling out the empty years with the results of the next survey. This is consistent with the set up of the surveys which asks companies to report figures as averages over the last two or three years.

Table 17: Data coverage over sectors, indicators and years

NACE	Description	CONC	CAPINT	CHURN	VOLAT	LPG	PCM	IMPENE	RDINT*
05	Mining of coal and lignite	0	0	1	1	0	0	1	0
07	Mining of metal ores	0	0	2	2	1	0	2	0
08	Other mining and quarrying	10	10	9	9	8	10	10	10
09	Mining support service activities	10	10	9	9	0	10	0	0
10	Manufacture of food products	10	10	9	9	8	10	10	3
11	Manufacture of beverages	10	10	9	9	8	10	10	3
12	Manufacture of tobacco products	10	10	9	9	8	10	10	10
13	Manufacture of textiles	10	10	9	9	8	10	10	10
14	Manufacture of wearing apparel	10	10	9	9	8	10	10	10
15	Manufacture of leather and related produ	10	10	9	9	8	10	10	10
16	Manufacture of wood and of products of w	10	10	9	9	8	10	10	3
17	Manufacture of paper and paper products	10	10	9	9	8	10	10	10
18	Printing and reproduction of recorded me	10	10	9	9	8	10	10	10
19	Manufacture of coke and refined petroleu	10	10	9	9	8	10	10	10
20	Manufacture of chemicals and chemical pr	10	10	9	9	8	10	10	10
21	Manufacture of basic pharmaceutical prod	10	10	9	9	8	10	10	10
22	Manufacture of rubber and plastic produc	10	10	9	9	8	10	10	10
23	Manufacture of other non-metallic minera	10	10	9	9	8	10	10	10
24	Manufacture of basic metals	10	10	9	9	8	10	10	10
25	Manufacture of fabricated metal products	10	10	9	9	8	10	10	10
26	Manufacture of computer, electronic and	10	10	9	9	8	10	10	10
27	Manufacture of electrical equipment	10	10	9	9	8	10	10	10
28	Manufacture of machinery and equipment r	10	10	9	9	8	10	10	10
29	Manufacture of motor vehicles, trailers	10	10	9	9	8	10	10	10
30	Manufacture of other transport equipment	10	10	9	9	8	10	10	10
31	Manufacture of furniture	10	10	9	9	8	10	10	10
32	Other manufacturing	10	10	9	9	8	10	10	10
33	Repair and installation of machinery and	10	10	9	9	8	10	0	10
35	Electricity, gas, steam and air conditio	10	10	9	9	8	10	10	10
36	Water collection, treatment and supply	10	10	9	9	8	10	0	10
37	Sewerage	10	10	9	9	0	10	8	3
38	Waste collection, treatment and disposal	10	10	9	9	0	10	10	3
39	Remediation activities and other waste m	10	10	9	9	0	10	0	3
41	Construction of buildings	10	10	9	9	0	10	0	0
42	Civil engineering	10	10	9	9	0	10	0	0
43	Specialised construction activities	10	10	9	9	0	10	0	0
45	Wholesale and retail trade and repair of	10	10	9	9	0	10	0	0
46	Wholesale trade, except of motor vehicle	10	10	9	9	0	10	0	10
47	Retail trade, except of motor vehicles a	10	10	9	9	0	10	0	0
49	Land transport and transport via pipelin	10	10	9	9	0	10	0	10
50	Water transport	10	10	9	9	0	10	0	10
51	Air transport	10	10	9	9	0	10	0	10
52	Warehousing and support activities for t	10	10	9	9	0	10	0	3
53	Postal and courier activities	10	10	9	9	0	10	0	10
55	Accommodation	10	10	9	9	0	10	0	0
56	Food and beverage service activities	10	10	9	9	0	10	0	0
58	Publishing activities	10	10	9	9	0	10	10	10
59	Motion picture, video and television pro	10	10	9	9	0	10	10	0
60	Programming and broadcasting activities	10	10	9	9	0	10	0	0
61	Telecommunications	10	10	9	9	0	10	0	10
62	Computer programming, consultancy and r	10	10	9	9	0	10	0	10
63	Information service activities	10	10	9	9	0	10	0	3
64	Financial service activities, except ins	10	10	9	9	0	10	0	3
65	Insurance, reinsurance and pension fundi	10	10	9	9	0	10	0	10
66	Activities auxiliary to financial servic	10	10	9	9	0	10	0	10
68	Real estate activities	10	10	9	9	0	10	0	0
69	Legal and accounting activities	10	10	9	9	0	10	0	0
70	Activities of head offices; management c	10	10	9	9	0	10	0	0
71	Architectural and engineering activities	10	10	9	9	0	10	10	3
72	Scientific research and development	10	10	9	9	0	10	0	10
73	Advertising and market research	10	10	9	9	0	10	0	0
74	Other professional, scientific and techn	10	10	9	9	0	10	10	0
75	Veterinary activities	10	10	9	9	0	10	0	0
77	Rental and leasing activities	10	10	9	9	0	10	0	0
78	Employment activities	10	10	9	9	0	10	0	0
79	Travel agency, tour operator and other r	10	10	9	9	0	10	0	0
80	Security and investigation activities	10	10	9	9	0	10	0	0
81	Services to buildings and landscape acti	10	10	9	9	0	10	0	0
82	Office administrative, office support an	10	10	9	9	0	10	0	0
95	Repair of computers and personal and hou	10	10	9	9	0	10	0	0
96	Other personal service activities	10	10	9	9	0	10	0	0

* R&D Intensity is based on 3 CIS surveys, which have been applied in 2004, 2006 and 2008; the data from these surveys has been extended to the uncovered periods on an equal basis

3.7 Correlation between the Indicators

In this sections we will analyze the pair wise correlation between the different indicators presented so far. Because of the different coverage of the indicators for the different indicators, we distinguish between manufacturing and services sectors (see detailed overview of the sector grouping in appendix).

For the manufacturing sectors, we included import penetration (IMPENE) and R&D Intensity (RDINT) in the analysis because we have data on these indicators for almost all manufacturing sectors. As can be seen from Table 18, correlations are generally low but statistically significant at 5% level. Of course, these pair wise correlations cannot be interpreted as saying anything about causal relationships between indicators but still, they do reveal an interesting pattern of relationship. In line with intuition we observe that manufacturing sectors with high capital intensity, low churn, low volatility of market shares, slow growth of labor productivity and low import penetration are characterized by lower price cost margins. Somewhat surprising is that PCM correlates negatively with HHI and R&D Intensity. Hence highly concentrated sectors and sectors with high R&D Intensity are characterized by lower price cost margins. The highest correlations are recorded for the pairs Volatility-Churn (+27.5%) and Volatility-Import Penetration (+25.7%). That Churn and Volatility are correlated is hardly surprising as both measures are based on changes in market shares. And it is tempting to conclude that higher import penetration, hence higher competitive pressure from abroad, would lead to high churn rates but again, we have to warn against interpreting these significant statistical correlations as causal relationships .

Table 18: Correlation between indicators for Manufacturing sectors

	PCM	HHI	CAPINT	CHURN	VOLAT	LPG	IMPENE	RDINT
PCM	1.000							
HHI	-0.068*	1.000						
CAPINT	0.104*	0.095*	1.000					
CHURN	-0.004	-0.004	0.021	1.000				
VOLAT	-0.096*	0.156*	0.048*	0.275*	1.000			
LPG	-0.125*	0.059*	0.027	0.155*	0.116*	1.000		
IMPENE	-0.019	-0.023	0.021	0.101*	0.257*	0.077*	1.000	
RDINT	-0.089*	0.033	-0.006	0.053*	0.056*	-0.007	0.145*	1.000

pair wise correlations using data at NACE 4 level and for all years 2001-2009
** is significant at the 5% level)*

Table 19 contains the pair wise correlations for the Services sectors for which we do not have sufficient observations on Import Penetration and R&D Intensity. We observe particularly high correlations between Price Cost Margin and Capital Intensity (37.5%), between Churn and Volatility (24.5%) and between Churn and Labor Productivity Growth (21.9%). Contrary to the Manufacturing sectors, there is a negative correlation between Volatility of Market Shares and Price Cost Margin in the group of

Services industries. High volatility of market shares of the top four companies goes hand in hand with high price cost margins.

Table 19: Correlation between indicators for Services sectors

	PCM	HHI	CAPINT	CHURN	VOLAT	LPG
PCM	1.000					
HHI	0.026	1.000				
CAPINT	0.375*	0.104*	1.000			
CHURN	0.007	0.009	0.007	1.000		
VOLAT	0.064*	0.061*	0.080*	0.245*	1.000	
LPG	0.018	0.054*	-0.002	0.219*	0.028	1.000

pair wise correlations using data at NACE 4 level and for all years 2001-2009
** is significant at the 5% level)*

A more detailed analysis of the relationships between the different indicators (for instance by means of multivariate regression analysis) is an option for further research. However, one should be aware of the fact that this type of Structure-Conduct-Performance analyses have proven little successful in the past because of data issues and because complicated (reverse) causal relationships may exist, see for instance Cabral (2000).

3.8 Caveats using the composite indicator

3.8.1 Relevant market

As previous efforts for monitoring markets[20], we rely primarily on a sector classification (NACE-BEL). A shortcoming of looking through a sector lens is that sectors may not coincide with relevant markets. One way in which we address this issue is by performing the analysis at much more detailed NACE-levels than what has been done in prior efforts.

3.8.2 Applicability of individual indicators

An important issue for policymakers at (national) competition authorities is to address the tension between data sources on the one hand (which are often national in scope) and the markets under study on the other hand (which often stretch across national boundaries). This problem is particularly important for small, open economies since only very few markets may be confined within the national

[20] See also EU KLEMS, which looks at 2-digit NACE level.

borders. In terms of analyzing the functioning of markets, this implies that certain structural indicators, such as concentration indices that include only firms active in the national market, make little sense.

One possible stance towards competition analysis in open markets is that the need to monitor competition in such markets is less because openness provides discipline for firm behavior. For example, in a study for two small, open economies (Belgium and the Netherlands), Konings, Van Cayseele & Warzynski (2001) do not find evidence for this argument, which suggests that even in open markets screening for signs of market malfunctioning may be called for. Therefore, we do not a priori rule out very open sectors from the analysis but rather include a measure of the market's openness (import penetration) in the composite indicator. The endogenous weighting procedure ensures that the composing indicators act as communicating vessels such that the openness is taken into account. The weighting technique will be commented upon in more detail in the analysis report.

4 Results of the composite market functioning indicator

4.1 Traditional composite indicators

4.1.1 Implementation of composite indicator scores at FPS Economy

In order for our exercise to be easily repeated in the future, we have implemented it in the software environment available at the FPS Economy, SMEs, self-employed and Energy. The key issue has been giving future users as much flexibility as possible, at the same time requiring as little technical knowledge as possible of the processes involved. The end-result is a user-friendly environment which gives analysts a multitude of choices in order to fit a wide variaty of needs in terms of the following criteria:

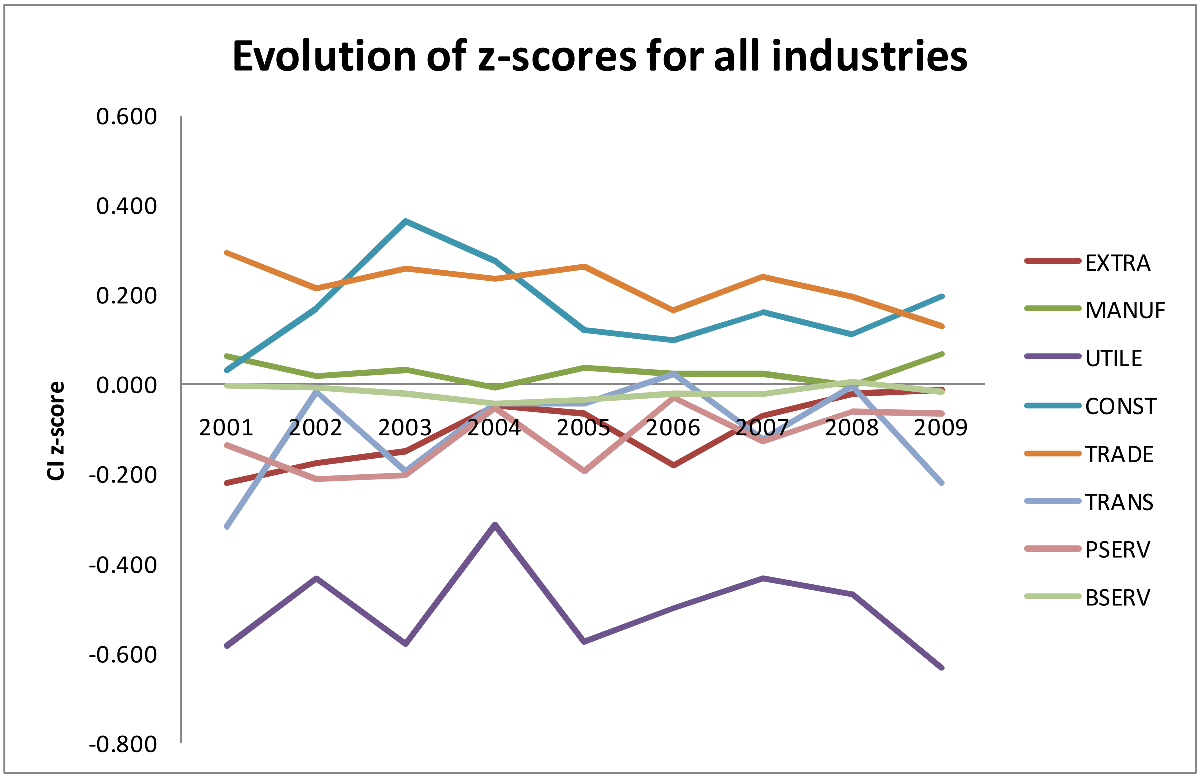
- period of analysis – currently the program has been run for 2001-2009, but, as data becomes available, changing start and end dates can be easily done;
- aggregation level – the user can choose at which level of aggregation the analysis will be done, based on NACE sector classifications;
- set of indicators – the user can choose among a range of 9 indicators: HHI, capital intensity, price-cost margin, churn rate, volatility of market shares, import penetration, R&D intensity, minimum efficiency scale, and labor productivity; however, as more indicators become available in the future, including them in the composite indicator can be easily accomplished by replicating the available code;
- indicator weights – the weight each indicator gets in the composite score can be chosen by the user;
- normalization method – the analyst can choose his/her preferred normalization method from the following list:
    - z-score
    - distance to leader
    - distance to mean
    - ranks
    - categorical (category threshold can also be chosen at runtime)
    - min-max.

The results are presented in a single table per period, per aggregation level and per normalization and can be analyzed afterwards via specific econometric methods.

4.1.2 General picture

In a first run, 219 NACE 3-digit sectors have been analyzed, covering the entire Belgian economy in different groups of industries. In order to keep a relatively broad sector coverage, the indicators used were HHI, capital intensity, weighted churn rates, price-cost margins, volatility of market shares, and changes in labor productivity. Import penetration and R&D intensity were left out. All indicators were given the same weight.

Figure 28: Evolution of Composite Indicator z-scores over Period 2001-2009



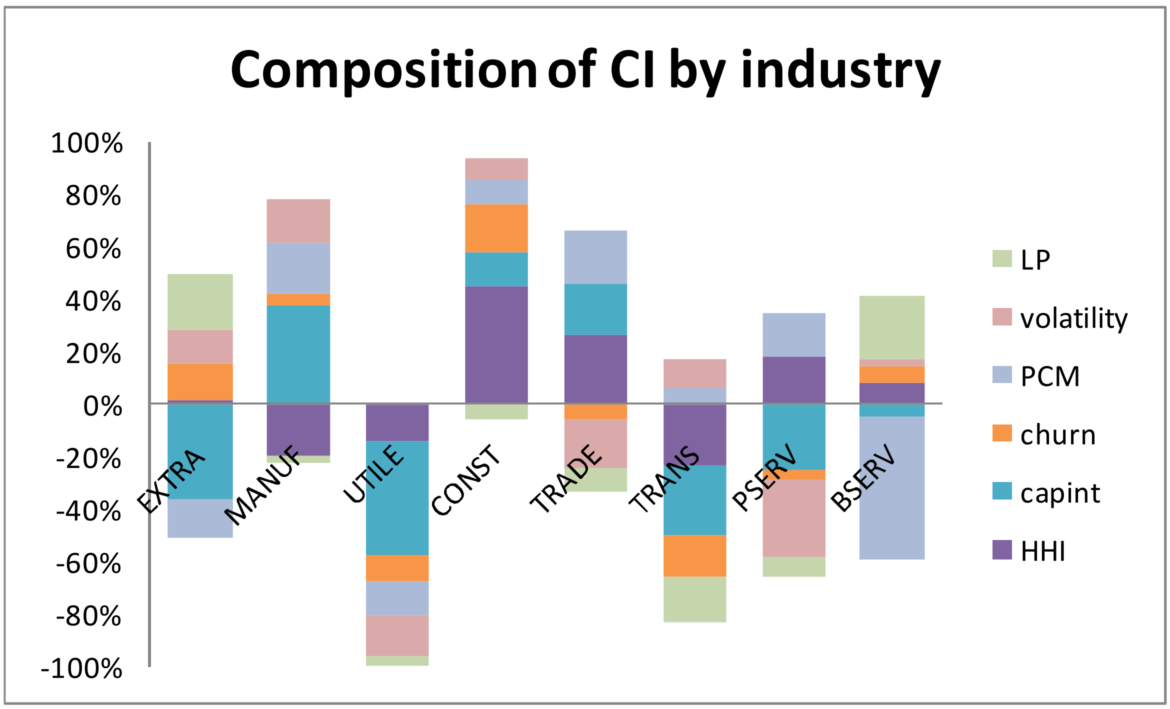
We can see quite a large discrepancy between different industries over time, but also a rather up-and-down evolution of most industries. Trade and Construction sectors are outperforming the other sectors, while Utilities are lagging behind in every period. Although the financial crisis' impact on performance is not evident from this graph – a number of industries do seem to experience a drop in performance in 2008-2009. This observation could however be explained by the choice of indicators: volatility of market shares and churn rates show higher values during turbulent times, and, taken together, they represent 33% of the indicators going into our composite z-scores. The economy average is normalized to zero due to specificity of the z-score normalization.

Grouping similar industries together and analyzing them separately should yield a better picture, as sectors should maybe be benchmarked against similar ones and not the entire economy. We have therefore grouped industries into two main groups. The first one comprises Extraction (EXTRA), Manufacturing (MANUF) and Utilities & Electricity (UTILE). The second group consists of services-related sectors: Construction (CONST), Trade (TRADE), Transport (TRANS), Business Services (BSERV) and Personal Services (PSERV). Again, we have left out import penetration and R&D intensity in order to have a better coverage of the economic sectors in Belgium.

4.1.3 Individual indicators' impact on CI

Looking from a different perspective at the composite indicator based on z-scores, we can see that some industry specificities are revealed. For example, capital intensive industries have their composite indicator influenced in an important way by their score on the capital intensity indicator, while labor productivity is mostly important either in labor intensive industries or industries where labor became less and less important in the economic process compared to capital, and thus labor productivity has risen due to a drop in labor force. The figure below shows the comparison for the year 2009. The figure also captures the fact that some industries (e.g. utilities) lag behind on virtually all the indicators analyzed – they have negative z-scores on all six indicators. At the opposite, construction scores highly on most indicators, with the exception of labor productivity, which has a negative z-score. We can also see that the extraction industry's score is driven down by a highly negative capital intensity results, although the sectors are doing better on the other indicators.

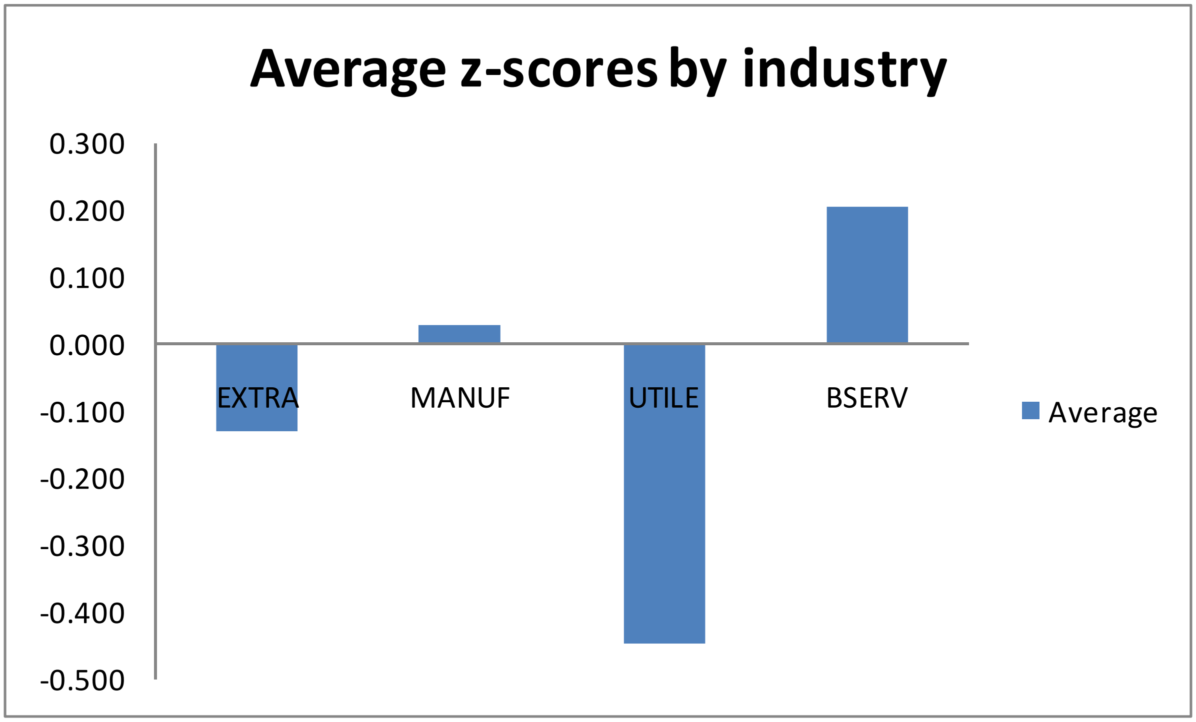
Figure 29: Composition Composite Indicator z-score for year 2009 for all sectors



Different components of CI for 219 NACE 3-digit sectors on chosen indicators

In order to check the robustness of our results, we will look at how the results change if we introduce new indicators in the analysis, namely import penetration and R&D intensity. Due to the restricted coverage of these two indicators, we can only analyze 96 NACE 3-digit sectors, covering only partially manufacturing, extraction, utilities and business services industries. The figure below shows the average CI z-scores for these sectors on eight indicators: HHI, capital intensity, weighted churn rate, price-cost margin, volatility of market shares, change in labor productivity, R&D intensity and import penetration. The results seem very similar to the ones above, the only (important) difference being the better performance of business services, which were doing worse than their current peers when only six indicators were used.

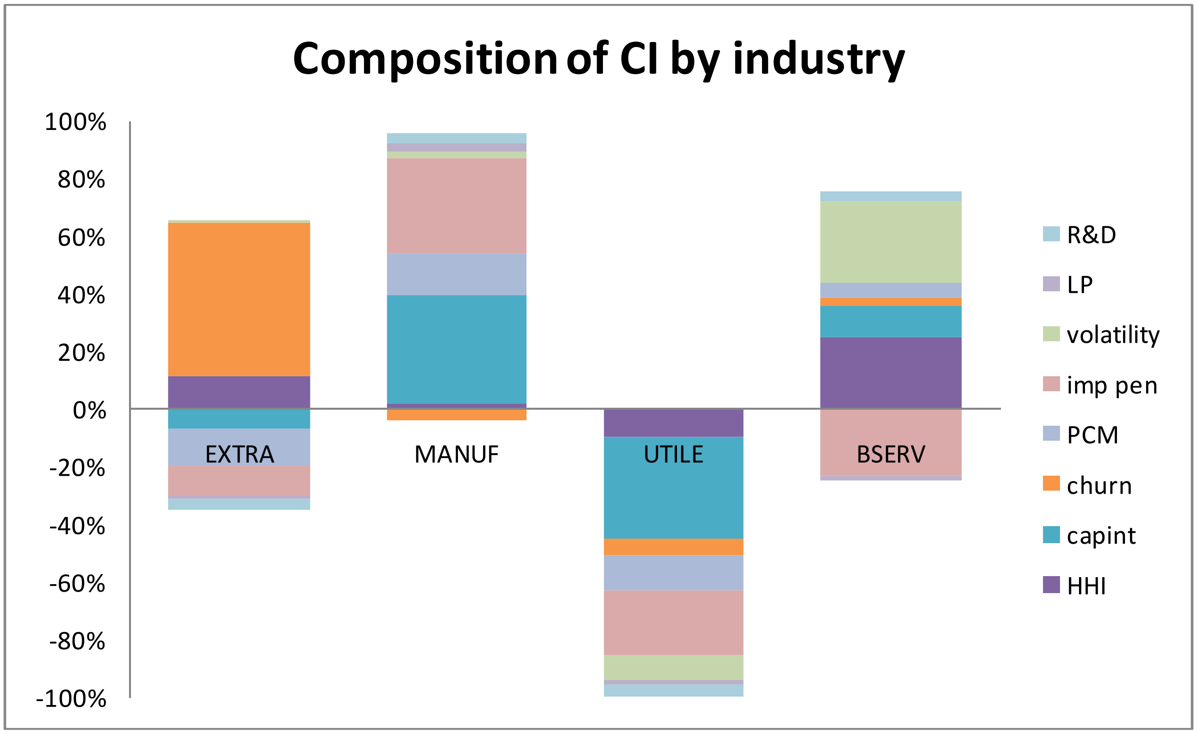
Figure 30: Average Composite Indicator z-scores for 2009 including Import Penetration and R&D Intensity



In order to check for the reasons of such a jump in performance for business services, we can look at the performance of each industry on individual indicators. As we can see, the difference is not due to adding the two indicators – import penetration and R&D intensity – but rather to the fact that the sample of sectors has changed and, by comparison, business services are performing better than those sectors that are now included in extraction, manufacturing and utilities in the new sample (96 sectors compared to 219 before).

The conclusion is that choosing indicators is not a straight-forward task. The choice involves changing the sample of sectors in the analysis and, with it, changing the basis of comparison between sectors. Thus, a tradeoff has to be made between having data on more characteristics of the economy and reducing the sample size of sectors.

Figure 31: Composition Composite Indicator z-score for year 2009 for all sectors including Import Penetration and R&D Intensity



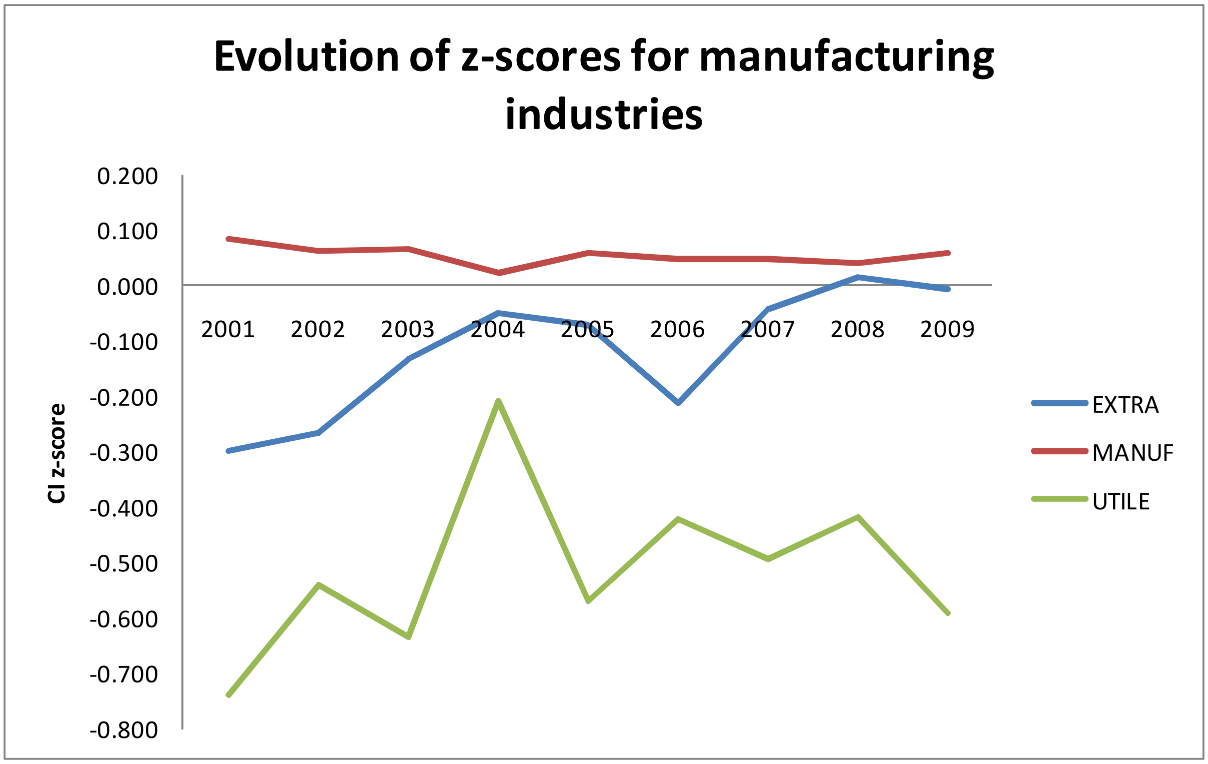
Different components of CI for 96 NACE 3-digit sectors on eight indicators

4.1.4 Manufacturing group

4.1.4.1 General picture

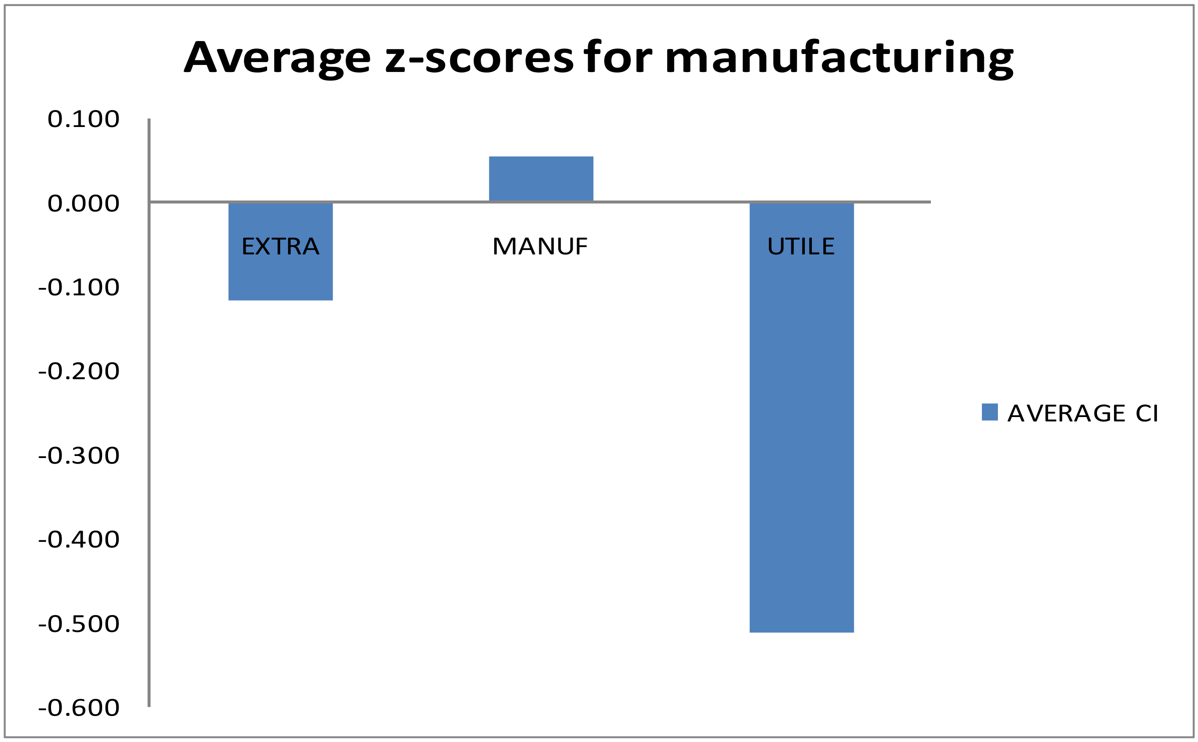
The figure below shows the evolution over time of the first group of industries, which we generically call "manufacturing industries". It can be seen that the utilities sectors are characterized by a different evolution compared to manufacturing and extraction activities. The utilities sectors are also constantly outperformed by these latter two.

Figure 32: Evolution over period 2001-2009 of Composite Indicator z-scores for manufacturing sectors



Compressing the evolution into average z-scores, the picture does not change too much: manufacturing sectors are still better performers than extraction and utilities sectors overall, with utilities lagging well behind.

Figure 33: Average Composite Indicator z-scores over period 2001-2009 for manufacturing sectors



Going further into detail, we analyze the top and bottom 20 sectors at NACE 3-digit level from those three Manufacturing industries. Best performers on average between 2001-2009 seem to be Manufacturing of fur, Manufacturing of railway locomotives, Manufacturing of games and toys, Manufacturing of computers and other manufacturing sectors, while the first extraction sector is Mining and quarrying at position 11, and the first utilities sector is Materials recovery, ranked 19th.

Table 20: Top 20 sectors in Manufacturing

CD_NACE3	AVG_ZSCORE	2009	2008	2007	2006	2005	2004	2003	2002	2001
142	0.513	0.351	0.466	0.551	1.066	0.310	0.184	1.267	0.350	0.072
302	0.431	0.300	0.835	1.513	0.120	-0.105	-0.060	0.675	0.238	0.362
324	0.401	1.007	0.488	0.553	0.929	0.104	-0.111	0.045	0.199	0.394
262	0.366	0.330	0.040	0.218	0.086	0.209	0.263	0.222	0.714	1.213
141	0.334	0.252	0.122	0.168	-0.037	0.783	0.119	0.924	0.314	0.366
131	0.315	0.959	0.671	0.429	0.135	0.015	-0.044	0.079	0.024	0.566
301	0.310	-0.611	1.977	-0.291	1.212	0.079	-0.093	0.554	-0.029	-0.007
132	0.307	0.335	0.576	0.413	0.468	0.035	0.225	0.154	0.113	0.442
253	0.307	0.104	0.389	0.235	0.093	0.026	0.552	0.007	0.070	1.285
102	0.273	0.539	0.470	0.044	0.073	0.194	0.035	0.163	0.134	0.808
089	0.271	1.075	0.574	0.062	0.198	0.215	0.178	0.142	0.007	-0.012
268	0.261						-0.892	0.339	0.149	1.446
309	0.257	0.043	0.062	0.064	0.593	0.099	0.137	0.429	0.406	0.482
255	0.247	0.166	0.084	0.268	0.118	0.296	1.103	-0.141	0.150	0.177
205	0.244	0.050	-0.020	0.281	0.409	0.490	0.304	0.224	0.362	0.100
261	0.237	0.052	0.136	0.299	0.244	0.223	0.038	0.222	0.859	0.060
265	0.236	0.323	-0.489	0.276	0.565	0.436	0.424	0.332	0.195	0.060
257	0.236	0.084	-0.126	0.626	0.341	-0.056	0.430	0.204	0.326	0.291
383	0.224	0.190	0.570	0.182	0.385	0.041	0.358	0.177	0.133	-0.019
279	0.216	-0.561	-0.044	-0.421	0.136	2.465	0.586	-0.412	0.125	0.068

Table 21: Bottom 20 sectors in Manufacturing

CD_NACE3	AVG_ZSCORE	2009	2008	2007	2006	2005	2004	2003	2002	2001
233	-0.179	0.217	-0.042	-0.119	-0.172	-0.199	-0.502	-0.419	-0.176	-0.201
172	-0.186	-0.098	-0.017	-0.168	-0.241	-0.268	-0.334	-0.273	-0.297	0.019
120	-0.231	-0.487	-0.210	-0.527	-0.822	-0.159	0.243	0.048	-0.015	-0.149
104	-0.263	0.231	-0.683	-0.438	-0.328	-0.143	-0.236	-0.354	-0.246	-0.173
081	-0.266	0.544	-0.271	-0.349	-0.172	-0.570	-0.180	-0.172	-0.598	-0.626
192	-0.281	-0.592	-0.523	-0.357	-0.402	0.327	-0.358	-0.287	-0.425	0.092
381	-0.336	-0.375	-0.402	-0.361	-0.352	-0.333	0.521	-0.581	-0.465	-0.681
351	-0.373	-0.495	-0.569	-0.496	-0.445	-0.475	-0.179	0.119	-0.279	-0.539
099	-0.401	-1.646	-0.244	0.121	-0.873	0.070	-0.198	0.194	-0.474	-0.554
235	-0.411	0.105	-0.317	-0.658	-0.031	-0.253	-0.553	-0.651	-0.543	-0.799
390	-0.420	-0.429	-0.145	0.318	0.644	-0.778	-0.905	-0.917	-0.809	-0.762
110	-0.482	-0.432	-0.458	-0.554	-0.526	-0.498	-0.447	-0.529	-0.387	-0.503
353	-0.537	-0.035	0.719	0.542	0.456	-0.211	-0.132	-1.521	-2.255	-2.399
272	-0.551	-0.603	-0.595	-0.842	-0.744	-0.524	-0.707	-0.290	-0.397	-0.255
091	-0.693							-0.693		
352	-0.906	-1.636	-1.461	-1.905	-1.434	-0.779	-0.493	-0.825	0.435	-0.057
191	-0.949	-1.489	-1.199			-0.861	-0.884	-0.520	-0.400	-1.287
370	-1.064	-1.587	-1.447	-1.647	-1.618	-1.841	-0.264	-0.632	-0.276	-0.264
360	-1.078	-0.743	-0.823	-0.780	-1.242	-0.661	-1.130	-1.577	-1.326	-1.420
266	-1.249					-0.335	-2.164			

Among the worst 20 performers there are mostly utilities sectors, such as water collection, treatment and supply, Sewerage, or Distribution of gas, but also some manufacturing sectors like Manufacturing of coke oven products or manufacturing of batteries, and extractions sectors like Support activities for mining and extraction of different materials. The average scores also show a rather big lag for the bottom 5-10 sectors.

4.1.4.2 Zooming in on the Food sector

When looking at specific sectors within the economy, we see a heterogeneous picture. Specifically, we zoom in on the Food industry – NACE sectors 101-110 – and we get the following results.

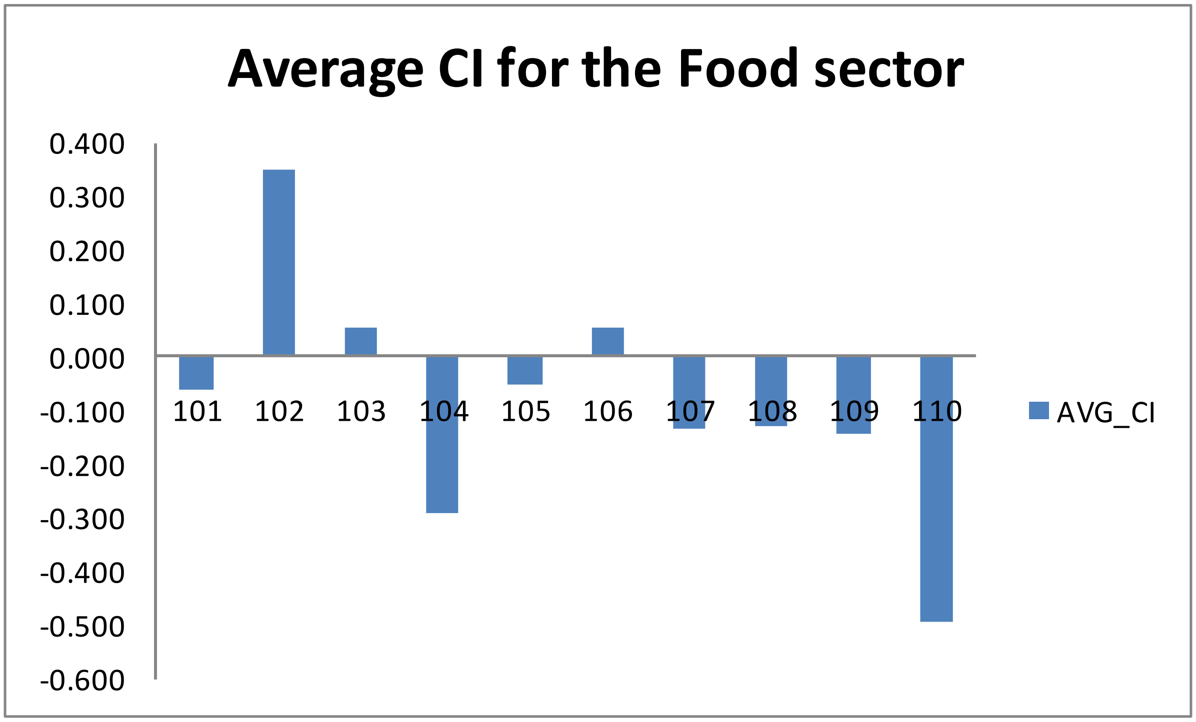
Table 22: Composite z-scores for sectors 101-110 on eight indicators

CD_NACE	Description	Rank	AVG_CI	2009	2008	2007
101	Processing and preserving of meat and pr	61	-0.060	0.010	-0.051	-0.140
102	Processing and preserving of fish, crust	9	0.349	0.490	0.459	0.096
103	Processing and preserving of fruit and v	41	0.057	0.084	0.154	-0.066
104	Manufacture of vegetable and animal oils	80	-0.290	0.145	-0.632	-0.382
105	Manufacture of dairy products	60	-0.052	-0.111	0.030	-0.076
106	Manufacture of grain mill products, star	42	0.055	0.009	0.405	-0.249
107	Manufacture of bakery and farinaceous pr	69	-0.133	-0.127	-0.055	-0.216
108	Manufacture of other food products	68	-0.130	0.112	-0.246	-0.255
109	Manufacture of prepared animal feeds	73	-0.143	-0.216	-0.046	-0.167
110	Manufacture of beverages	91	-0.491	-0.482	-0.450	-0.541

Composite z-scores for sectors 101-110 on eight indicators

Due to the fact that for these sectors data on R&D expenditure is only available from 2007 onwards, the average composite indicator takes into account only the 2007-2009 period. We can see that the average composite z-scores tend to be quite different from one sector to another in the food industry, with sectors 102, 103 and 106 performing above the rest, while sectors 104 and 110 are doing somewhat worse. For reference, sector 102 is Processing and serving of fish, sector 104 – Manufacture of vegetable and animal oils – and sector 110 is Manufacture of beverages.

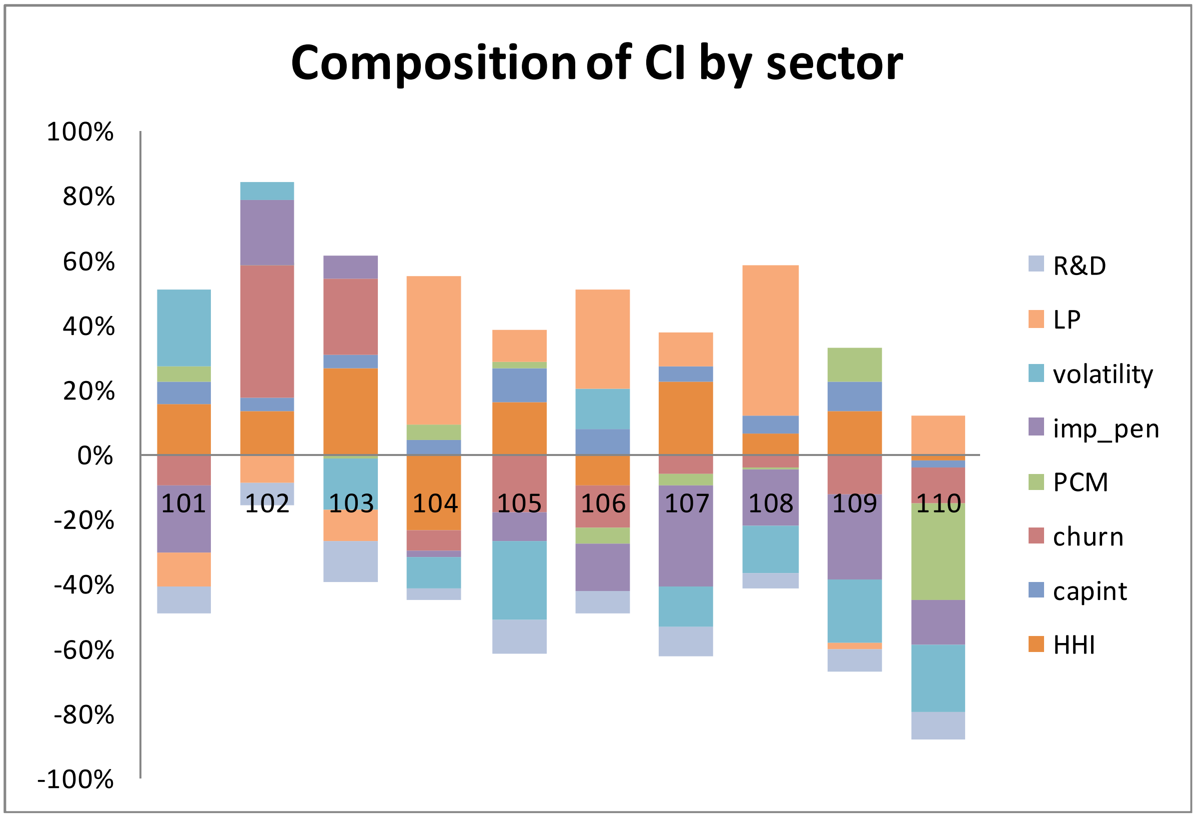
Figure 34: Average Composition Composite Indicator z-score for Food Related Sectors at NACE 3



Average composite z-scores for sectors 101-110 (NACE 3) on eight indicators

Further, we split the composite z-scores in separate indicators in order to get a clearer insight of what is actually happening in the food industry. We remain at NACE 3 digit level, but we only look at the year 2009, and the picture we get is presented in the figure below.

Figure 35: Composition Composite Indicator z-score for year 2009 for food related sectors

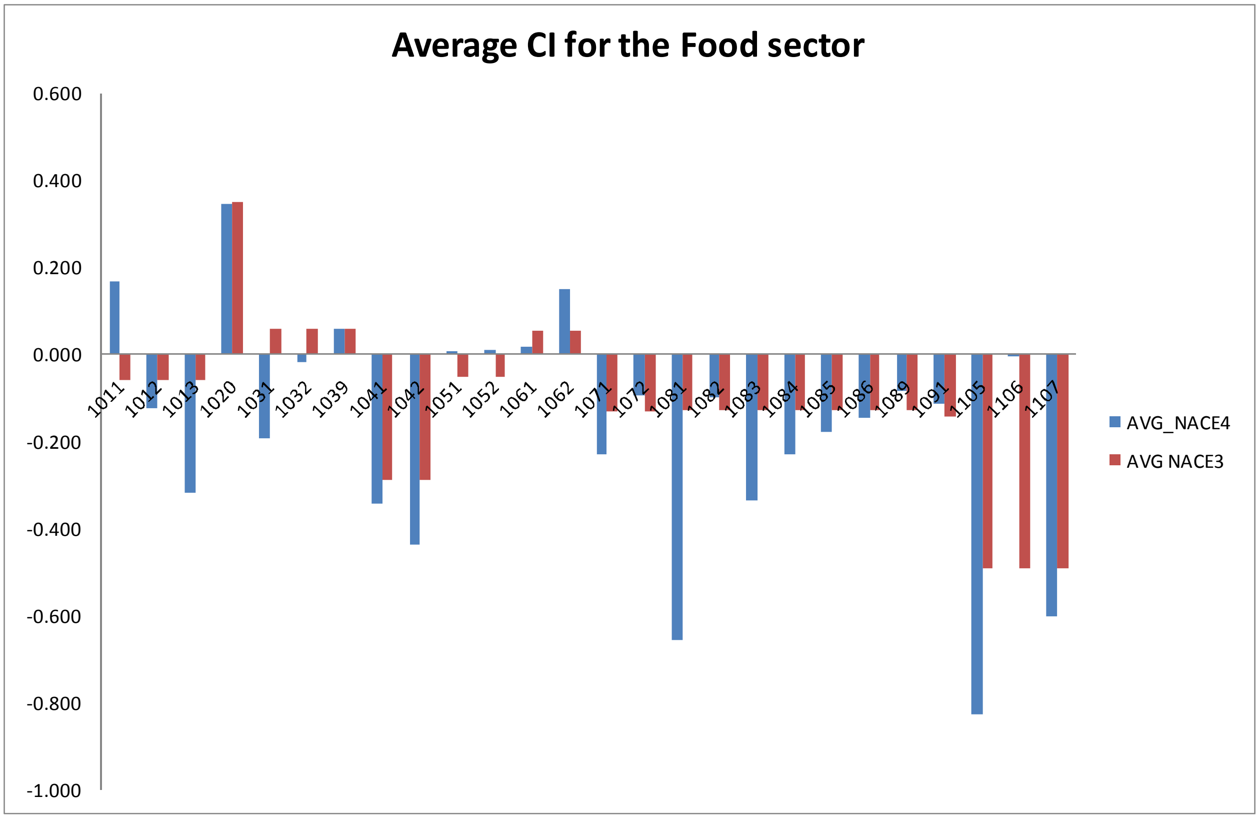


Composition of CI for sectors 101-110 on eight indicators in 2009

It now becomes more clear why some sectors are doing well, while others are doing badly. Specifically, sector 102 (processing and preserving of fish) is outperforming the rest due to its good scores on churn, import penetration, and, to a lesser extent, concentration. On the other hand, sector 110 (Manufacture of beverages) shows high price-cost margins and low volatility among the top players, while its score on labor productivity is not as bad. An interesting analysis can be done on sectors like 107 (Manufacture of bakery products), which appears to have high labor productivity, low concentration, but at the same time low import penetration and a low volatility of market shares. The reasons for such a heterogeneous picture can be numerous, and an in-depth study should be able to tell us more about the exact market mechanisms. The Entry Thresholds Ratio is a possible candidate of such a study, and sectors like Bakery are its main targets.

Further, we check the composition of the Food industry at higher resolution. There are 26 NACE 4 digits sub-sectors within this industry, and the following graph compares them with their *parent* sector at NACE 3-digit level.

Figure 36: Average Composition Composite Indicator z-score for Food Related Sectors at NACE 4



Average CI for sectors in the food industry on eight indicators – comparison NACE 3 vs. NACE 4

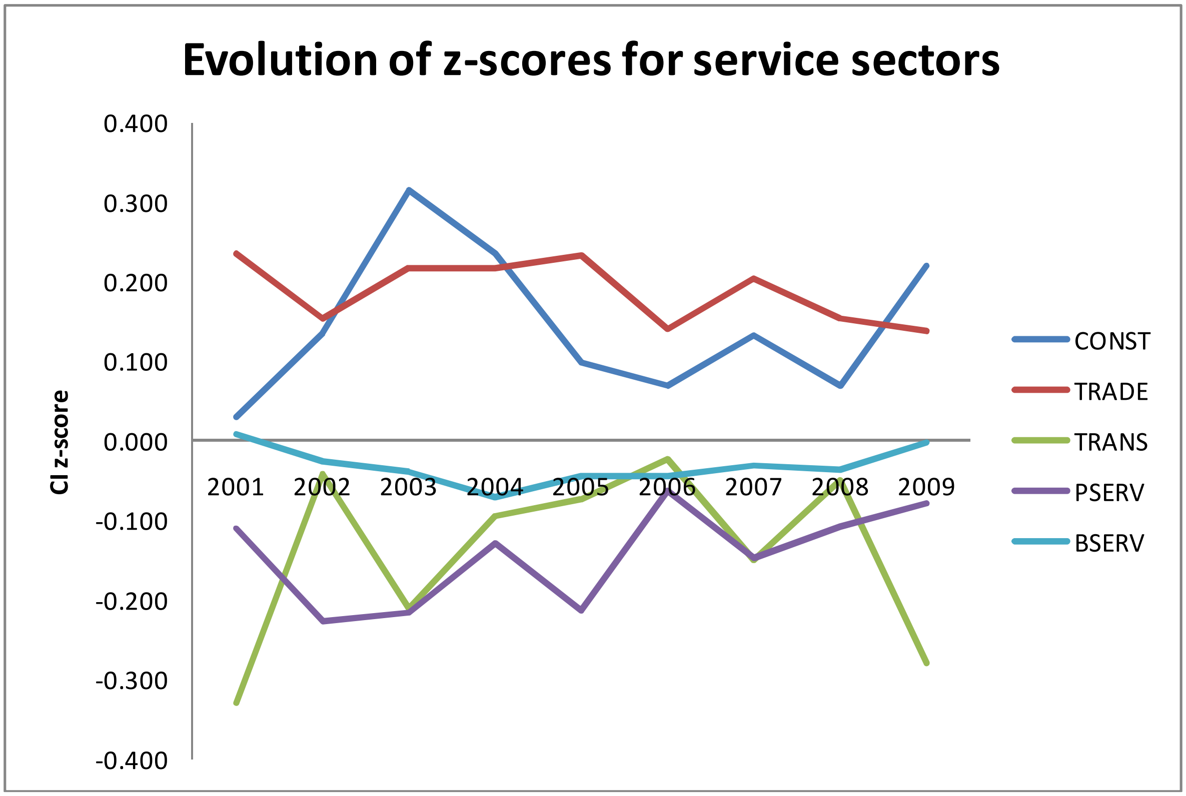
The analysis of this graph shows that most of the sub-sectors (NACE 4-digits) within the bad-performing NACE 3-digit sectors are doing even worse than their *parents* (looking at sectors 107x-110x), while the ones that are performing well at NACE 3 digit are more varied at sub-sector level. The implications are that results of any analysis can be quite different and are dependent on the resolution chosen. However, there seems to be some consistency over different resolutions, and sub-sectors which outperform their larger *parents* by a large margin are rare.

4.1.5 Services group

4.1.5.1 General picture

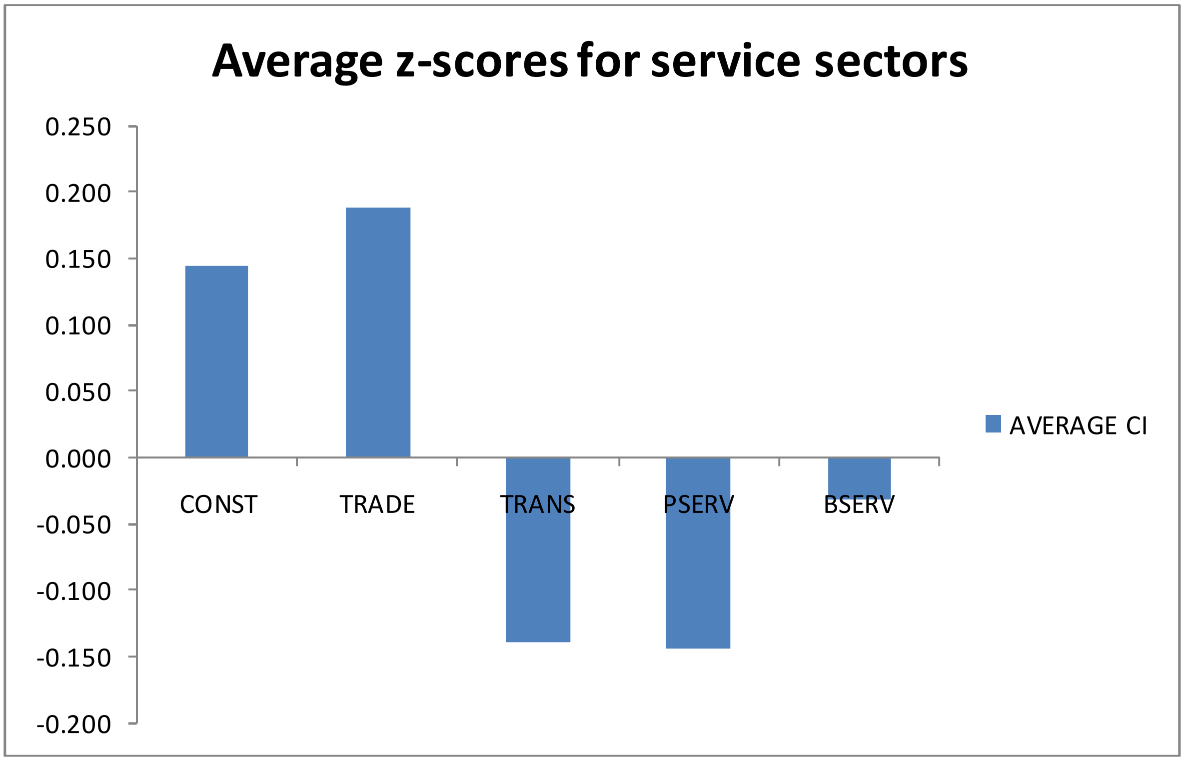
The evolution over time of the services sectors is represented in the figure below. It shows two quite distinguishable pictures: firstly, construction and trade industries seem to be constantly outperforming the others, while between these two there is not much to pick in terms of best-performance. We can also see that in 2006 and 2008 the five industries were closest to each other in terms of performance, while 2003 and 2009 seem to be the periods with most variation. There is no clear trend for any industry, but business service providers have the most constant performance over time, and also a slight upward trend which started in 2004.

Figure 37: Evolution over period 2001-2009 of Composite Indicator z-scores for Services sectors



Not taking into account the variation over time of z-scores, we can look at differences between different industries in a more compact way: construction and trade sectors are best performers on average over nine years, while transportation, business and personal services are lagging behind overall. The figure below shows there is quite a large difference between best and worst performing industries.

Figure 38: Average Composite Indicator z-scores over period 2001-2009 for services sectors



Looking at the details of these results, we see that in the top 20 performers there are quite a large numbers of business services sectors, like Software publishing, Architectural and engineering activities, Activities of employment placing agencies and so on, but also personal services like Beverage serving activities. Of course construction and trade industries are also represented by 5 of the top 20 sectors, while Passenger air transport is ranked 3rd overall.

Table 23: Top 20 sectors in Services

NACE3	AVG_ZSCORE	2009	2008	2007	2006	2005	2004	2003	2002	2001
582	0.821	0.354	-0.091	1.045	0.296	1.498	1.828	1.202	0.467	0.792
563	0.523	0.438	0.630	0.625	0.810	0.429	0.355	0.562	0.392	0.470
511	0.522	0.641	0.301	0.222	0.066	0.119	0.298	0.280	2.616	0.156
783	0.486	1.838	0.692	0.216	0.676	-0.013	0.772	0.142	0.148	-0.101
422	0.464	0.247	0.151	-0.005	0.250	0.345	0.240	1.923	0.919	0.108
642	0.436	0.012	0.870	0.279	0.651	0.832	-0.006	0.480	0.447	0.359
461	0.432	0.258	0.451	0.358	0.394	0.212	0.364	0.730	0.555	0.567
711	0.403	1.088	0.335	0.736	0.047	0.207	0.195	0.488	0.155	0.373
741	0.390	1.097	0.482	0.382	0.275	0.278	0.205	0.356	0.317	0.122
781	0.379	0.332	0.155	0.434	0.527	0.376	0.135	0.419	0.761	0.277
799	0.351	0.655	0.289	0.104	1.303	0.305	0.190	-0.074	0.326	0.061
652	0.331			-0.106	-0.536	1.339	-0.559	1.516		
478	0.321	0.493	0.203	0.233	0.337	1.067	0.136	-0.010	-0.032	0.465
464	0.320	0.305	0.085	0.345	0.156	0.530	0.345	0.121	0.495	0.496
681	0.315	-0.229	0.316	2.677	-0.188	0.185	0.590	-0.210	-0.419	0.113
469	0.315	-0.072	0.161	0.195	0.261	0.168	1.123	0.339	0.069	0.588
651	0.290	0.310	0.809	0.045	0.202	0.395	0.407	0.285	0.253	-0.092
439	0.286	0.244	0.238	0.221	0.488	0.015	0.499	0.510	0.102	0.258
639	0.266	0.146	-0.021	-0.210	0.656	0.138	0.661	0.370	0.190	0.465
791	0.260	0.309	0.242	0.334	0.059	0.363	0.038	0.490	0.142	0.361

Turning attention to the worst performers, we can again see a big difference in average z-scores from the top and middle sectors. Indeed, as we expected from the overall analysis, most worst performing sectors are from the three lagging industries: transport (5 sectors in the bottom 20), business (4 sectors in the bottom 20) and personal services (11 sectors in the bottom 20). The table below shows the entire group of worst-performing sectors in the services industry.

Table 24: Bottom 20 sectors in Services

NACE3	AVG_ZSCORE	2009	2008	2007	2006	2005	2004	2003	2002	2001
501	-0.289						0.464		-0.760	-0.571
512	-0.304	-0.265	-0.087	-0.408	-0.416	-0.330	-0.358	-0.256	-0.206	-0.410
811	-0.355	-0.436	-0.201	-0.438	-0.422	-0.184	-0.492	-0.375	-0.342	-0.304
643	-0.361	-0.494	-0.305	-0.249	0.725	-0.525	-1.311	-1.154	0.170	-0.109
552	-0.396	0.192	-0.238	-0.552	0.282	-0.421	-0.849	-0.730	-0.641	-0.609
722	-0.411	-0.193	-0.249	-0.478	-0.207	-0.872	-0.869	-0.457	-0.184	-0.188
732	-0.480	0.242	-0.908	-0.655	-0.642	-0.328	-0.549	-0.375	-0.640	-0.468
493	-0.493	-0.427	-0.574	-0.690	-0.685	-0.437	-0.448	-0.479	-0.330	-0.368
559	-0.531	-0.788	-0.544	-0.706	-0.554	-0.692	0.059	-0.504	-0.466	-0.580
551	-0.650	-0.606	-0.763	-0.644	-0.775	-0.724	-0.695	-0.739	-0.562	-0.340
553	-0.703	-0.433	-0.582	-0.379	-0.857	-1.078	-0.389	-0.969	-0.836	-0.805
492	-0.708	-0.627	-0.728	-0.777	-0.563	0.550	-0.172	-0.519	-1.777	-1.755
663	-0.726	-0.671	-0.632	-0.984	-1.019	-0.860	-0.750	-0.781	-0.217	-0.616
611	-0.737	-1.169	-1.296	-1.054	-1.101	-0.872	-0.496	-0.380	-0.233	-0.027
531	-0.738	-0.746	-0.608	-0.780	-0.680	-0.457	-0.879	-0.958	-0.389	-1.146
612	-0.778	-0.945	-0.770	-0.990	-0.909	-0.569	-0.804	-0.861	-0.356	-0.800
682	-0.796	-1.139	-0.733	-0.981	-1.093	-0.951	-0.638	-0.154	-0.841	-0.638
602	-0.925	-0.943	-0.828	-0.933	-0.896	-0.917	-0.858	-0.758	-0.966	-1.227
771	-1.188	-1.300	-1.369	-1.225	-1.413	-1.418	-1.285	-1.245	-0.831	-0.610
613	-1.208	-1.358	-1.480	-1.409	-1.337	-1.227	-1.256	-1.015	-0.973	-0.819

4.1.5.2 Zooming in on the Retail sector

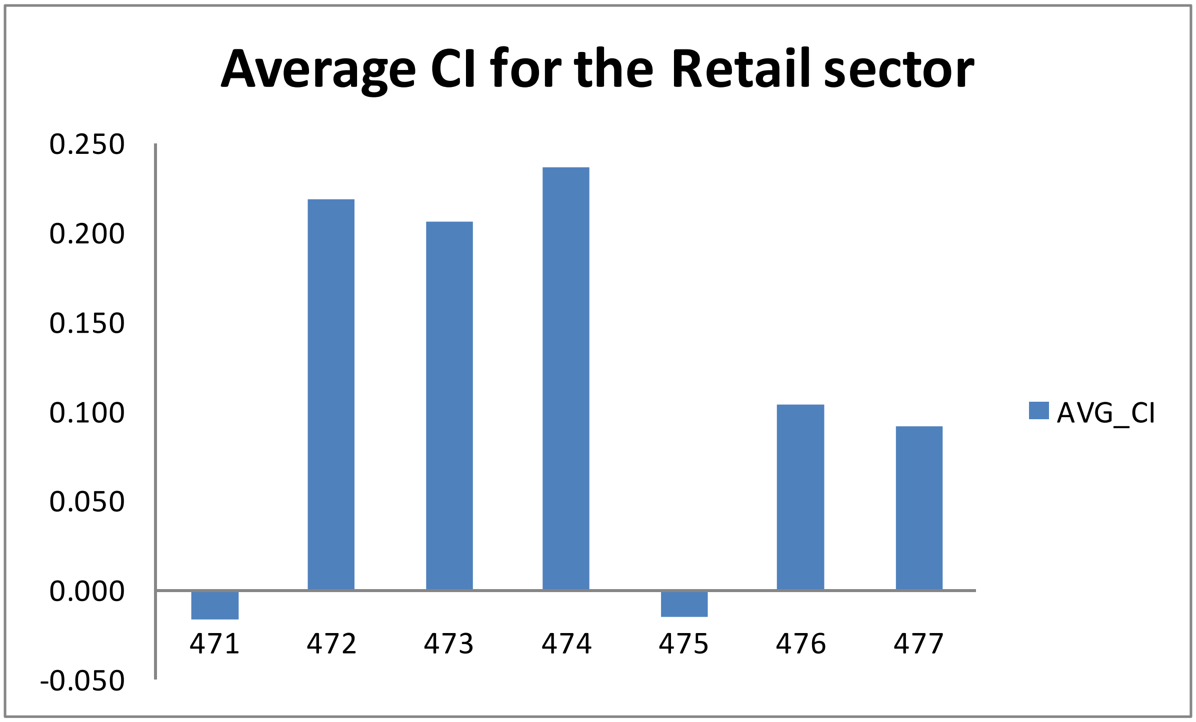
We now take the same in-depth look at the Retail sector (NACE 3 between 471 and 477). Again, results are quite heterogeneous, but they seem to be more clustered than the Food industry, with sector rankings varying between 22 and 77 out of 112 sectors (NACE 3 digit level, analysis of Service sectors, with no import penetration and R&D intensity).

Table 25: Composite z-scores for sectors 471-477 on six indicators

NACE	Rank	AVG	2009	2008	2007	2006	2005	2004	2003	2002	2001
471	77	-0.017	0.010	-0.033	-0.036	-0.024	-0.003	0.008	-0.016	-0.019	-0.041
472	27	0.219	0.052	0.529	-0.019	0.035	0.282	0.188	0.351	0.178	0.372
473	31	0.206	-0.001	0.114	0.542	0.132	0.167	0.038	0.093	0.042	0.727
474	22	0.237	0.230	0.039	0.152	0.157	0.201	0.409	0.524	0.125	0.295
475	76	-0.015	0.042	-0.125	-0.037	-0.019	0.040	0.021	-0.025	-0.016	-0.016
476	54	0.104	0.122	0.140	0.085	0.129	0.111	0.099	0.127	0.055	0.063
477	57	0.091	0.111	0.477	0.042	-0.017	0.003	0.362	-0.006	-0.011	-0.142

The next graph shows collapses the results in one comparison of averages over the entire period, where we can see sectors 474 (Retail sale of food, beverages and tobacco), 473 (Retail sale of automotive fuel) and 474 (Retail sale of information and communication equipment) performing better than their peers in the same industry. Sectors 471 (Retail sale in non-specialized stores) and 475 (Retail sale of other household equipment) are lagging behind.

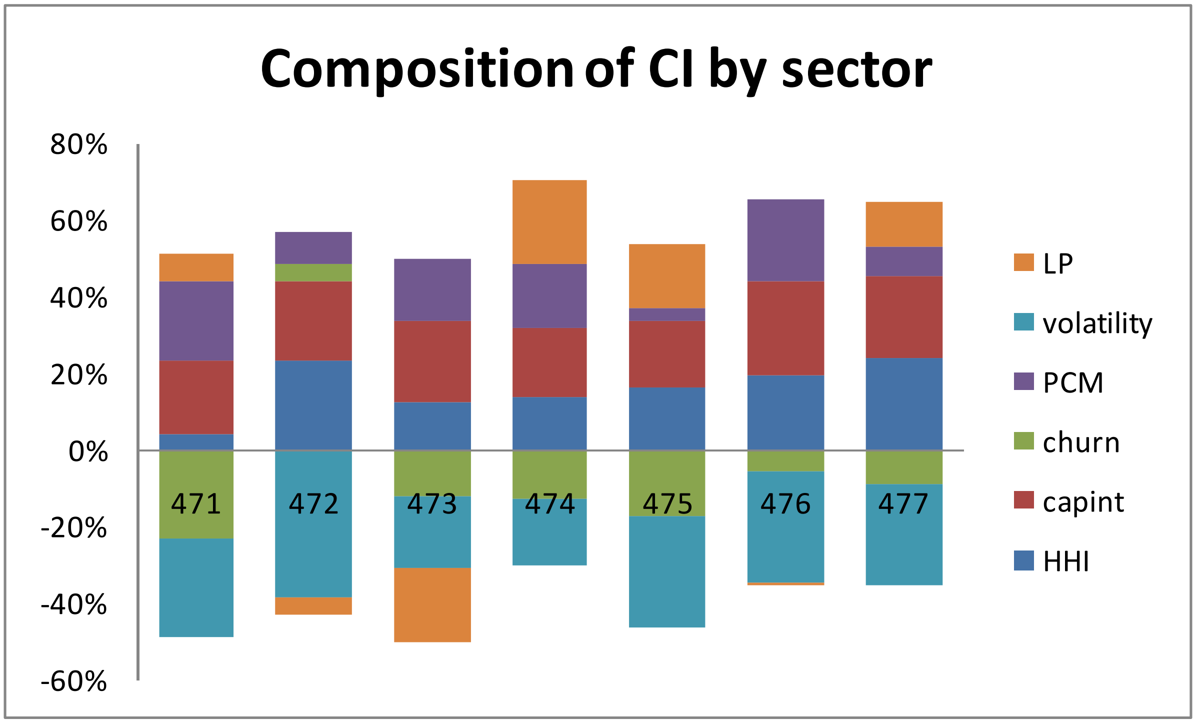
Figure 39: Average Composition Composite Indicator z-score for Retail Sectors at NACE 3



Average composite z-scores for sectors 471-477 (NACE 3) on six indicators

As for the Food industry, we will now briefly analyze the composition of CI z-scores on individual indicators for each of these NACE 3 digit sectors. The figure below shows results for 2009. As a reminder, the overall CI is computed as an average of the individual scores shown in this figure. We can thus see that all retail sectors perform rather poorly on volatility of market shares compared to other service sectors in their peer group. However, they have above-average performance on capital intensity, price-cost margin, and concentration, while labor productivity is somewhat uneven across sectors.

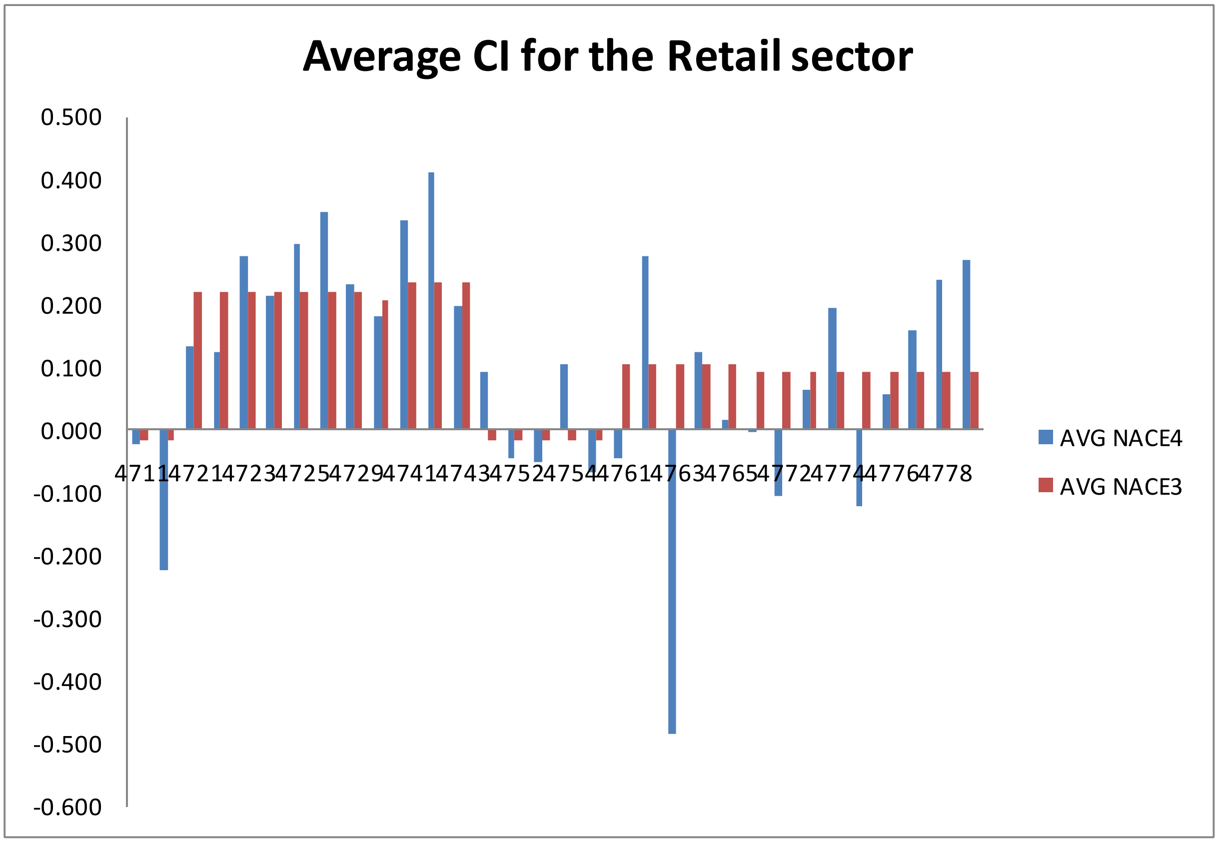
Figure 40: Composition Composite Indicator z-score for year 2009 for retail sectors



Composition of CI for sectors 471-477 on six indicators in 2009

Taking a more focused approach, we turn our attention to NACE 4 digit levels, where the retail industry splits in 32 sub-sectors. The figure below shows the comparison of each sub-sector's average CI over 2001-2009 (blue columns) and the *parent* (the higher-aggregation sector comprising a series of similar sub-sectors) sector's average for the same period (red columns). The analysis reveals that a series of sub-sectors largely outperform their peers and also their more aggregate parent sectors (such as 4742 - Retail sale of telecommunications equipment, 4762 - Retail sale of newspapers and stationery or 4779 - Retail sale of second-hand goods in stores), while other are lagging behind their more aggregate peers (4719 - Other retail sale in non-specialized stores or 4763 - Retail sale of music and video recordings).

Figure 41: Average Composition Composite Indicator z-score for Retail Sectors at NACE 4



Average CI for sectors in the food industry on eight indicators – comparison NACE 3 vs. NACE 4

4.2 Benefit of the Doubt

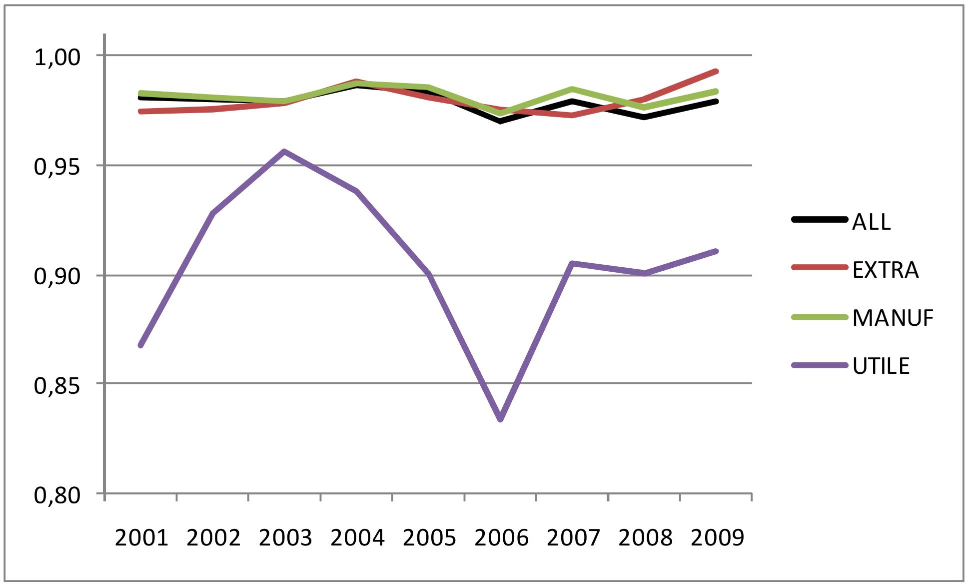
For the Benefit of the Doubt (BoD) method, it is not a good idea to consider all sectors together because this would mean that for a given sector, any possible other sector is a potential peer. Clearly, it makes little sense to have the hairdressers as a possible peer for steel industry for instance. In order to avoid this, we have chosen to split the sample of sectors into two broad groups. The first group consists of manufacturing related sectors, in particular Extraction (EXTRA), Manufacturing (MANUF) and Utilities & Electricity (UTILE). The second group consists of services related sectors: Construction (CONST), Trade (TRADE), Transport (TRANS), Business Services (BSERV) and Personal Services (PSERV). A more precise definition of these groups is given in Appendix 1. In the following paragraphs we will present results of the Benefit of the Doubt BoD calculations for both groups separately. For each group, we first look at the general picture, i.e. evolution over time and average over the period 2001-2009. Secondly, we list top and bottom sectors based on their average BoD score between 2001 and 2009. Finally, we zoom on some particular subsectors of particular interest.

4.2.1 Manufacturing group

Our default analysis for the Manufacturing industry takes into account all the indicators, including Import Penetration and R&D Expenditures. Figure 42 shows the evolution over time of the BoD scores for the Manufacturing group of sectors.

4.2.1.1 General picture

Figure 42: Evolution over period 2001-2009 of BoD score for manufacturing sectors



Overall, the BoD scores of the total group ("ALL") is relatively stable over time. Utilities and Electricity are performing consistently below average. It should be noted that these averages are to be interpreted with care since the Extraction and Utilities and Electricity groups covers only a very limited number of sectors compared to the Manufacturing group. The general pattern is confirmed if we look at the averages of the groups over the time period 2001-2009.

Figure 43: Average BoD score over period 2001-2009 for manufacturing sectors

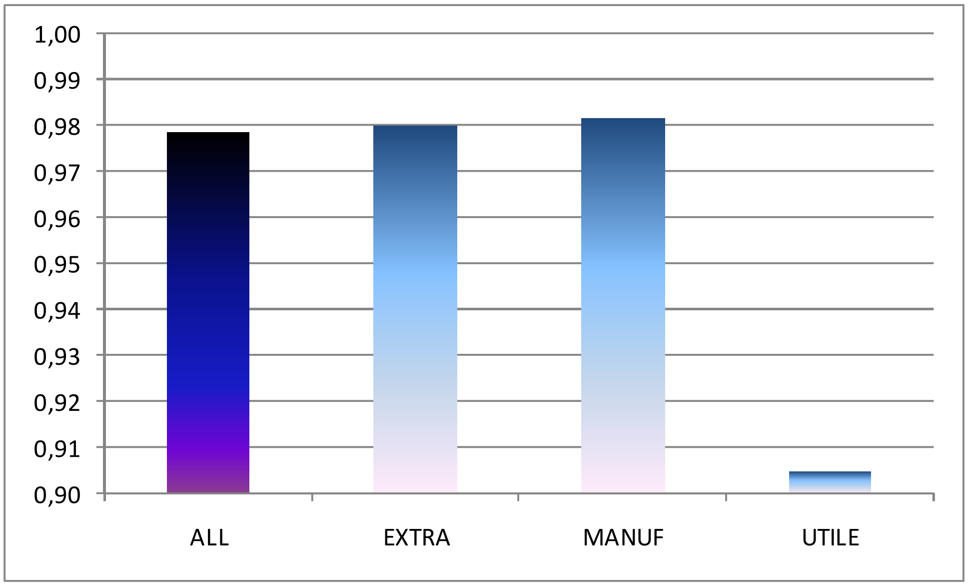


Table 26: Top 20 sectors in Manufacturing

	BOD score (HIGH value is GOOD)										
	NACE3	2001	2002	2003	2004	2005	2006	2007	2008	2009	average
1	071	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	**1.000**
2	089	1.000	1.000	1.000	1.000	1.000	1.000	n.a.	n.a.	n.a.	**1.000**
3	143	1.000	1.000	1.000	1.000	1.000	1.000	n.a.	n.a.	n.a.	**1.000**
4	262	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	**1.000**
5	266	n.a.	n.a.	n.a.	1.000	1.000	n.a.	n.a.	n.a.	n.a.	**1.000**
6	309	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	**1.000**
7	289	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	**1.000**
8	261	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	**1.000**
9	152	1.000	1.000	0.997	1.000	1.000	1.000	1.000	1.000	1.000	**1.000**
10	322	n.a.	n.a.	n.a.	n.a.	0.995	1.000	1.000	1.000	1.000	**0.999**
11	323	0.992	1.000	1.000	1.000	1.000	1.000	n.a.	n.a.	n.a.	**0.999**
12	257	1.000	0.996	1.000	1.000	1.000	1.000	1.000	0.992	1.000	**0.999**
13	212	1.000	1.000	0.990	0.996	1.000	1.000	1.000	1.000	1.000	**0.998**
14	102	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.995	1.000	1.000	**0.998**
15	264	1.000	0.997	0.986	1.000	1.000	1.000	1.000	1.000	1.000	**0.998**
16	162	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.993	1.000	1.000	**0.998**
17	211	1.000	1.000	1.000	1.000	0.998	1.000	0.991	0.985	1.000	**0.997**
18	141	0.988	1.000	1.000	0.991	1.000	0.993	1.000	0.995	1.000	**0.996**
19	325	0.987	0.991	1.000	0.994	0.996	0.995	1.000	1.000	1.000	**0.996**
20	302	1.000	0.992	1.000	0.999	1.000	0.968	1.000	1.000	1.000	**0.996**

Top performing sectors are mining of iron ore (071) and mining and quarrying (089). At first sight, this might seem strange because there is almost no mining or quarrying activity in Belgium. Probably the sector consists of companies with branches in Belgium but who are active worldwide in the mining business. In addition, we find some specific textile sectors in the top list: knitted and crocheted apparel (143) and wearing apparel (141). Furthermore manufacture of computers (262), electronic components

(261) and consumer electronics (264). We also find the manufacture of pharmaceutical preparations (212) and basic pharmaceutical products (211) high in the list. In addition, also the manufacture of music instruments (322), sport goods (323) and medical and dental supplies (325) end up high in the list of top performing sectors.

Table 27: Bottom 20 sectors in Manufacturing

	BOD score (HIGH value is GOOD)										
	NACE3	2001	2002	2003	2004	2005	2006	2007	2008	2009	average
1	370	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.785	0.801	0.802	**0.796**
2	352	n.a.	n.a.	0.912	0.928	0.887	0.804	0.811	0.858	0.812	**0.859**
3	351	0.868	0.928	1.000	0.948	0.914	0.864	0.905	0.862	0.925	**0.913**
4	272	0.944	0.921	0.975	0.921	0.917	0.877	0.907	0.952	0.920	**0.926**
5	235	0.901	0.937	0.906	0.930	0.938	0.941	0.927	0.939	0.955	**0.930**
6	110	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.923	0.933	0.941	**0.932**
7	192	0.963	0.906	0.948	0.958	0.994	0.909	0.967	0.904	0.960	**0.946**
8	081	0.924	0.926	0.936	0.964	0.944	0.927	0.945	0.960	0.986	**0.946**
9	171	0.933	0.958	0.948	0.965	0.958	0.934	0.970	0.919	0.974	**0.951**
10	104	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.966	0.890	1.000	**0.952**
11	120	0.968	0.978	0.962	0.985	0.990	0.870	0.952	0.945	0.920	**0.952**
12	233	0.966	0.966	0.937	0.959	0.965	0.939	0.951	0.948	0.956	**0.954**
13	172	0.956	0.946	0.947	0.952	0.955	0.949	0.955	0.973	0.967	**0.955**
14	382	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.957	0.950	0.967	**0.958**
15	221	0.978	0.961	0.953	0.976	0.961	0.935	0.958	0.935	0.979	**0.960**
16	381	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.986	0.931	0.974	**0.964**
17	244	0.929	0.905	0.956	1.000	0.971	0.967	1.000	0.977	0.984	**0.965**
18	245	0.960	0.951	0.947	0.980	0.971	0.959	0.976	0.966	0.985	**0.966**
19	202	1.000	0.963	1.000	1.000	0.946	0.804	1.000	1.000	1.000	**0.968**
20	204	1.000	0.961	0.946	0.965	0.969	0.955	0.977	0.965	0.977	**0.968**

In the bottom 20 sector we find several sector of the Utilities and Electricity group. In particular sewerage (370), manufacture of gas (352) and electric power generation (351) are performing worst of all sectors in the manufacturing group. Also manufacture of batteries (272), cement (235), beverages industry (110) and refineries (192), perform badly. Note that many of these industries use very capital intensive production processes. Also remarkable is that some environmental services are among the bottom 20 sectors, in particular waste collection (381) and waste treatment and disposal (382).

4.2.1.2 Zooming in on the year 2009

So far, we have been looking at the BoD score of sectors without considering the details behind the score. There is however a large amount of additional information available when looking at a particular year. For instance, we can look at the composition of the BoD score, i.e. the "load" that each dimension gets and which can differ across sectors.

Table 28: Detailed BoD output for the top 20 Manufacturing sectors for year 2009

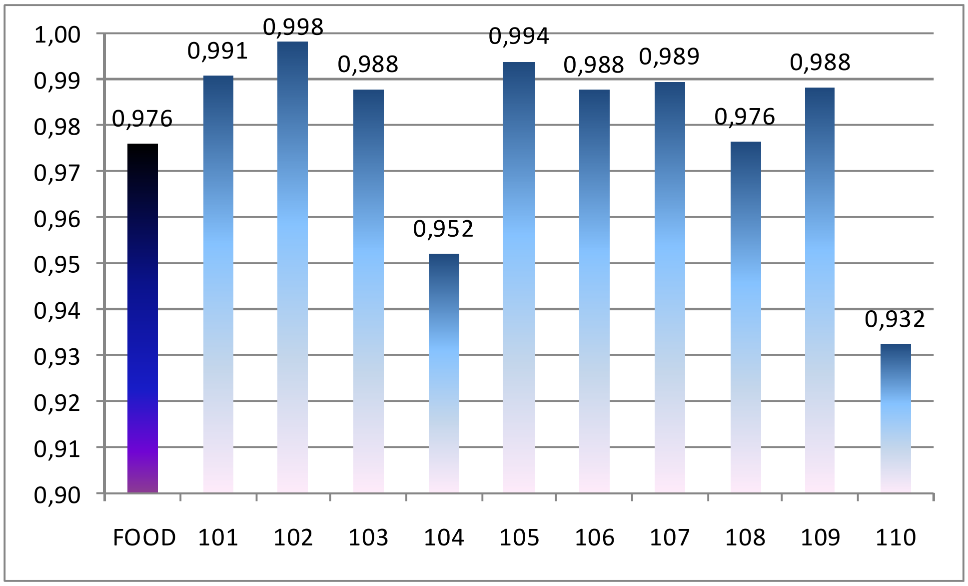
	YEAR	2009											
rank	NACE	GROU	sector	HHI	CAPINT	CHURN	VOLAT	LPG	PCM	IMPENE	RDINT	BoD	peer
1	325	MANUF	Manufacture of medical and dental instruments and supplies	0.213	0.477	0.000	0.026	0.154	0.096	0.020	0.016	1.000	44
2	071	EXTRA	Mining of iron ores	0.390	0.500	0.000	0.000	0.110	0.000	0.000	0.000	1.000	36
3	108	MANUF	Manufacture of other food products	0.257	0.500	0.000	0.007	0.236	0.000	0.000	0.000	1.000	23
4	324	MANUF	Manufacture of games and toys	0.185	0.500	0.012	0.080	0.223	0.000	0.000	0.000	1.000	18
5	139	MANUF	Manufacture of other textiles	0.500	0.204	0.027	0.000	0.188	0.073	0.005	0.002	1.000	15
6	211	MANUF	Manufacture of basic pharmaceutical products	0.126	0.500	0.000	0.039	0.209	0.077	0.015	0.034	1.000	13
7	104	MANUF	Manufacture of vegetable and animal oils and fats	0.146	0.500	0.000	0.005	0.349	0.000	0.000	0.000	1.000	8
8	141	MANUF	Manufacture of wearing apparel, except fur apparel	0.257	0.500	0.000	0.001	0.074	0.134	0.034	0.000	1.000	6
9	206	MANUF	Manufacture of man-made fibres	0.224	0.500	0.000	0.004	0.205	0.054	0.014	0.000	1.000	6
10	302	MANUF	Manufacture of railway locomotives and rolling stock	0.095	0.500	0.000	0.109	0.188	0.109	0.000	0.000	1.000	6
11	131	MANUF	Preparation and spinning of textile fibres	0.131	0.500	0.000	0.072	0.167	0.130	0.000	0.000	1.000	5
12	162	MANUF	Manufacture of products of wood, cork, straw and plaiting mate	0.483	0.330	0.036	0.003	0.148	0.000	0.000	0.000	1.000	5
13	267	MANUF	Manufacture of optical instruments and photographic equipme	0.101	0.500	0.000	0.024	0.145	0.133	0.037	0.059	1.000	5
14	303	MANUF	Manufacture of air and spacecraft and related machinery	0.126	0.500	0.000	0.097	0.171	0.084	0.022	0.000	1.000	5
15	289	MANUF	Manufacture of other special-purpose machinery	0.269	0.500	0.000	0.000	0.088	0.119	0.024	0.000	1.000	3
16	212	MANUF	Manufacture of pharmaceutical preparations	0.122	0.500	0.000	0.016	0.174	0.080	0.000	0.107	1.000	2
17	262	MANUF	Manufacture of computers and peripheral equipment	0.202	0.475	0.000	0.000	0.129	0.102	0.088	0.004	1.000	2
18	309	MANUF	Manufacture of transport equipment n.e.c.	0.247	0.500	0.000	0.008	0.042	0.181	0.010	0.012	1.000	2
19	322	MANUF	Manufacture of musical instruments	0.500	0.000	0.000	0.000	0.011	0.000	0.489	0.000	1.000	2
20	102	MANUF	Processing and preserving of fish, crustaceans and molluscs	0.315	0.500	0.011	0.001	0.000	0.151	0.022	0.000	1.000	1

For instance, we can deduce from Table 28 that the sector of railway locomotives and rolling stock (302) is characterized by very high concentration which translates into a relatively low contribution of the concentration (HHI) dimension to its BoD score. We also observe that for most sectors R&D intensity does not contribute significantly to their BoD score. Only for the pharmaceutical sectors (211 and 212) and the optical and photographical equipment sector (267), R&D is an important contributor to their scores. Finally, we want to draw attention to the last column (peers) which denotes how many times a particular sector served as a benchmark for other sectors. This is useful information for two reasons. First, it gives an additional indication of the good performance of a sector if it often serves as a benchmark for others because that means that it is on the boundary of the efficiency frontier. Secondly, it enables us to refine the ranking of sectors who obtained a BoD score of one. In 2009, we have a lot of sectors which are deemed efficient (22 out of 89) and which we cannot further differentiate without additional criterion. For instance, the sector of medical instruments (325) serves 44 (out of 89) times as a benchmark for other sectors meaning that it is surely a well performing sector.

4.2.1.3 Zooming in on the Food sector

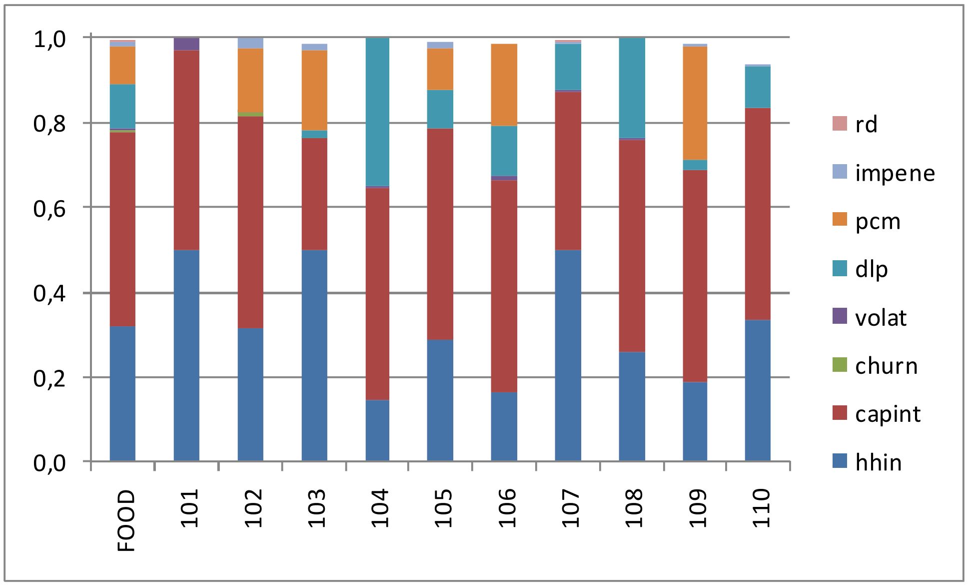
In the following graph, we zoom in on the Food sector, NACE 3 codes 101-109. Because of data limitations (there are only data for R&D expenditure from 2007 onwards), we can only compare the three last years 2007, 2008 and 2009. We report the average BoD score over these three years for the different Food sectors. The worst performing subsectors are vegetable and animal oils and fats (104) and beverages (110). Best performing in this group are processing and preserving of meat (101) and fish (102) and manufacture of dairy products (105).

Figure 44: Average BoD score over period 2007-2009 for food related sectors



If we zoom in on one particular year 2009) and on the composition of the BoD score, we get the following picture. Many food sectors (101, 103 and 107) are characterized by low levels of concentration compared to other manufacturing sectors. Therefore, they receive high credit (at most 50%) for that dimension in the BoD score. More concentrated sectors like 104 (vegetable and animal oils and fats), 106 (grain mill products and starch) and 109 (prepared animal feeds) get less weight on the concentration dimension in the BoD analysis. Most food sectors have relatively low capital intensity, and hence low entry barriers, leading to relatively high weight for that dimension in the BoD. Notable exceptions are processing and preserving of fruits and vegetables (103) and manufacture of bakery and farinaceous products (107). R&D expenditures in food industries are low compared to the other manufacturing sectors and therefore gets no weight. For import penetration, only sector 102 (processing and preserving of fish) gets some credit for its substantial import penetration. As regards Price Cost Margin PCM, the beverage sector (110) has the highest of all PCM in the food industry and this dimension gets no weight in that sector's BoD. Low PCM sectors like 103, 106 and 109 get some credit for that in their BoD score.

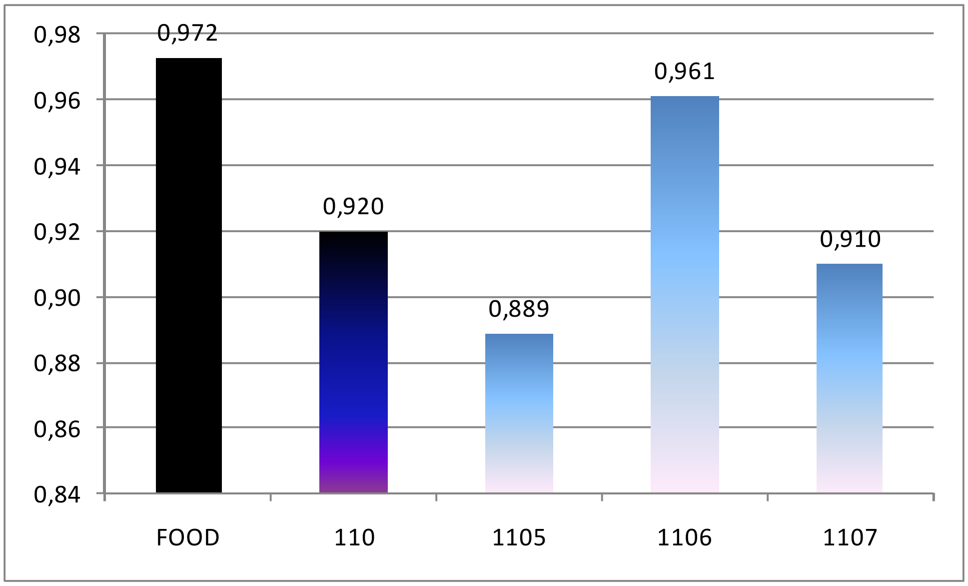
Figure 45: Composition BoD score for year 2009 for food related sectors



At NACE 3 level, the sectors are still rather aggregated and do not coincide with economic markets. We therefore look at the more detailed NACE 4 level for the Food sector to see how the different NACE 4 subsectors contribute to the overall result at NACE 3. We consider two sectors in more detail: first 110 (beverages), then 108 (other food products).

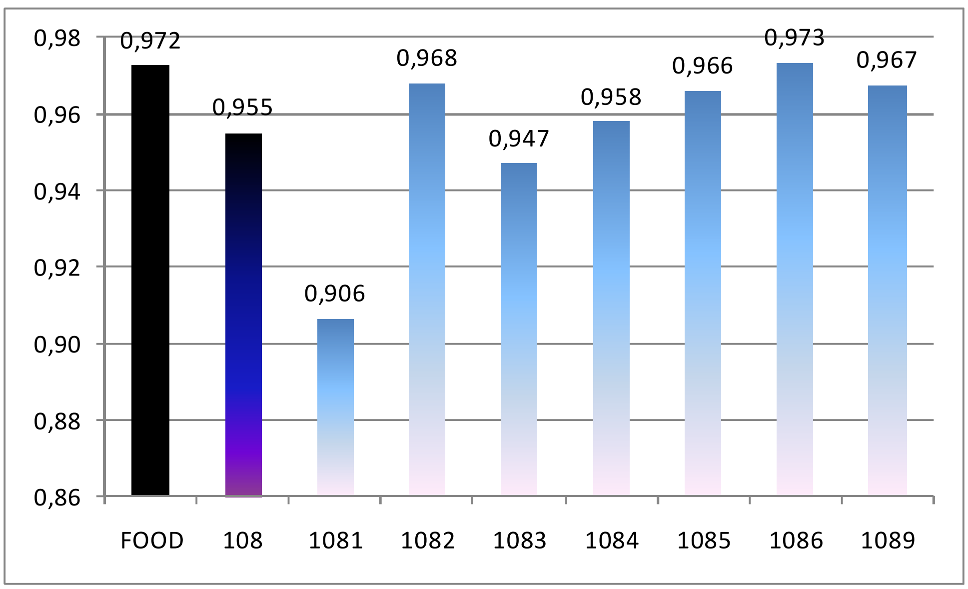
For the beverages we observe that especially the producers of beer (1105) and soft drinks and bottled water (1107) perform badly in the BoD analysis. Manufacture of malt (1106) performs relatively better but still below the average of the entire group of Food sectors.

Figure 46: Beverage sector at NACE 4



The sector 108 (other food products) consists of several subsectors at NACE 4 level and therefore, it is important to trace back the relatively poor performance of the sector at NACE 3 to the underlying NACE 4 subsectors. We see from the figure below that it are mainly 1081 (sugar) and to some extent 1083 (coffee and tea) that are responsible for the relatively poor performance of sector 108 within the group of Food sectors.

Figure 47: Manufacture of other food products at NACE 4



4.2.1.4 Sensitivity analysis: no R&D expenditures

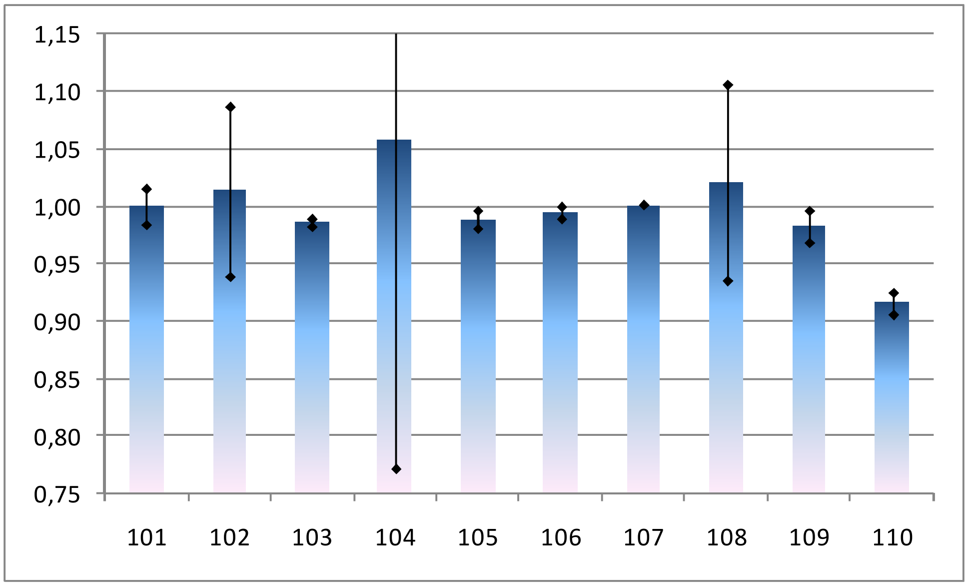
As there are no data for R&D expenditures for some sectors in the Manufacturing group, we have calculated the BoD scores also without this indicator to test the robustness of the analysis reported higher.

Without Import Penetration or R&D, most sectors remain close to their relative position compared to the default analysis with all indicators. The correlation of the ranks amounts to 93%. The largest fall back is observed for the pharmaceutical sectors (211 and 212). Because they do extremely well on the R&D indicator, they were listed high in the default analysis. Without R&D, they fall back strongly. Other sectors that fall down in the ranking are manufacture of consumer electronics (264), manufacture of grain mill products (106) and manufacture of music instruments (322).

4.2.1.5 Sensitivity analysis: robust BoD scores

As we explained in the methodological section, it is possible to calculate robust BoD scores taking into account possible outlier bias. Every sector's BoD score is potentially influenced by the presence of some better performing outliers which might cast doubt on the robustness of the BoD scores. In order to compute robust BoD scores, we focused on one particular year (2009) and we drew subsamples with a size of 80% (i.e. order m approach with m=0.8) of the full sample of sectors. By repeating this sampling a few hundred times using a Monte Carlo methodology, we can construct a simulated confidence interval around the average BoD estimate. Note that if we assume that the BoD scores are normally distributed, 95% of the calculated scores lies within two standard deviations from the mean. We therefore show in the picture below the average BoD scores for the Food sector at NACE 3 (i.e. the bars in the graph) and an interval of two times the standard deviation over all Monte Carlo runs.

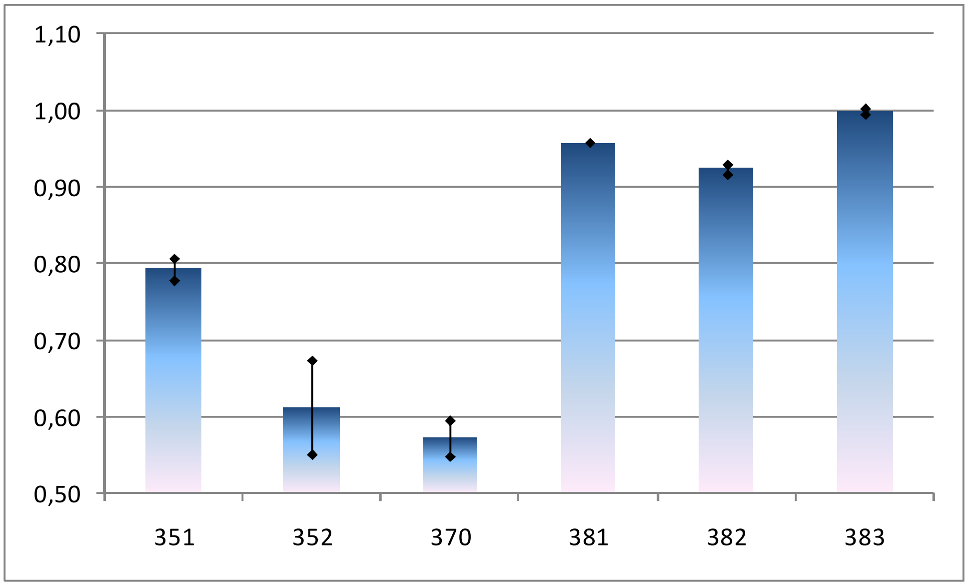
Figure 48: BoD score and two times standard deviation intervals for food related sectors in year 2009



We observe from Figure 48 that the BoD score for the beverages sector (110) is very stable over all Monte Carlo runs. We can therefore be very confident when singling out this sector as the worst performing among the food subsectors at NACE 3 level in 2009. The BoD scores for Subsector 104 (vegetable and animal oil and fats) on the other hand are very volatile ranging between 0.77 and 1.34. Hence, we should be careful with statements about this sector as its BoD score seems to be strongly influenced by some outliers. Similarly, the results for 102 and 108 are to interpreted cautiously.

A similar analysis is shown in Figure 49 for the Utilities and Electricity group of sectors. The confidence intervals around the point estimates are relatively narrow for all the subsectors and do not change the overall picture that appears from looking at the average BoD scores: electricity (351) and manufacture of gas (352) perform substantially worse than the other subsectors in the UTILE group.

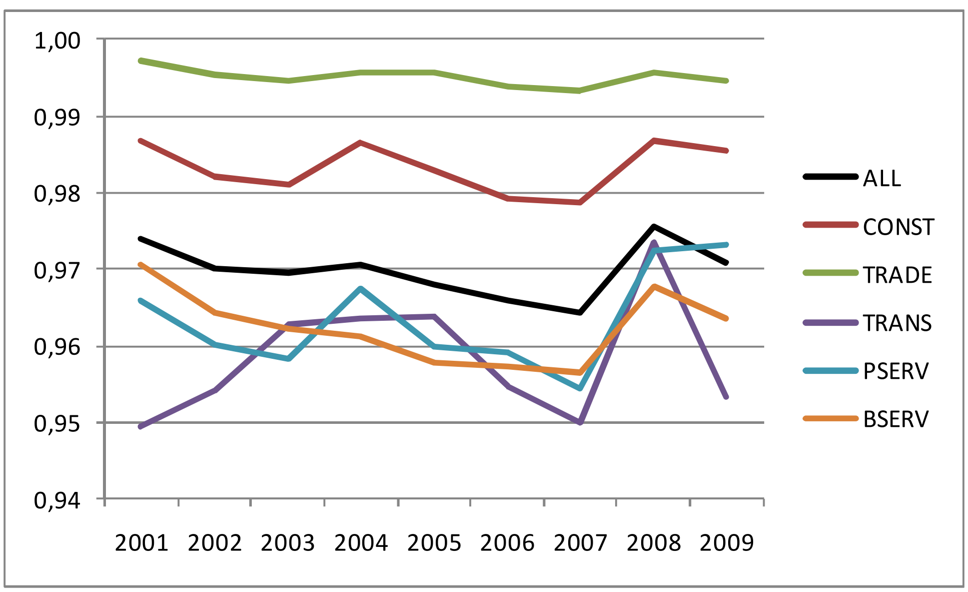
Figure 49: BoD score and two times standard deviation intervals for utilities and electricity sectors in year 2009



4.2.2 Services group

4.2.2.1 General picture

Figure 50: Evolution over period 2001-2009 of BoD score for services sectors



We observe that the Trade sector and Construction sector are performing consistently better than the total of all service related sectors. Personal Services, Business Services and Transport are performing below average but it should be noted that the pattern for these sectors is rather variable over time. Most sectors experience an upward temporary peak in 2008.

On average, over the years 2001-2009, we observe the following ranking of sector groups. Transport and Personal and Business Services rank below average, Construction and Trade above.

Figure 51: Average BoD score over period 2001-2009 for services sectors

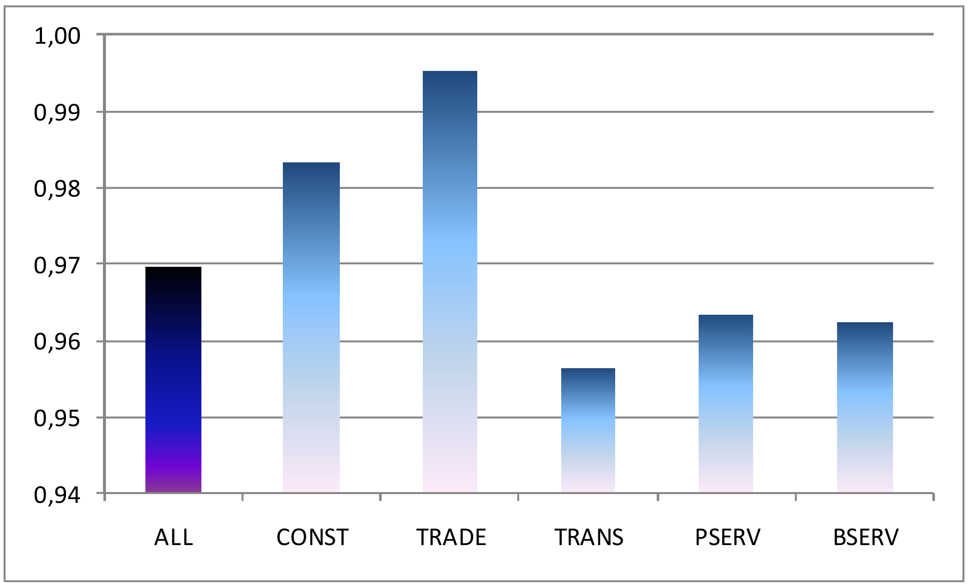


Table 29: Top 20 sectors in Services

	BOD scores (HIGH value = GOOD)										
	NACE3	2001	2002	2003	2004	2005	2006	2007	2008	2009	AVG
1	463	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	464	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
3	479	1.000	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4	951	0.998	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5	791	1.000	0.999	1.000	1.000	1.000	0.999	1.000	0.998	0.995	0.999
6	451	0.999	0.998	0.995	0.999	0.997	1.000	1.000	1.000	1.000	0.999
7	466	1.000	1.000	0.999	0.996	0.999	1.000	0.998	0.997	0.997	0.998
8	781	0.997	1.000	0.998	0.995	1.000	1.000	0.998	0.998	0.999	0.998
9	461	0.999	0.992	1.000	1.000	0.994	1.000	0.998	1.000	0.997	0.998
10	412	0.998	0.998	0.996	0.998	0.995	0.998	1.000	0.997	0.998	0.997
11	465	0.994	0.996	0.995	0.998	0.998	0.997	1.000	0.999	1.000	0.997
12	474	0.998	0.998	1.000	1.000	0.997	0.996	0.995	0.994	0.998	0.997
13	467	0.999	1.000	1.000	0.995	0.995	0.994	0.993	1.000	0.999	0.997
14	473	1.000	0.995	0.994	0.997	0.998	0.997	1.000	0.998	0.995	0.997
15	511	1.000	1.000	1.000	1.000	0.994	0.994	0.981	1.000	1.000	0.996
16	462	1.000	0.999	0.992	0.992	1.000	0.997	1.000	0.995	0.994	0.996
17	432	0.997	0.999	0.993	0.993	1.000	0.994	0.996	0.995	0.998	0.996
18	691	0.996	0.996	0.996	0.992	0.994	0.995	0.995	1.000	1.000	0.996
19	782	0.993	0.993	0.998	0.998	0.993	0.996	0.995	0.998	0.997	0.996
20	711	0.998	0.995	0.991	0.993	0.990	0.993	1.000	1.000	1.000	0.996

In the top 20 of the services group, we encounter many of the wholesale sectors (463, 464, 466, 465, 467, 462) and some retail sectors (474, 473). Also 951 (repair of computer and communications equipment),), 791 (travel agencies), 781 (activities of employment placement agencies) and 511 (passenger air transport) rank high among the services group of sectors. Note that for some of the sectors, one could argue that competition is more a local phenomenon (in particular for lawyers 691 and architects 711) and should therefore better be analyzed using different methodologies, in particular the entry threshold approach.

Table 30: Bottom 20 sectors in Services

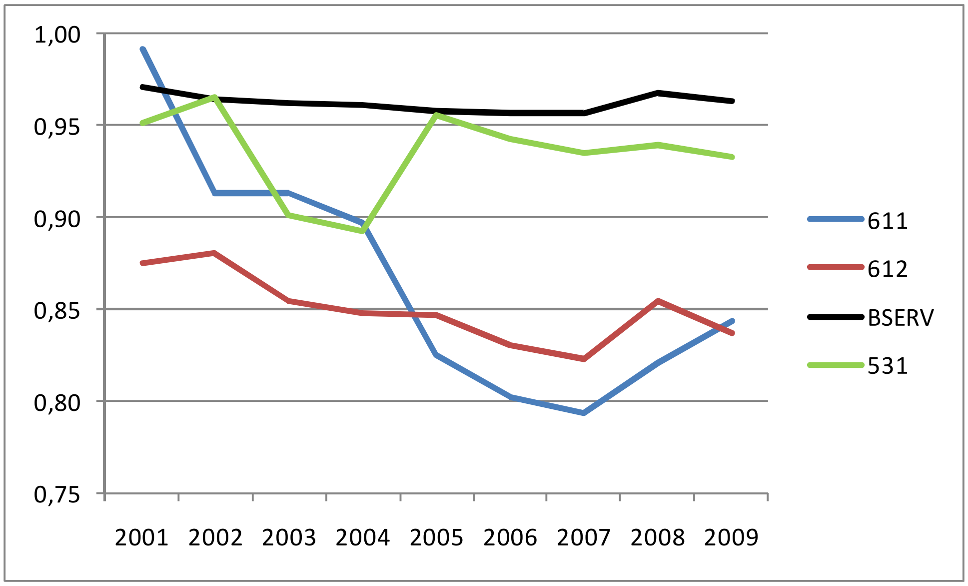
	BOD scores (HIGH value = GOOD)										
	NACE3	2001	2002	2003	2004	2005	2006	2007	2008	2009	AVG
1	613	0.909	0.872	0.846	0.831	0.831	0.816	0.824	0.861	0.835	0.847
2	612	0.875	0.880	0.854	0.848	0.847	0.831	0.823	0.855	0.837	0.850
3	611	0.992	0.913	0.913	0.897	0.825	0.803	0.793	0.821	0.844	0.867
4	663	0.874	0.864	0.834	0.850	0.858	0.867	0.848	0.925	0.920	0.871
5	771	0.910	0.872	0.875	0.880	0.849	0.843	0.845	0.888	0.902	0.874
6	602	0.859	0.873	0.878	0.880	0.882	0.881	0.882	0.895	0.896	0.881
7	722	0.933	0.924	0.890	0.835	0.847	0.887	0.880	0.886	0.921	0.889
8	553	0.887	0.876	0.883	0.935	0.889	0.891	0.894	0.933	0.947	0.904
9	682	0.886	0.902	1.000	0.909	0.883	0.877	0.866	0.929	0.906	0.907
10	492	0.800	0.802	1.000	1.000	1.000	0.890	0.876	0.906	0.926	0.911
11	501	0.920	0.882	n.a.	0.960	n.a.	n.a.	n.a.	n.a.	n.a.	0.921
12	811	0.931	0.942	0.911	0.926	0.934	0.913	0.890	0.932	0.917	0.922
13	495	0.863	0.870	0.882	0.921	0.917	1.000	0.943	1.000	0.908	0.923
14	531	0.952	0.965	0.901	0.893	0.956	0.943	0.935	0.939	0.933	0.935
15	619	0.981	0.951	0.937	0.940	0.929	0.919	0.925	0.932	0.941	0.939
16	649	0.971	0.950	0.942	0.938	0.930	0.927	0.916	0.949	0.952	0.942
17	772	0.962	0.967	0.941	0.926	0.943	0.933	0.927	0.943	0.944	0.943
18	502	0.970	0.986	0.986	0.926	1.000	0.876	0.885	0.972	0.886	0.943
19	551	0.940	0.946	0.958	0.957	0.935	0.933	0.929	0.947	0.944	0.943
20	552	0.923	0.914	0.920	0.925	0.934	0.973	0.941	0.971	0.996	0.944

Worst performing in the service group are telecommunications (611, 612, 613 and to some lesser extent, 619). Also some transport sectors like freight rail transport (492), transport via pipelines (495) and postal services (531) are doing badly. Many of these sectors are characterized by important network effects and are classified as so called “natural monopolies”, that is sectors in which there are very strong economies of scale such that there is room for only a few producers in the entire sector. Also the hotel and holiday accommodation (551 and 552) appear in the bottom 20 list.

4.2.2.2 Zooming in telecom sectors

In the graph below we zoom in on some telecom sectors, in particular wired telecom (611), wireless telecom (612) and postal activities with universal service obligation (531). The telecom sectors have experienced a gradual deregulation over time and in spite of that we observe that there BoD scores deteriorates over the period 2001-2009. Postal services (531) are close to the group average for Business services by the end of the period.

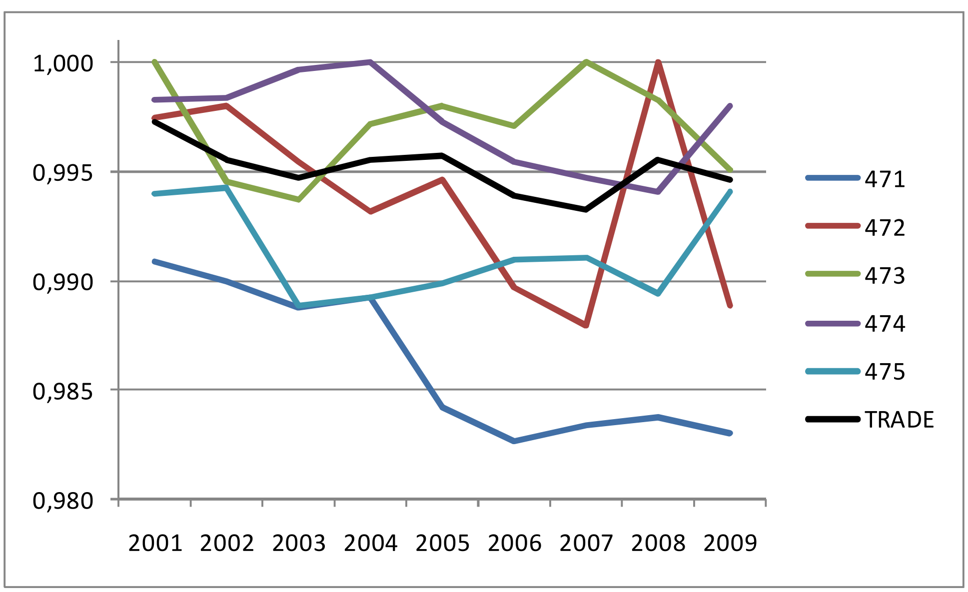
Figure 52: Evolution over period 2001-2009 of BoD score for selected telecom and postal services



4.2.2.3 Zooming in on the retail sector

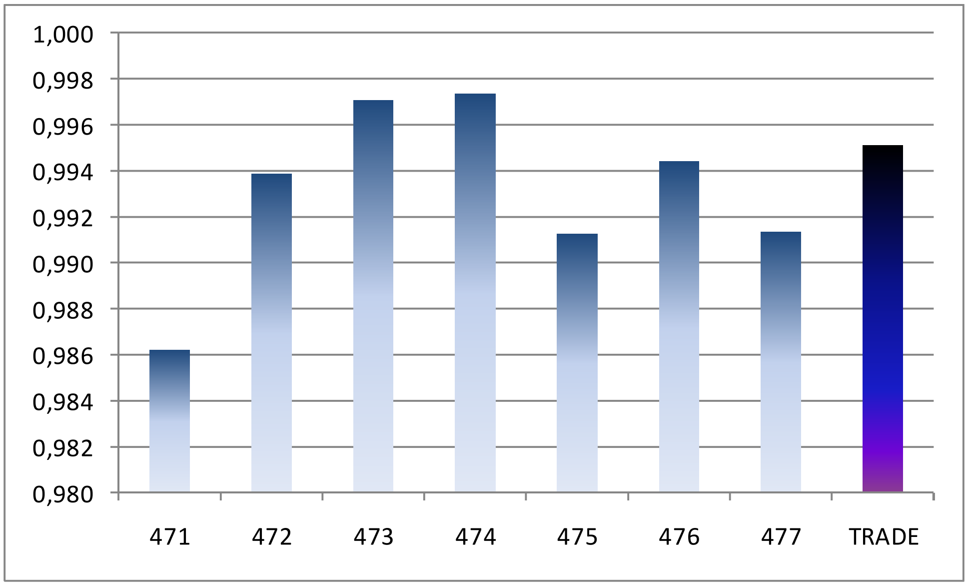
Finally, we consider the retail sector in more detail. We consider sector 471 to 475. Among these sectors, retail sale in non-specialized stores (471) performs substantially below the retail sectors of food, beverages and tobacco (472), automotive fuel (473), information and communication equipment (474) and other household equipment (475). The non-specialized stores sector is also the only one that gradually declines over the period 2001-2009.

Figure 53: Evolution over period 2001-2009 of BoD score for selected retail services



Taking averages over the period 2001-2001, the general picture from above is confirmed. The non-specialized stores are outperformed by all other retail subsectors.

Figure 54: Average BoD score over period 2001-2009 for selected retail sectors



PART TWO:
OTHER MARKET MONITORING TOOLS

5 A decision tree or quick scan

This sector screening tool constructs a decision tree structure to screen industries for possible malfunctioning using a strategic set of indicators reflecting potential, internal and international competition. Based on this conditional combination of market characteristics and taking into account the life cycle of industries, we classify industries into different groups with a low or high probability that market malfunctioning is present. A detailed description of the methodology and empirical results for the Belgian economy can be found in the separate research paper Coucke, Cheung & Neicu (2011).

6 Entry threshold ratios for local markets

For some industries, such as butchery and plumbing, data availability is limited as the firms that make up the industry are small businesses that fall under a reduced reporting regime. Therefore, the more conventional methods of measuring competitive conduct, such as looking at price-cost margins, are not feasible. Furthermore, these small businesses typically compete only with other small businesses that are located close to them, implying that overall industry indicators are not relevant measures of these firms' conduct.

Bresnahan and Reiss (1991) addressed this problem by putting forward an innovative approach to assess competitive entry in industries with localized competition from the relationship between concentration (i.e. the number of firms in the local market) and market size. The intuition of their approach is simple. If market size increases proportionally with the number of firms, then new entry is interpreted to leave the degree of competition unaffected. That is, in order to break-even in the local market, the presence of extra competitors does not increase the number of costumers a single firm needs. This implies that variable profits remain stable, despite the presence of more competitors. On the other hand, if market size has to increase disproportionately to profitably support additional firms, then new entry can be interpreted to intensify the degree of competition. That is, breaking-even in the market requires more costumers per firm when there are more competitors. Therefore, variable profits decrease due to entry. To implement their approach, Bresnahan and Reiss (1991) proposes the concept of "entry threshold ratios", i.e. the per-firm percentage market size increase that is required to support an additional firm. By estimating these entry threshold ratios for an industry, we can thus evaluate whether competition plays a role in these local markets or whether firms seem to be colluding.

A major strength of Bresnahan and Reiss' methodology is that it can be applied with relatively modest data requirements. One basically needs data on a cross-section of local markets, with information on the number of firms per market, population size and other market demographics as control variables. No information on prices or marginal costs is required. This makes their approach also appealing from a competition policy perspective, as a first monitoring tool to assess in which local markets there may potentially exist competition problems.

Bresnahan and Reiss (1991) demonstrate their method on different US industries, such a doctors, plumbers and tire dealers. For most of the industries tested the authors find evidence of competition significantly driving down variable profits until the third firm is present in the local market. Once three firms are competing in the market, extra competitors do not change the required number of customers, indicating the market is fully competitive.

Other empirical work has used the methodology of Bresnahan and Reiss (1991) to model the competitive conduct in several markets, such as Manuszak (2002) on the US brewery industry, Dranove et al (2003) for the US HMO market, Schaumans and Verboven (2009) for the Belgian pharmacy and general practitioners markets and Noailly and Nahuis (2010) for the Dutch notary market.

Detailed description of the methodology and results of the empirical application to some selected sectors of the Belgian economy can be found in the separate research paper Verboven & Schaumans (2011).

7 Persistence of profits

7.1 Discussion

The static market functioning indicators defined in the previous sections generally focus on a snapshot of the sector taking the implicit assumption that the indicator reaches its long-run equilibrium value in every period. However, there is no guarantee for this to be the case. For example, a high price-cost margin at some specific moment in time could just represent a temporary phenomena reflecting a disequilibrium state of the market. We partly control for this by computing the indicators over longer time periods. Another option is to explicitly examine the dynamics of market processes applying time-series analysis and use the results to draw inferences about the nature of competition in the market. Most often the evolution of a measure for firm profitability over time has been investigated, generally referred to as the "persistence of profit" literature. Examples include Mueller (1977, 1986), Glen et al. (2003), Geroski and Jacquemin (1988) and McGahan and Porter (1999). The general idea is that firms with an abnormal level of profits in one period are not expected to maintain their high level of profitability in subsequent periods if they are operating in a competitive environment. This will lead to a low measured persistency of profits. For example because profits are competed away by imitation or entry of firms attracted by high profits. On the other hand, firms operating in a less competitive environment are more likely to maintain their high profits and profits are expected to be more persistent.

In its simplest form, a typical persistence of profits study estimates a first-order autoregressive model for a measure of firm profitability:

$$\pi_{it} = \alpha_i + \lambda_i \pi_{it-1} + \varepsilon_{it}$$

where π_{it} represents the deviation of firm i's profitability, $\tilde{\pi}_{it}$, from the average profitability of all other firms, $\tilde{\pi}_t$, in period t, i.e. $\pi_{it} = \tilde{\pi}_{it} - \tilde{\pi}_t$. This standardization of the profitability measure filters out business cycle effects. The firm specific parameters to be estimated are α_i and λ_i and ε_{it} is the error term. Short-run persistence of profits is measured by λ_i. When $\lambda_i = 0$ there is no relation between current and future profits which means that any abnormal profit realized in this period is eroded away in the next period and firms are operating in a competitive environment. When $0 < \lambda_i < 1$, current and future profitability are positively correlated and there exists some persistence of profits. The higher λ_i, the higher the persistence of profits and the lower competition is. If $\lambda_i < 1$, profitability converges to its long-run equilibrium value given by:

$$\pi_{i,LR} = \frac{\alpha_i}{1 - \lambda_i}$$

In the absence of (long-run) entry barriers, long-run profitability should be the same for all firms and there is no long-run persistence of profits. When there exists long-run persistence of profits, long-run profitability will be positive for some firms and negative for others. Again, the presence of long-run persistence of profits can point to underlying variables hampering competition.

To measure persistence of profits for a particular sector/country, the average value of the short-run persistence of profits parameter λ_i is computed over all firms in that sector/country. Most researchers have reported a value of this statistic in the range 0.4-0.5. Moreover, significant differences between long-run profitability have been found pointing to the absence of convergence to the same equilibrium value (Lypczinski et al. 2009, p. 309).

The estimation equation used to measure persistence of profits is best regarded as a reduced form of a more sophisticated structural model. This model includes not only entry and exit of firms but also the threat of entry, which is obviously mostly impossible to observe. The advantage of the persistence of profits framework is that it does not require any unobservable variables to map competitive dynamics (Glen et al. 2003). The drawback is that the framework does not allow us to take a stand on the sources of profit persistency.

7.2 Data Requirements

The two mostly used variables to measure firm profitability are

1. The profit rate, defined as the ratio of after-tax profits over total assets
2. The profit margin, defined as the ratio of after-tax profits over total turnover,

which are typically computed using accounting data. Again, the use of accounting profitability measures can generate biases in the analysis. For example, differences in accounting profits across sectors can be caused by different accounting conventions. However, these biases are more likely to be relevant for differences in profitability levels than for differences in the persistence of profits. Only changes in accounting practices over time that differ across industries could be problematic for a comparison of profits persistency across sectors.

Ideally we should observe profit rates or margins for a long time period. Mostly, the time span of the data used in the persistence of profits literature is over 15 years. However, also shorter time periods render sensible results (f.e. Glen et al. 2003).

In the context of the MMS project, we can compute profit rates and profit margins using data from the income statements, collected by the National Bank of Belgium. These income statements report the value of total assets, profits after tax and total sales value. As already mentioned, small firms do not have to report sales data which could be problematic for the computation of the profit margin for these firms. Therefore we opt to perform the analysis using profit rates instead of profit margins. As a robustness check, we restrict the estimation of profit persistency to large firms and use the profit margin as a measure for profitability[21].

Detailed description of the methodology and results of the empirical application for the Belgian economy can be found in the separate research paper Cheung & Vanormelingen (2011).

[21] An alternative would be to use the VAT declarations to get a measure for turnover of small firms.

8 Comparison of the different tools

The comparison between different normalization methods for computing traditional composite indicators has yielded highly correlated results, as can be seen in the following table.

Table 31: Correlation between Different Normalization Methods and BoD scores

	zscore	*categ*	*leader*	*minmax*	*ranks*	*distmean*	*bod*
zscore	1						
categ	0.8249	1					
leader	0.9628	0.7825	1				
minmax	0.9609	0.7803	0.9999	1			
ranks	0.8489	0.8836	0.7992	0.7965	1		
distmean	0.7008	0.6882	0.6623	0.6576	0.7320	1	
bod	0.7856	0.6893	0.8044	0.8025	0.7335	0.4589	1

Spearman Rank Correlations between different composite indicators for 2007 for 485 NACE 4 sectors

As can be seen, most traditional normalizations correlate highly among themselves. The correlation between the z-score, distance to leader and minmax normalizations is higher than 95%. The correlation of the z-score with the ordinal normalizations like categorical and ranks is typically lower but still high (82% and 85% respectively). The lowest correlation is found between z-score and distance to mean (70%).

PART THREE: CONCLUSIONS

9 Conclusion and next steps

9.1 Concluding remarks

In this report we have given an overview of different screening tools that were developed under the AGORA-MMS project to assess market functioning in a broad sense. Compared to earlier experiences with sector screening tools in Belgium, in other EU member states and at the EU level, the AGORA-MMS project introduced at least three improvements. First, all the indicators (like for instance concentration or market share volatility) used in the AGORA-MMS project, were computed bottom-up using firm-level or product-level data with a very broad coverage over the companies active in the Belgian economy. Hence, the project went further than other exercises that relied only on data of stock market listed or publicly reporting firms. For many of the indicators, information for more than half a million Belgian firms was used. Secondly, the project was able to analyze market functioning at a finer level of resolution than the NACE 2 (about 80 sectors) that is often employed. The default level of analysis is NACE 3 (about 270 sectors) and for many sectors the analysis went further down to NACE 4 level (about 600 sectors). The advantage of this is that the sector classification matches more closely the concept of an economic market than exercises that stick to NACE 2 level. Thirdly, the project adopted an explicitly dynamic perspective. Composite indicator scores were computed by year over the period 2001–2009 which allowed to study the evolution over time of market functioning. This makes it possible to assess the differential effect of for instance an economic crisis on different sectors or the effect of particular policies of market (de)regulation on the sector's performance over time. In addition, an explicitly dynamic methodology was implemented focusing on the persistence of profits over time and linking this to market functioning.

We now highlight the main findings of the project for each methodology focusing on juxtaposing the relative contribution of each methodology. For detailed results on sector level, we refer to the full text of the final report. As mentioned above, for the data-driven approach in tier one (economy wide screening tools) of the project, two composite indicator methodologies were developed and implemented under the AGORA-MMS project. The first one is a flexible arithmetic mean composite indicator based on a set of individual indicators. This tool was constructed allowing for maximal flexibility such that the user can adapt the indicators to be included and the weights to be attached to each indicator. It was implemented in the sectoral database software environment of the FPS Economy. The second composite indicator uses the same individual indicators but allows for endogenous weights that can differ across sectors according to the "benefit of the doubt" idea. Sectors are given more credit for the dimensions they are good at and less for dimensions they are lagging behind. This approach is computationally more demanding and has been programmed in a dedicated software package but the specific requirements to implement it in the FPS Economy IT environment are listed, well documented and discussed. Comparing the results of both composite indicator approaches, it was observed that they correlate strongly but at the same time, they do show some marked differences. Also it was observed that the results are often, but certainly not always, in line with intuition. For instance, many sectors that are characterized by "natural monopoly" characteristics (i.e. large economies of scale like in network industries) show up in the list of sectors that deserve further investigation.

For the more theory-driven approach in tier one, a quick scan or decision tree tool was developed that makes use of intuitive, but theoretically well established, relationships between a limited set of indicators like entry rate, import penetration, concentration and volatility of market shares. Compared to the composite indicators which are primarily data-driven, the quick scan screening device presents some advantages: it is based on theoretical insights, it requires only modest data input, and it is tractable. Its disadvantages are that it does not include all possible information that is available at the FPS Economy and that it leads only to a crude classification of sectors in terms of risk for market malfunctioning. This quick scan approach has also been implemented for the Belgian economy in the sector database software environment of the FPS Economy and the results are in line with the results derived with the broader composite indicator tools.

In tier two of the AGORA-MMS project, two specific methodologies were implemented. First, a specific methodology was developed for markets in which competition is local, like in the case of bakeries or architects, and for which the composite indicators are less appropriate. The methodology was applied to a limited set of local markets in the Belgian economy leading to the preliminary conclusion that the markets of bakeries and real estate agencies deserve further investigation in terms of market functioning. Computationally, this approach is very demanding and therefore, it was implemented in specialized software programs and not directly in the FPS Economy sectoral database software environment.

Second, a dynamic perspective was adopted in the persistence of profits tool. The basic philosophy of this indicator is very different from the one that is underlying the composite indicators. In the composite indicators, structural characteristics of markets or pre-conditions for competition and market functioning are included. The persistence of profits approach however, focuses solely on the outcome of the market functioning and competition process: profits and their evolution over time. Also this tool has been implemented in the FPS Economy sectoral database software environment ensuring reproducibility in the future.

9.2 Benefits for the FPS Economy

The tool box of analytical and screening methods that were developed by the AGORA-MMS-project, strengthens the capacity of the "Sector and Market Monitoring" division of the FPS Economy by both enlarging (e.g. the development and computation of new indicators at sector level) and deepening (e.g. at NACE 4 level) the existing framework for analysis. In general, the tools can be used for two main objectives. First they can be used for screening exercises that aim to identify sectors for which further analysis is needed. Second, when used in a flexible and intelligent way, the tools offer interesting possibilities to provide additional valuable "top-down" information, that complements the "bottom-up" and other information used by SMM in its sector analysis. These analysis cover a wide range of topics like price fluctuations and their causes, the degree of competition in particular sectors, the impact of regulation in specific markets or the valorization of statistics, developed by Statistics Belgium.

On a general level, the FPS Economy is well aware that there exists only a weak link between NACE sector classification and the economic concept of a market. For instance, bread is sold in independent bakeries, in large scale supermarkets and in large scale chains of bakery shops. Hence, it is very difficult, if not impossible, to delineate the market for bread using only NACE sector classifications. But the tools developed by the AGORA-MMS-project offer interesting perspectives to deal adequately with this issue. Ad hoc tailor made populations of companies and / or products can be built up that correspond better to the relevant market and for which market functioning indicators can be computed. One can expect that an intelligent combined use of these computed indicators with other relevant knowledge on the context provides interesting results.

9.3 Next Steps

In spite of the improvements over many other market monitoring exercises, several problems remain unsolved, many of which are discusses in the main text of the final report. The principle remaining issues are the following.

First, all of the methodologies are based on internal benchmarking within the Belgian economy. The performance of sectors is assessed by comparing it to performance of other sectors in the Belgian economy. This might cause a problem in the sense that a sector is doing well in class but that the entire class is underperforming when comparing it internationally. Theoretically, this problem could be resolved, for instance, by normalizing indicators to the average performance of all EU member states. Practically however, there is a lack of comparable data on the international level, at least at more detailed level than NACE 2. Therefore, developments at the EU level should be followed up closely such that Belgian data series can be benchmarked when comparable international information becomes available.

Second, most of the project resources were spent on data work to construct the individual indicators. One should realize that this time consuming data work is part of the process of building up sector knowledge. Only by using the data one acquires a good feeling for its quality and limitations. In the AGORA-MMS project a set of indicators was chosen based on data availability and reproducibility. In the section on the indicators in this report, alternative measures and indicators that are available in the literature are discussed and it is strongly advisable to continue working on additional indicators and refining existing ones. In particular, much more can be done with the existing data on international trade (used for import penetration and openness indicators). The product data are very detailed but also challenging to use. In addition, much work is to be done on measuring productivity and on the importance of R&D as a crucial aspect of market functioning. Intensive collaboration with other federal institutions that are working on specific datasets, for instance the National Bank for international trade data, the Federal Planning Bureau for productivity and Federal Science Policy for R&D data is a conditio sine qua non for further progress.

Third, many more market functioning screening tools and indicators exist than the ones we have chosen to implement. Some of these are relatively easy to implement, others are more sophisticated and challenging. In the first place, one might think of alternative synthetic indicators of market functioning like the Boone indicator. This type of indicator has low data requirements and could be implemented relatively easily using the software procedures developed for the persistence of profits analysis. A second candidate is the econometric estimation of productivity and mark ups. Very strong progress has been made in this field, both in the theoretical and more applied literature, and some relevant references were listed in the section on price cost margins. The implementation of this methodology for a broad set of sectors is however technically very demanding and will probably require a dedicated additional research project.

To conclude, the AGORA-MMS project has been a very fruitful exercise in making use of databases accessible by the FPS Economy to construct quantitative tools for monitoring market functioning. But this project's results should not be seen as a final products or an end point. On the contrary, they should serve as starting points for additional research projects and more in depth data analyses. For this type of work, the analysis process is as important as the end product. In the course of the project, a lot of knowledge was built up and plenty of interesting routes for further research remained unexplored. We are confident that the FPS Economy will build further on the expertise developed during our collaboration in the AGORA-MMS project to serve its general mission "to identify economic sectors and markets that do show signals of suboptimal functioning, to look for the causes of these dysfunctions and to suggest solutions."

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Appendix 1: Sector aggregation and selection

AGRI (agriculture):

NACE 2 sectors 01 to 03

EXTRA (extraction):

NACE 2 sectors 07 to 09

MANUF (manufacturing):

NACE 2 sectors 10 to 33

UTILE (utilities and electricity):

NACE 2 sectors 35 to 39

CONST (construction):

NACE 2 sectors 41 to 43

TRADE (trading):

NACE 2 sectors 45 to 47

TRANS (transport):

NACE 2 sectors 49 to 53

PSERV (personal services):

NACE 2 sectors 55, 56 and 95, 96

BSERV (business services):

NACE 2 sectors 58 to 82

OTHER (other): everything else

NACE 2 sectors 84 to 99, except for 95 and 96

For the COMPOSITE INDICATOR, we have used all sectors except AGRI and OTHER.

For the BENEFIT OF THE DOUBT, we have used two groups of sectors:

GROUP 1: EXTRA + MANUF + UTILE

GROUP 2: CONST + TRADE + TRANS + PSERV + BSERV

Appendix 2: File Locations at FPS Economy

	File Location on Windows Network			SAS Library	
Indicators	X:\Indicators			\SHARE	
Capital Intensity	**Documentation**		**File Name Format**		
Churn	Factsheet	\"Indicators"\Documentation\Factsheet\	Indicators_Form		
Concentration	Literatures	\"Indicators"\Documentation\Literatures\	Author-Year		
Import Penetration	**Results**			**Results**	**File Name Format**
Labour Productivity	Excel	\"Indicators"\Results\	"Indicators"_Results	SAS	ID_"Indicators"_NACE"X"
Price-cost Margin	**Projects**				
Volatility of Market Share	SAS	\"Indicators"\SAS Projects\	"Indicators"		
R&D					
Composite Indicator	X:\Composite Indicator				
Traditional Composite Indicator	**Documentation**		**File Name Format**		
Benefit of the Doubt	Literatures	\"Composite Indicator"\Documentation\Literatures\	Author-Year		
	Results			**Results**	**File Name Format**
	Excel	\"Composite Indicator"\Results\	"Composite Indicator"_Results	SAS	ID_"Composite Indicator"_NACE"X"
	Projects				
	SAS	\"Composite Indicator"\SAS Projects\	"Composite Indicator"		
Case Studies	X:\Case Studies				
Entry Threshold Ratios	**Documentation**		**File Name Format**		
Quick Scan	Paper	\"Case Studies"\Documentation\Paper\	"Case Studies"-Authors-Year		
Persistence of Profits	Literatures	\"Case Studies"\Documentation\Literatures\	Author-Year		
	Results			**Results**	**File Name Format**
	Excel	\"Case Studies"\Results\	"Case Studies"_Results	SAS	ID_"Case Studies"_NACE"X"
	Projects				
	SAS	\"Case Studies"\SAS Projects\	"Case Studies"		
General	X:\General				
Final Report	\Final Report\				
Expert Workshops	\Expert Workshops\				
Sources	\Sources\				
Meetings	\Meetings\				

Appendix 3: Additional Documents

- Technical notes
  - Luc Mariën on the selected turnover
  - Stijn Kelchtermans on R&D data
  - Johan Eyckmans on technical implementation of Benefit of the Doubt
- Referee comments by Marcel Cannoy (Ecorys Nederland)
- Referee comments by Jan Bouckaert (Universiteit Antwerpen)
- Expert meeting 2010
  - Program
  - Conclusions
- Expert meeting 2011
  - Program
  - Conclusions
- Technical forms on the indicators
  - Capital Intensity
  - Churn
  - Concentration
  - Import Penetration
  - Volatility of Market Shares (1 and 2)
  - Price-Cost Margin
  - Labor Productivity
- Papers:
  - Cheung, C. , Coucke, K. and Neicu, D. (2011). Decision tree structure as screening tool for market malfunctioning
  - Schaumans and Verboven (2011). Entry and Competition in Differentiated Products Markets
  - Cheung, C. and Vanormelingen, S. (2011), Persistence of profits

Selected Turnover: Technical Note

Luc Mariën (FOD Economie)

1. In general

Yearly tables TU_SEL_AGGREGATES_YEAR (from 2000 to 2009) are created with the objective to include calculated variables per company (and also the background variables used for the calculation) that allow the production of values, aggregated at Nace 2, 3 or 4-digit-level, that allow a maximal consistency with aggregated values produced by the National Accounts, that can be considered as an essential reference. The objective is to strengthen the consistency and complementarity between National Accounts data (=aggregates) and the company level data in the sectoral database.

For technical elements on the National Accounts, the NBB publication "De berekeningsmethode voor het Bruto Binnenlands Product en het Bruto Nationaal Inkomen volgens het ESR 1995" is used.

The first variable SELECTED_TRNOV = selected turnover or operating income. This variable is related to the national accounts variable P.1 (Output). This note gives technical elements on its calculation.

2. Important recent elements on Company Accounts data (tables TU_NBB_YEAR)

The actual tables adopt a ventilation of accounting periods data to calendar years data similar to that applied by the national accounts. It takes into account that the big majority of the accounting periodes cover more or less 12 months, but that there are also exceptions (varying between 1 and 64 months).

The ventilation is done as follows:

1) If the start date and the end date of the accounting period fall in the same year, the accounting periods data are ventilated to that calendar year.

2) If the start and the end data belong to 2 consecutive years (say year 1 and year 2):
   a) Either the accounting period covers between 10 and 15 months:
      - if the accounting period covers at least 74% of year 2, the accounting periods data are entirely ventilated to year 2
      - if the accounting period covers at least 74% of year 1, the accounting periods data are entirely ventilated to year 1
      - if neither of the two cases is fulfilled, the accounting periods data are pro rata ventilated over year 1 and year 2 according to the proportion (weight) of each calendar year
   b) Either the accounting period covers 9 months or less: the accounting periods data are entirely ventilated to either year 2 or year 1, depending on the which of the two coincides most with the accounting period

c) Either the accounting period covers between 16 and 24 months: then the accounting periods data are pro rata ventilated over year 1 and year 2 according to the proportion (weight) of each calendar year

3) If the period from the start date to the end date covers 3 consecutive years (say year 1, year 2 and year 3), the ventilation depends on the weight of respectively year 1 and year 3 in the total accounting period.
   a) If as well year 1 as year 3 have both a weight of at least 20%, the accounting data are pro rata ventilated of the three years (according to the respective weights of each year). . If only year 1 and not year 3 has a weight of 20% or more, the ventilation goes to year 1 and 2. In only year 3 and not year 1 has a weight of 20% or more, the ventilation goes to year 2 and 3
   b) If the weight of neither year 1 neither year 3 reaches 20%, the accounting data are entirely attributed to year 2.

4) In the other cases (almost not existant), the accounting data are entirely attributed to the calendar year of the stop date.

Each yearly table has the following three new variables:
- NR_ACCPER : the total number of accounting periods incorporated in the data: in the most of the cases this is 1, in some cases it is two (= the maximum).
- NR_PRORATA: the total number of "pro-rata-calculated" amounts incorporated in the data. In most of the cases this variable is 0. The maximum for this variable = the previous variable (NR_ACCPER). Both variables allow to make the link, if necessary, to the original accounting data as produced by the company.
- CD_SCHM_TYPE (this variable existed before in the TU_BR_ACTIVE_YEAR tables, where it will be omitted):

Values	Signification
1	Abbreviated accounting scheme for companies
2	Complete accounting scheme for companies
4	Abbreviated accounting scheme for associations
5	Complete accounting scheme for associations

3. Selected Turnover

- The selected turnover is calculated by selecting one of four sources, having priority 1 to 4: this means:
  > if source 1 is available, selected turnover equals this one,
  > if source 1 is not available and source 2 is available, selected turnover equals this one,
  > if neither source 1 or 2 are available and source 3 is available, selected turnover equals this one,
  > selected turnover equals source 4 if it's available and if sources 1 to 3 are not available

- The four sources are the following:

  1) COMPACC_TRNOV_TOT = the total operating income based on the yearly company accounts, more precisely the accounts 70 (Turnover) + 71 (Stocks of finished goods and work in progress: increase (decrease) + 72 (Own work capitalised) + 74 (Other operating

income) - 740 (Operating subsidies and compensatory amounts received from public authorities)

For companies with a complete schema, this variables are mandatory, for companies with an abbreviated scheme, they're facultative.

2) SBS_TRNOV_TOT = the operating income based on the yearly SBS-survey (=Structural Business Survey). SBS are available from 2000 to 2008.

3) <u>EXTRAPOL_TOT = the operating income obtained from an extrapolation based on the gross operating income</u>

This turnover is calculated as follows:

a) For each year and each Nace-3-digit-sector, a population of companies is composed with the following characteristics:
   > either it has an abbreviated scheme and its has a turnover figure and a positive gross margin (=account 9900). These companies get the code B1 (in CD_COMP) identical to the national accounts scheme
   > either it has a complete scheme (and registers automatically a turnover) and it is "small" (its yearly turnover doesn't exceed 3 mio euro): these companies receive the code

b) A coefficient (see variable MS_COEFF) is calculated as the total operating income divided by the total gross operating income. This coefficient is calculated for each year and for each Nace-3-digit-sector, except for a number of sectors excluded because of the limited number of companies (generally less than 10) and, related to that, the unreliability (unstability) of the results. The excluded sectors are 017, 089, 091, 099, 104, 120, 143, 142, 192, 202, 206, 211, 235, 241, 244, 254, 264, 266, 267, 268, 272, 301, 302, 03, 352, 353, 390, 492, 495, 501, 512, 531, 643, 652, 653, 68, 783, 799, 803, 822, 841, 842, 854, 871, 872, 881, 970 (for all the years) and 243 (for 2008 and 2009) and 852 and 853 (for 2000 to 2005).

c) A code B2 is given to those companies having an abbreviated scheme, that do not report a turnover but that report a positive gross operating margin. The "extrapolated turnover" of the company is calculated as the gross operating margin multiplied by the MS_COEFF of the Nace-3-digits-sector to which the company belongs.

4) VAT_TRNOV_TOT = turnover based on VAT data

- VAT-units

Data for all the companies called "VAT-Units" has been omitted from the calculation of the selected turnover. "VAT-units" are companies (about 1000 now), started up since 2007 and, still more active in 2008 and 2009, that are created by groups of related companies (their "affiliates") and that are charged with the relationships, for all their affiliates, with the VAT-administration. Examples are "BTW-eenheid Colruyt" or "Procter and Gamble Belgium".

Data on the VAT-turnover from these companies are not taken into account in order to avoid double counting and inconsistencies in the calculation of the selected turnover: indeed, some or all of the affiliates, register already a turnover from other possible sources (company accounts, SBS and/or extrapolation).

- Marketable goods (handelsgoederen / marchandises):

  Like explained on page 142 of the Manual of the SDB, in the National Accounts, the costs related to the purchases and the stock changes of marketable goods are subtracted from total output.

  This is particularly important for the the trade sector in the economy (= trade in cars, wholesale, retail, reparation cars, etc.) (= Nace 50, 51 and 52 (Nace-2003) and 45, 46 and 47 (Nace-2008)). The total output of these sectors, after subtraction of the costs of marketable goods, correspond to their commercial (trade) margins. Also in other sectors, these costs are subtracted from total output, but there it's less important.

  For our comparison between the SDB and NA, we estimated, using SBS figures, these costs for the sectors 45-47 and subtracted it from total output.

- Final results of the comparison SDB - NA: the differences SDB-NA seem reasonable: in general: they turn around 10%. For the years 2006, 2007 and 2008 they are higher (respectively 15,5%, 16,3% and 17%). The yearly growth figures are highly parallel (except for 2002 and 2003).
  (P.S.: version of 16/5/2011 of this paragraph: the differences SDB-NA are remarkably low (generally less than 1% of NA figures). Also the yearly growth figures are highly parallel).

Combination of innovation data with sectoral database: methodological note

For analytical purposes, it is important that all sectoral indicators are based on a sector definition that is consistent over time. Since there is no simple 1-to-1 mapping between NACE rev1.1 and NACE rev.2 (with the latter used from 2008 onwards), the Directorate General Statistics and Economic Information[1] carried out a NACE 'backcasting' exercise in which multiple information sources (Structured Business Survey, PRODCOM, ONSS) are used to assign firms to a NACE rev.2 sector based on a propensity score. This assignment of firms to sectors was done on a yearly basis and resulted in yearly tables of firm-level identifiers linked to the NACE rev.2 code for the firm in that year. These firm-level mapping tables can in principle be used to integrate external firm-level data sources into the sectoral database, ensuring that firms are linked to sectors in the same way as for other data sources.

Also for the Community Innovation Survey data, this approach was used since the CIS4 and CIS2006 surveys use the NACE rev.1.1 classification to designate firms' sector membership while CIS2008 is based on NACE rev.2. Using the conversion tables, the firms in the CIS-data were linked to their NACE rev.2 code as defined by the NACE backcasting exercise. This results in a linkage of firms to sectors using a common classification across the CIS waves, which is also consistent with the other indicators in the sectoral database.

However, the following issues arise with re-assigning firms surveyed in the CIS to NACE rev.2 sectors using the NACE backcasting approach.

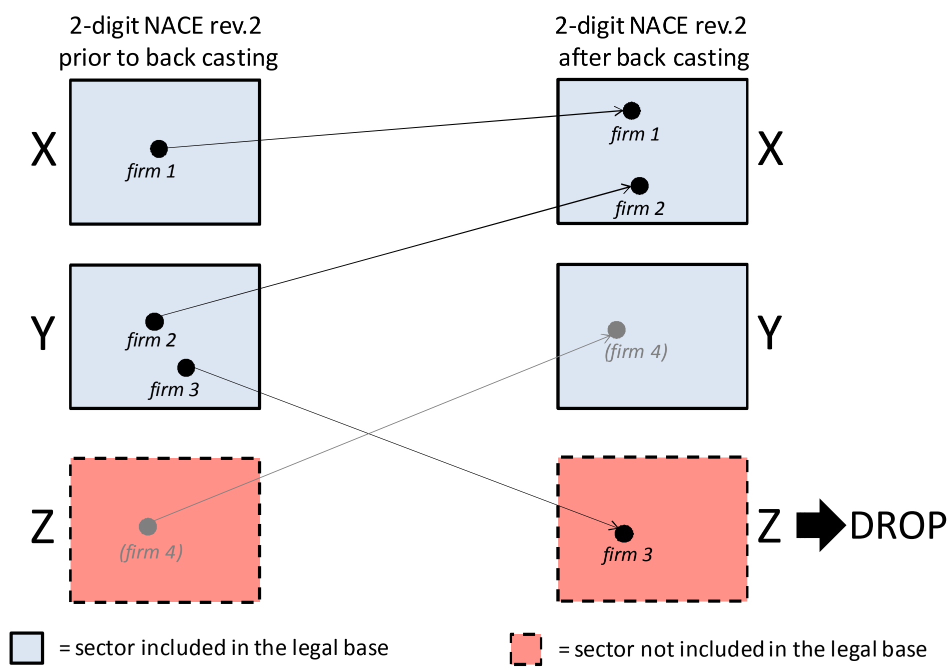
First, ***the NACE backcasting gives rise to a non-representative coverage of sectors given that the CIS survey does not cover the entire economy.*** The set of NACE sectors surveyed for the Community Innovation Survey is based on the Eurostat legal base, which is a subset of the entire economy. The current legal base is defined at the 2-digit NACE rev.2 level and covers the sectors 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 46,49, 50, 51, 52, 53, 58, 61, 62, 63, 64, 65, 66, 71, and 72. These sectors are surveyed in the CIS 2008 survey. A problem may arise with the representativeness of the data for some sectors since our sector-level data is based on firms' NACE rev.2 sector membership according to the NACE backcasting exercise, which may reclassify firms across the boundaries of the legal base. Figure 1 gives an overview of the possible cases for firms in CIS2008.

- The firms in a sector <u>within</u> the legal base (=surveyed in CIS2008) that are reclassified to a sector <u>within</u> the legal base (firm 2 in Figure 1), represent no immediate problem: this is essentially a regrouping of firms in sectors according to NACE rev.2 that is considered to be a more sensible grouping of firms than the previous NACE rev.1.1 classification.[2]

[1] DGSEI, part of the Federal Public Service Economy and in charge of the national statistics in Belgium.
[2] An example of this situation are firms that are reclassified from NACE rev.2 sector 28 (*Manufacture of machinery and equipment*) to NACE rev.2 sector 33 (*Repair and installation of machinery and equipment*).

- The firms in a sector within the legal base that are reclassified to a sector outside of the legal base (firm 3 in Figure 1), lead to a problem of representativeness: since these sectors Z were not surveyed in the CIS, there is no guarantee that the group of firms that is reclassified to such a sector yields a representative picture of the sector composition.[3] *The sectors Z should be excluded from any analysis.*[4]
- The firms in a sector outside of the legal base that *would be* reclassified (if they had been surveyed!) to a sector inside the legal base (firm 4 in Figure 1), also give rise to incomplete coverage of sectors. Since these firms are per definition not observed, the magnitude of the problem cannot be assessed directly although one could assume that it is similar in size to the previous case.

Figure 1: Reclassification of firms (NACE backcasting) in CIS2008



Second, ***the change of the legal base from NACE rev1.1*** (used for CIS4 & CIS2006) ***to NACE rev.2*** (used for CIS2008) ***gives rise to a non-representative coverage of sectors***. The legal base defined in terms of NACE rev.1.1 covers the sectors 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 40, 41, 51, 60, 61, 62, 63, 64, 65, 66, 67, 72, 74.2, and 74.3. Figure 2 gives an overview of the possible cases for firms in CIS4 and CIS2006. The first three cases are analogous to the ones for the CIS2008 data.

[3] An example of this situation are firms that are reclassified from NACE rev.2 sector 30 (*Manufacture of other transport equipment*) to NACE rev.2 sector 42 (*Civil engineering*).
[4] In total, 18 sectors at the NACE 4-digit level outside of the NACE rev.2 legal base have a positive firm count after the NACE backcasting exercise for the firms in CIS2008, accounting for 13.5% of all observations at the 4-digit sector level. It concerns NACE rev.2 sectors 41, 42, 43, 45, 47, 60, 68, 70, 73, 74, 77, 78, 79, 80, 81, 82, 92 and 95.

- The firms in a sector within the legal base (=surveyed in CIS2008) that are reclassified to a sector within the legal base (firm 2 in Figure 2), represent no immediate problem: this is essentially a regrouping of firms in sectors according to NACE rev.2 that is considered to be a more sensible grouping of firms than the previous NACE rev.1.1 classification.[5]
- The firms in a sector within the legal base that are reclassified to a sector outside of the legal base (firm 3 in Figure 2), lead to a problem of representativeness: since these sectors Z were not surveyed in the CIS, there is no guarantee that the group of firms that is reclassified to such a sector yields a representative picture of the sector composition.[6] ***The sectors Z should be excluded from any analysis.***
- The firms in a sector outside of the legal base that *would be* reclassified (if they had been surveyed!) to a sector inside the legal base (firm 4 in Figure 2), also give rise to incomplete coverage of sectors. Since these firms are per definition not observed, the magnitude of the problem cannot be assessed directly although one could assume that it is similar in size to the previous case.
- The change of the NACE system implies regroupings of sectors, which combined with the change in the legal base leads to incomplete coverage of certain sectors. More specifically, a certain NACE rev.2 sector may be linked[7] to multiple NACE rev1.1 sectors where at least one of the NACE rev1.1 sectors was not within the legal base i.e. it was not surveyed in CIS4 or CIS2006.[8] ***The sectors Y that are linked to multiple NACE rev1.1 sectors where at least one of the NACE rev1.1 sectors was outside of the legal base should be excluded from analysis***. It concerns 11 NACE rev.2 sectors: 9, 10, 11, 16, 37, 38, 39, 52, 63, 64, 71.

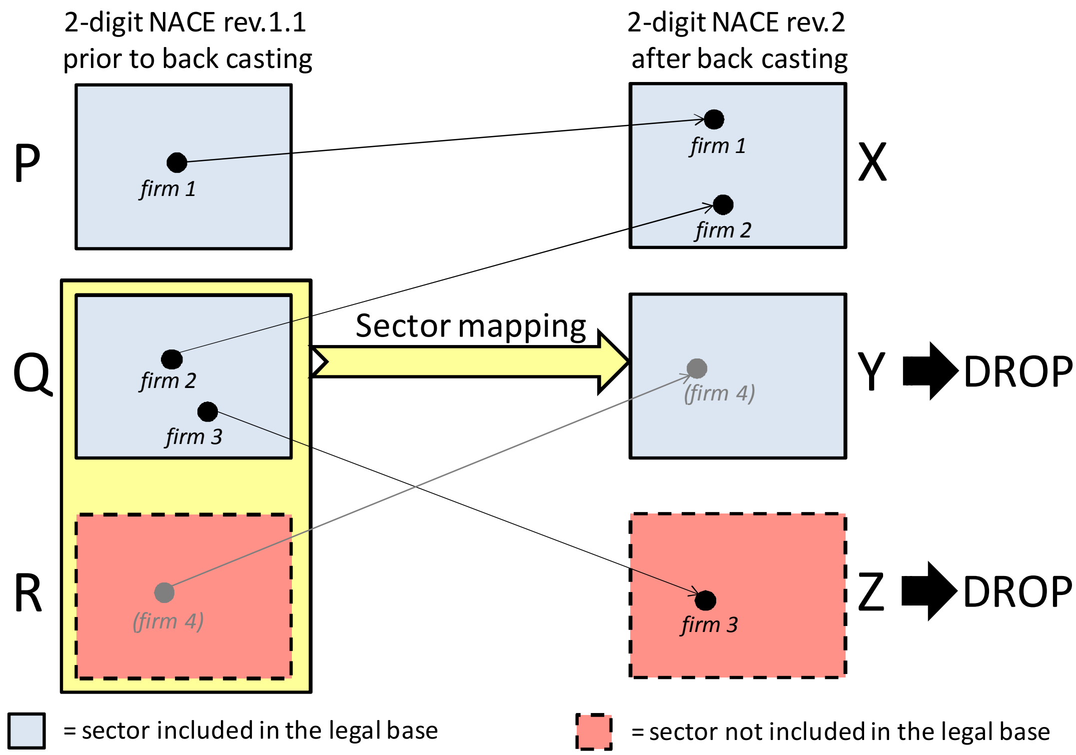
[5] An example of this situation are firms that are reclassified from NACE rev.1.1 sector 22 (*Publishing, printing, and reproduction of recorded media*) to NACE rev.2 sector 17 (*Manufacture of paper and paper products*).

[6] An example of this situation are firms that are reclassified from NACE rev.1.1 sector 15 (*Manufacture of food products and beverages*) to NACE rev.2 sector 47 (*Retail trade, except of motor vehicles and motorcycles*). Another example is NACE rev.1.1 sector 63.3 (Travel Agencies) that were included in the legal base of CIS4/CIS2006 as part of ‘support and auxiliary transport activities’ within Section I (Transport, storage and communication). The NACE backcasting exercise classifies these firms in NACE rev.2 sector 79, which is outside of the NACE rev.2 legal base.

[7] By ‘linked’ we mean that the sector-level conversion tables for NACE rev 1.1 and NACE rev.2 contain a mapping between the sectors. This is illustrated by the ‘sector mapping’ arrow in Figure 2.

[8] An example is NACE rev.2 sector 38 (*Waste collection, treatment and disposal activities; materials recovery*). This sector was surveyed in CIS2008 since it is part of the legal base. The NACE conversion tables indicate that NACE rev1.1 sector 90 (*Sewage and refuse disposal, sanitation and similar activities*) is a related sector in the previous NACE classification. However, NACE rev1.1 sector 90 was not part of the legal base and was therefore not surveyed in CIS4 or CIS2008.

Figure 2: Reclassification of firms (NACE backcasting) in CIS4 & CIS2006



Technical note on the calculation of Benefit of the Doubt scores using linear programming techniques

Johan Eyckmans (HUBrussel)

June 28, 2011

This technical note describes how we implemented the Benefit of the Doubt composite indicator for the AGORA-MMS project. More information on composite indicators, literature references and so on can be found in the final report of the project. This note is only a complement to the report and is not intended as a standalone or self contained document.

The Benefit of the Doubt (BoD in the sequel) technique is a composite indicator methodology. This means that it is a technique to aggregate the information of several indicators into one single number, a composite indicator score. For the AGORA-MMS project, this means that we have information for sectors (at NACE 2, 3 or 4 level) of structural indicators like for instance concentration, volatility of market shares, price cost margins, … and that we want to aggregate the scores of a particular sector on each of the structural indicators into one single composite indicator score.

Many traditional composite indicators aggregate the information by computing a weighted average of the (normalized) indicator values. It is very common to use the same set of weights for all sectors and to give equal weight to each dimension. Assume that y_s^i denotes the value of indicator i for sector s. The traditional composite indicator score of sector s is given by:

$$CI_s = \sum_i \omega^i \cdot y_s^i$$

Note that the weights of the different indicators ω^i are not indexed on the sectors, hence they are assumed to be the same for all sectors s.

The innovative idea of the BoD aggregation methodology is to allow for more flexibility in the weights. Different indicators can have different weights and the set of weights can be different for different sectors. Hence, the BoD approach relaxes in two important ways the usual restrictions on traditional composite indicators (equal weights for all indicators and equal sets of weights for all sectors). In terms of aggregation, the idea behind the BoD methodology is to give sectors more credit for dimensions they are good in, compared to dimensions they are lagging behind compared to other sectors.

Technically, the calculation of the BoD score for a sector requires solving a linear programming problem. Consider a set of sectors $S=\{1,2,\dots,\#S\}$ indexed by s or r and a set of indicators $I=\{1,2,\dots,\#I\}$ indexed by i or j. For practical purposes it is often convenient to consider only a subset of sectors $SS(S)\subseteq S$ and a subsets of indictors $II(I)\subseteq I$ for calculating the BoD scores. For instance, we want to limit the set of peers for a manufacturing sector to the set of manufacturing sectors only (we do not want to compare the steel sector to the sector of hairdressers). Or we want to include only a subset of all possible indicators, for instance because we have no full coverage of the data for some indicators for all sectors.

The BoD score for a particular sector $s\in SS(S)$ is the given by the optimal objective value of the following linear programming problem:

$$\mathrm{BoD}_s = \max_{\{\omega_s^i\}_{i\in II(I)}} \sum_{i\in II(I)} \omega_s^i \cdot y_s^i$$

$$\text{s.t.}\begin{cases} \sum_{i\in II(I)} \omega_s^i \cdot y_r^i \le 1 & r\in SS(S) \qquad [\lambda_r] \\ \underline{w}_s^i \le \omega_s^i \cdot y_r^i \le \overline{w}_s^i & i\in II(I) \\ \omega_s^i \ge 0 & i\in II(I) \end{cases}$$

Note that, compared to traditional composite indicators, the weights ω_s^i are indexed on sectors and hence they can differ across sectors. The linear program seeks a set of weights for the different indicators such that the weighted average for sector s of its indicators' values is maximal, under the constraint that no sector has a score higher than one using the same set of weights (i.e. the first constraint which is a normalization constraint). In addition, it is required that all weights are non-negative (cfr. third constraint) and often it is imposed that the share of a particular indicator in the overall BoD score lies in an interval $\left[\underline{w}_s^i,\overline{w}_s^i\right]$ (cfr. second constraint which is often based on expert opinion or theoretical indications).

In terms of dimension, the typical linear program to be solved has as many decision variables as there are indicators (for instance 6 to 8 in the AGORA-MMS project) and as many normalization restrictions as there are sectors (for instance 100 at NACE 3 level or 200 at NACE 4 level). As such, these are relatively small linear programming problems without too many complications (for instance there are no integer decision variables) which can be solved by standard optimization algorithms (for instance variations on the original simplex algorithm by Dantzig for linear program problems, or more sophisticated modern linear programming solvers like CPLEX). The real technical challenge for the implementation of these problems in SAS is therefore not the solution of the linear programs itself, but more the set up of the different LP problems and the management of the data and results. It requires flexible routines to set up efficiently many different LP problems (one for each sector) with different sets of constraints.

As of today, the BoD implementation used for the AGORA-MMS project is written in GAMS (General Algebraic Modeling System, see www.gams.com), a generic programming language dedicated to solving numerical optimization problems. We included some crucial elements of the GAMS code to illustrate how the LP problems are set up and solved.

Excerpts of GAMS code:

```
xxx
reading and preparing data
defining parameters
xxx
SETS
set I indicators /HHI, CAPINT, CHURN, VOLAT, LPG, PCM, IMPENE, RDINT/ ;
set S sectors / "0111","0112","0113",...,"3900"/ ;

SETS
II(I) subset of active indicators
SS(S) subset of active sectors
;

ALIAS S, S1, S2, S3 ;

VARIABLES
w(s,i)   weight of indicator i for sector s
obj      objective value
;

POSITIVE VARIABLE w(s,i) ;

*** equations
EQUATIONS
E_OBJ              objective equation
```

```
E_CONSTRAINT(s,s1) benchmarking constraints
E_BOUND_lo(i,s)    lower bound on individual indicator
E_BOUND_up(i,s)    upper bound on individual indicator
;

E_OBJ..
      OBJ =E= sum((s,i)$(ss(s) AND ii(i)), d(s)*w(s,i)*y(s,i)) ;
E_CONSTRAINT(s,s1)$(ss(s) AND ss(s1))..
      sum(i$ii(i), d(s)*w(s,i)*y(s1,i)) =l= 1 ;
E_BOUND_lo(i,s)$(ss(s) AND d(s) AND ii(i))..
      w(s,i)*y(s,i) =L= 0.50 ;
E_BOUND_up(i,s)$(ss(s) AND d(s) AND ii(i))..
      w(s,i)*y(s,i) =G= 0.000001 ;

*** models
MODEL BOD /all/ ;

*** begin loop over SECTORS
loop(s3$ss(s3),
    {* initialize membership dummies *}
    d(s2) = 0 ;
    d(s3) = 1 ;
    {* solving model BOD *}
    w.L(s,i) = 0.1 ;
    SOLVE BOD using LP Maximizing OBJ ;
    {* writing output *}
    score(s3,i) = w.L(s3,i)*y(s3,i) ;
    outw(s3,i)  = w.L(s3,i) ;
    outobj(s3)  = obj.L ;
    outpeer(s3,s2) = E_CONSTRAINT.M(s3,s2) ;
    bodstat(s3) = BOD.modelstat ;
) ;
*** end loop over SECTORS
```

```
xxx
writing output
xxx
```

The following remarks should be made.

- In order to construct a general algorithm that can be applied automatically to the full set of sectors and indicators under consideration, the objective value and constraints have been defined using a “membership dummy vector”. For instance `d(s) = (0,0,0,1,0,…,0)` if we want to solve the LP problem for sector 4. The `d(s)` picks the relevant part of the more general objective function and set of constraints (only those constraints referring to sector s that we want to evaluate).
- The actual BoD score of the sectors are given by the value of the objective variable `OBJ` and are recorded for output reporting outside the loop over sectors. The optimal value of the solution is

given in GAMS by the ".L" (L of "level") suffix:

```
outobj(s3) = obj.L ;
```

- The set of peers, i.e. the sectors for which the normalization constraint is binding (i.e. holds with equality) is constructed by using information on the marginal value of the constraint in the optimum. If a sector r is a peer for sector s, it will show up in the solution because the shadow price or multiplier of that particular constraint is nonzero. Hence, the set of peers for sector s is the set of sectors for which the marginal value of the corresponding normalization constraint is nonzero: $P_s(S) = \left\{ r \in SS(S) \middle| \sum_{i \in \Pi(I)} \omega_s^i \cdot y_r^i = 1 \right\} = \left\{ r \in SS(S) \middle| \lambda_r > 0 \right\}$. In the GAMS program we therefore record the value of the slack variables associated with the normalization constraints, i.e. the marginal values (".M" suffix in GAMS).

```
outpeer(s3,s2) = E_CONSTRAINT.M(s3,s2)) i
```

- The actual implementation in GAMS is more complicated because we solve BoD problems for every year between 2001 and 2009. Hence, the excerpt of the GAMS code above is embedded in an additional loop over at set of years:

```
SET YEAR years /2001,2002,2003,2004,2005,2006,2007,2008,2009/ ;
```

- It is important to keep track of the status of the solution (infeasible, optimal solution found, …) in order to check whether the problems have been solved correctly. This information is recorded in GAMS in the "modelstat" (model status) variable. A value of "1" for modelstat means that the LP program has been solved correctly (no infeasibilities, no convergence problems and so on). Other values than "1" are indications of non-optimal solutions.

```
bodstat(s3) = BOD.modelstat ;
```

- The typical solution time for 9 years of data, 100 NACE 3 manufacturing sectors and 8 indicators (i.e. 900 LP problems of 8 decision variables and 125 constraints each) is about 15 minutes on a standard PC.
- It is important to warn against "mechanical" implementation of the BoD methodology. In the process of solving the LP problems, many things can go wrong (for instance, the lower bound constraints $\underline{w}_s^i \leq \omega_s^i \cdot y_s^i$ become infeasible when $y_s^i = 0$ and $\underline{w}_s^i > 0$, hence indicators with zero values are problematic when combined with lower bound constraints). The analysist should always carefully check the detailed output of the optimization software in order to detect possible anomalies. We therefore have to warn against "push the button" implementations of the BoD methodology.

- For completeness, we have included all GAMS programs for a typical BoD problem in the AGORA-MMS project, in particular for the manufacturing sectors (95 at NACE 3) for all 8 indicators and all 9 years for which data is available:
    - `COMPIND.GMS`:
      main GAMS program (DOS command line "GAMS COMPIND.GMS PS=9999")
    - `DATA3.INC`:
      include file for including and preparing data in which the set of indicators, sectors and years has to be chosen by the user
    - `data_NACE3_2001.TXT` to `data_NACE3_2009.TXT`:
      text files containing data for all sectors and indicators for years 2001 to 2009
- Output is gathered in different text files that can easily be imported in Excel for editing and reporting.
    - `EXCEL_BOD.TXT`:
      output of the different BOD scores for all sectors (rows) and years (columns)
    - `DETAIL_BOD.TXT`:
      weight or load of every indicator (columns) for every sector (rows) and every year (tables are appended from 2001 to 2009)
    - `PEERS.TXT`:
      overview of all peers (columns) for all sectors (rows) and years tables are appended from 2001 to 2009)

```
$ontext
===========================================================================
Benefit of the Doubt composite indicator
input: indicator data
output: weights and composite indicators and rankings
===========================================================================
(c) 2011 Johan Eyckmans
version 25062011
===========================================================================
$offtext

$TITLE MARKET FUNCTIONING MONITORING TOOL

$inlinecom {* *}
$offupper
$offsymxref offsymlist offuellist offuelxref



**************************************
*** set definitions and data input ***
**************************************
* set definitions and raw data input
$batinclude data3.inc ;


******************
*** parameters ***
******************

PARAMETERS
d(s)             membership dummy sectors
y(s,i)           value for sector s of indicator i
score(s,i)       output score of sector s for indicator i
outw(s,i)        output weight of sector s for indicator i
outobj(s)        output objective function sector s
outpeer(s,s)     output peers sector s
bodstat(s)       model status for BOD
data(s,i,*)      data table
restriction      restrictions dummy
peernum(s)       number of peers
CI(s,*)          composite indicator score for sector s
CIR(s,*)         composite indicator rank of sector s
we(s,i)          weight of sector s for indicator i
yn(s,i)          normalized indicator of sector s for indicator i
ymin(i)          minimum indicator value
ymax(i)          maximum indicator value
ys(s)            sorted indicator
rank(s)          rank
order(s)         order
tel              teller
missing(S,I)     dummy missing value for indicator i
yaver(i)         average indicator value
ystdev(i)        standard deviation indicator value
xCI(s,*,year)    composite indicator score for sector s in year
xCIR(s,*,year)   composite indicator rank of sector s in year
perc             percentage
ytemp(s,i)       temporary variable
cow              column wide
dec              decimals
xpeer(s,s1,year) peers
xpeernum(s,year) number of peers
xmis(s,year)     missing observations
;

perc = 0.25 ;
cow = 10 ;
dec = 4 ;
xmis(s,year) = 0 ;
xmis(s,year)$(not ss(s)) = 1 ;


*********************
*** raw data input ***
*********************
```

```
* data tables per year
$batinclude data_NACE3_2001.txt ;
$batinclude data_NACE3_2002.txt ;
$batinclude data_NACE3_2003.txt ;
$batinclude data_NACE3_2004.txt ;
$batinclude data_NACE3_2005.txt ;
$batinclude data_NACE3_2006.txt ;
$batinclude data_NACE3_2007.txt ;
$batinclude data_NACE3_2008.txt ;
$batinclude data_NACE3_2009.txt ;


* choose one year
y(S,I) = 999999 ;
y(S,I) = indicators2001(S,I) ;


******************
*** variables ****
******************

VARIABLES
w(s,i)   weight of indicator i for sector s
obj      objective value
;

POSITIVE VARIABLES
w(s,i)
;

*** equations
EQUATIONS
E_OBJ               objective equation
E_CONSTRAINT(s,s1) benchmarking constraints
E_BOUND_lo(i,s)    lower bound on individual indicator
E_BOUND_up(i,s)    upper bound on individual indicator
E_BOUND_STRU(s)    relative bound on weight for STRUCTURE dimension
E_BOUND_COND(s)    relative bound on weight for CONDUCT dimension
E_BOUND_PERF(s)    relative bound on weight for PERFORMANCE dimension
;

E_OBJ..               OBJ =E= sum((s,i)$(ss(s) AND ii(i)), d(s)*w(s,i)*y(s,i)) ;
E_CONSTRAINT(s,s1)$(ss(s) AND ss(s1))..
                      sum(i$ii(i), d(s)*w(s,i)*y(s1,i)) =l= 1 ;
E_BOUND_lo(i,s)$(ss(s) AND d(s) AND ii(i))..
                      w(s,i)*y(s,i) =L= 0.50 ;
E_BOUND_up(i,s)$(ss(s) AND d(s) AND ii(i))..
                      w(s,i)*y(s,i) =G= 0.000001 ;
E_BOUND_STRU(s)$(ss(s) AND d(s))..
                      sum(i$STRU(i), w(s,i)*y(s,i)) =G= (1/5)*sum(i, w(s,i)*y(s,i)) ;
E_BOUND_COND(s)$(ss(s) AND d(s))..
                      sum(i$COND(i), w(s,i)*y(s,i)) =G= (1/5)*sum(i, w(s,i)*y(s,i)) ;
E_BOUND_PERF(s)$(ss(s) AND d(s))..
                      sum(i$PERF(i), w(s,i)*y(s,i)) =G= (1/5)*sum(i, w(s,i)*y(s,i)) ;



**************
*** models ***
**************

*MODEL BOD /all/ ;
*MODEL BOD /E_OBJ, E_CONSTRAINT/ ;
MODEL BOD /E_OBJ, E_CONSTRAINT, E_BOUND_lo/ ;
*MODEL BOD /E_OBJ, E_CONSTRAINT, E_BOUND_lo, E_BOUND_up/ ;
*MODEL BOD /E_OBJ, E_CONSTRAINT, E_BOUND_is, E_BOUND_STRU, E_BOUND_COND, E_BOUND_PERF/ ;



*********************
*** solver options ***
*********************

OPTION optcr    = 0 ;
OPTION iterlim  = 1000000 ;
OPTION reslim   = 1000000 ;
```

```
OPTION LIMROW   = 5 ;
OPTION LIMCOL   = 5 ;
OPTION SOLPRINT = OFF ;
option decimals = 6 ;

* output BOD
file detail_BOD /detail_BOD.txt/ ;
detail_BOD.PW = 150 ;
*detail_BOD.ap = 1 ;


************************
*** begin loop YEARS ***
************************
loop(year$yy(year),

* reconstruct base set of sectors
ss(s) = NO ;
ss(s)$show(s) = YES ;

*** loading data
y(S,I) = 999999 ;
if(ord(YEAR) EQ 1, y(S,I) = indicators2001(S,I)) ;
if(ord(YEAR) EQ 2, y(S,I) = indicators2002(S,I)) ;
if(ord(YEAR) EQ 3, y(S,I) = indicators2003(S,I)) ;
if(ord(YEAR) EQ 4, y(S,I) = indicators2004(S,I)) ;
if(ord(YEAR) EQ 5, y(S,I) = indicators2005(S,I)) ;
if(ord(YEAR) EQ 6, y(S,I) = indicators2006(S,I)) ;
if(ord(YEAR) EQ 7, y(S,I) = indicators2007(S,I)) ;
if(ord(YEAR) EQ 8, y(S,I) = indicators2008(S,I)) ;
if(ord(YEAR) EQ 9, y(S,I) = indicators2009(S,I)) ;

*** data manipulation
* detecting missing values
missing(S,I) = 0 ;
loop(I$ii(i),
   loop(S$ss(s),
       if(y(S,I) GE 9999998,
           missing(S,I) = 1 ;
       else
           missing(S,I) = 0 ;
       ) ;
   ) ;
) ;

* drop sectors for which there are missing values
ss(s)$(sum(i$ii(i), missing(s,i)) GE 1) = NO ;
xmis(s,year) = 1 ;
xmis(s,year)$ss(s) = 0 ;

* all indicators should be "goods", not "bads"

* high concentration is bad: inverse transformation
*y(s,"c4")$ss(s)   = 1 / y(s,"c4") ;
*y(s,"c8")$ss(s)   = 1 / y(s,"c8") ;
* inverse transformation IS NOT NEUTRAL for BOD
*y(s,"hhin")$ss(s) = 1 / y(s,"hhin") ;
* linear transformation
y(s,"hhin")$ss(s) = smax(s1$ss(s1), y(s1,"hhin")) - y(s,"hhin") + 1;

* high CAPINT is bad:
* inverse transformation
*y(s,"capint")$ss(s) = 1 / y(s,"capint") ;
* linear transformation
y(s,"capint")$ss(s) = smax(s1$ss(s1), y(s1,"capint")) - y(s,"capint") + 1 ;

* high MES is bad:
* inverse transformation
*y(s,"MES")$ss(s) = 1 / y(s,"MES") ;
* linear transformation
y(s,"MES")$ss(s) = smax(s1$ss(s1), y(s1,"MES")) - y(s,"MES") + 1 ;

* high DLP is good
* but deduct minimum to convert to positive numbers
y(s,"dlp")$ss(s) = y(s,"dlp") - smin(s1$ss(s1), y(s1,"dlp")) + 1 ;
```

```
* high PCM is bad
* deduct minimum to convert to positive numbers
y(s,"pcm")$ss(s) = y(s,"pcm") - smin(s1$ss(s1), y(s1,"pcm")) + 1 ;
* inverse transformation
*y(s,"pcm")$ss(s) = 1 / (y(s,"pcm")+1) ;
* linear transformation
*y(s,"pcm")$ss(s) = smax(s1$ss(s1), y(s1,"pcm")) - y(s,"pcm") ;

* high RD is good

*** Benefit of the doubt LP programs

* for loglinear specication
if(LOGLINEAR, y(s,i)$(ii(i) AND ss(s)) = log(y(s,i))) ;

*******************************
*** begin loop over SECTORS ***
*******************************
loop(s3$ss(s3),
    {* initialize membership dummies *}
    d(s2) = 0 ;
    d(s3) = 1 ;
    {* solving model BOD *}
    w.L(s,i) = 0.1 ;
    SOLVE BOD using LP Maximizing OBJ ;
    {* writing output *}
    score(s3,i) = w.L(s3,i)*y(s3,i) ;
    outw(s3,i)  = w.L(s3,i) ;
    outobj(s3)  = obj.L ;
    outpeer(s3,s2) = E_CONSTRAINT.M(s3,s2) ;
    bodstat(s3) = BOD.modelstat ;
) ;
*****************************
*** end loop over SECTORS ***
*****************************

*** anti log
if(LOGLINEAR, y(s,i)$(ii(i)  AND ss(s)) = exp(y(s,i))) ;

* display solution in listing file
display outw, score, outobj, outpeer ;
outpeer(s,s1)$(outpeer(s,s1) GT EPS) = 1 ;
outpeer(s,s1)$(outpeer(s,s1) LE EPS) = 0 ;
display outpeer ;
peernum(s) = sum(s1, outpeer(s1,s)) ;
display peernum ;

* store BOD
xCI(s,"BOD",year) = round(sum(i$ii(i), score(s,i)),6) ;
xCI(s,"BOD",year)$(NOT ss(s)) = 999999 ;
xpeer(s,s1,year) = outpeer(s,s1) ;
xpeernum(s,year) = peernum(s) ;

* output in detailed filed
put detail_BOD ;
put year.TL:>cow / ;
put "sector":<cow ;
loop(i$ii(i), put i.TL:>cow ) ;
put "BOD":>cow ;
put "peer":>cow ;
put "test":>cow ;
put / ;
loop(s$ss(s),
    put s.TL:<cow ;
    loop(i$ii(i),
        put score(s,i):cow:dec ;
    ) ;
    put xCI(s,"BOD",year):cow:dec ;
    put xpeernum(s,year):cow:0 ;
    put BODstat(s):cow:0 ;
    put / ;
) ;
put  //  ;

* ordinary arithmetic average z-score normalized data
yaver(i) = sum(s$ss(s), y(s,i)) / card(ss) ;
```

```
ystdev(i) = sqrt((1/card(ss))*sum(s$ss(s), (y(s,i)-yaver(i))*(y(s,i)-yaver(i)) )) ;
yn(s,i) = (y(s,i) - yaver(i)) / ystdev(i) ;
we(s,i) = 1 / card(ii) ;
xCI(s,"STDEV",year) = sum(i$ii(i), we(s,i)*yn(s,i)) ;
xCI(s,"STDEV",year)$(NOT ss(s)) = 999999 ;

* ordinary arithmetic average minmax
ymin(i) = smin(s$ss(s), y(s,i)) ;
ymax(i) = smax(s$ss(s), y(s,i)) ;
yn(s,i) = (y(s,i) - ymin(i)) / (ymax(i) - ymin(i)) ;
we(s,i) = 1 / card(ii) ;
xCI(s,"MINMAX",year) = sum(i$ii(i), we(s,i)*yn(s,i)) ;
xCI(s,"MINMAX",year)$(NOT ss(s)) = 999999 ;

) ;
**********************
*** end loop YEARS ***
**********************

* display
display xCI ;

* write to txt files
* output BOD
file excel_BOD /excel_BOD.txt/ ;
excel_BOD.PW = 150 ;
put excel_BOD ;
*excel_BOD.ap = 1 ;

put / ;
put @(cow+1);
loop(year$yy(year),
    put year.TL:>cow ;
) ;
put / ;
loop(s$(prod(year$yy(year), xmis(s,year)) EQ 0),
    put s.TL:<cow ;
    loop(year$yy(year),
        if(xCI(s,"BOD",year) NE 999999,
            put xCI(s,"BOD",year):cow:dec ;
        else
            put "n.a.":>cow ;
        ) ;
    ) ;
    put / ;
) ;
put / ;

* output STDEV
file excel_STDEV /excel_STDEV.txt/ ;
excel_STDEV.PW = 150 ;
put excel_STDEV ;
*excel_STDEV.ap = 1 ;

put / ;
put @(cow+1);
loop(year$yy(year),
    put year.TL:>cow ;
) ;
put / ;
loop(s$(prod(year$yy(year), xmis(s,year)) EQ 0),
    put s.TL:<cow ;
    loop(year$yy(year),
        if(xCI(s,"STDEV",year) NE 999999,
            put xCI(s,"STDEV",year):cow:dec ;
        else
            put "n.a.":>cow ;
        ) ;
    ) ;
    put / ;
) ;
put / ;

* output MINMAX
file excel_MINMAX /excel_MINMAX.txt/ ;
excel_MINMAX.PW = 150 ;
```

```
put excel_MINMAX ;
*excel_MINMAX.ap = 1 ;

put / ;
put @(cow+1);
loop(year$yy(year),
    put year.TL:>cow ;
) ;
put / ;
loop(s$(prod(year$yy(year), xmis(s,year)) EQ 0),
    put s.TL:<cow ;
    loop(year$yy(year),
        if(xCI(s,"MINMAX",year) NE 999999,
            put xCI(s,"MINMAX",year):cow:dec ;
        else
            put "n.a.":>cow ;
        ) ;
    ) ;
    put / ;
) ;
put / ;

* output peers
file peers /peers.txt/ ;
peers.PW=150 ;
put peers ;
*peers.ap = 1 ;

put / ;
loop(year$yy(year),
    put year.TL:>cow ;
    put / ;
    put @6 ;
    loop(s$ss(s), put$(xpeernum(s,year) GT 0) s.TL:>5) ;
    put / ;
    loop(s$ss(s),
        put s.TL:<5 ;
        loop(s1$ss(s1),
            if(xpeernum(s1,year) GT 0,
                put$(not xpeer(s,s1,year)) "     " ;
                put$xpeer(s,s1,year) 1:5:0 ;
            ) ;
        ) ;
        put / ;
    ) ;
    put @6 ;
    loop(s$ss(s), put$(xpeernum(s,year) GT 0) xpeernum(s,year):5:0) ;
    put /// ;
) ;
put  //  ;


***************************************************************************

$label END

***************************************************************************
```

```
$ontext
===========================================================================
DATA3.TXT
set definitions and data input
=> choose data file and year
=> include import penetration (impene) or not
===========================================================================
(c) 2011 Johan Eyckmans
version 13062011
===========================================================================
$offtext


******************
*** parameters ***
******************

parameter LOGLINEAR ;
LOGLINEAR = 0 ;


************
*** sets ***
************

*** set of YEARS
set YEAR years
/2001,2002,2003,2004,2005,2006,2007,2008,2009/ ;

* alias
alias(year,year1,year2) ;

* subsets of years
set yy(year) active years ;
yy(year) = YES ;
*yy("2007") = YES ;
*yy("2008") = YES ;
*yy("2009") = YES ;

*** set of INDICATORS
set I indicators
/c4,
 c8,
 hhin,
 capint,
 mes,
 churn,
 volat,
 dlp,
 pcm,
 impene,
 rd
/ ;

* alias
alias(I,I1,I2) ;

* subsets of indicators
sets
STRU(I) STRUcture subset of indicators
COND(I) CONDuct subset of indicators
PERF(I) PERFormance subset of indicators
;
STRU(I)          = NO ;
STRU("hhin")     = YES ;
STRU("capint")   = YES ;
STRU("mes")      = YES ;
STRU("churn")    = YES ;
STRU("impene")   = YES ;
STRU("rd")       = YES ;
COND(I)          = NO ;
COND("volat")    = YES ;
PERF(I)          = NO ;
PERF("pcm")      = YES ;
PERF("dlp")      = YES ;
```

```
*** set of SECTORS
* this set contains all sectors that are in the raw data file
set S sectors
/
"000",
"011",
"012",
"013",
"014",
"015",
"016",
"017",
"021",
"022",
"023",
"024",
"031",
"032",
"051",
"071",
"072",
"081",
"089",
"091",
"099",
"100",
"101",
"102",
"103",
"104",
"105",
"106",
"107",
"108",
"109",
"110",
"120",
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"161",
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"182",
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"202",
"203",
"204",
"205",
"206",
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"212",
"221",
"222",
"231",
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"233",
"234",
"235",
"236",
"237",
"239",
"241",
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```
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"243",
"244",
"245",
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"257",
"259",
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"462",
```

```
"463",
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"702",
"711",
"712",
"721",
"722",
"731",
"732",
"741",
"742",
"743",
```

```
"749",
"750",
"771",
"772",
"773",
"774",
"781",
"782",
"783",
"791",
"799",
"801",
"802",
"803",
"811",
"812",
"813",
"821",
"822",
"823",
"829",
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"852",
"853",
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"855",
"856",
"861",
"862",
"869",
"871",
"872",
"873",
"879",
"881",
"889",
"900",
"910",
"920",
"931",
"932",
"941",
"942",
"949",
"951",
"952",
"960",
"970",
"981",
"982",
"990",
"999"
/ ;

* alias
alias(S,S1,S2,S3) ;

* subsets of sectors
set AGRIC(S) AGRICulture ;
AGRIC(S) = NO ;
*AGRIC("000") = YES ;
AGRIC("011") = YES ;
AGRIC("012") = YES ;
AGRIC("013") = YES ;
AGRIC("014") = YES ;
AGRIC("015") = YES ;
AGRIC("016") = YES ;
AGRIC("017") = YES ;
AGRIC("021") = YES ;
AGRIC("022") = YES ;
AGRIC("023") = YES ;
AGRIC("024") = YES ;
AGRIC("031") = YES ;
```

```
AGRIC("032") = YES ;
set EXTRA(S) EXTRAction ;
EXTRA(S) = NO ;
EXTRA("051") = YES ;
EXTRA("071") = YES ;
EXTRA("072") = YES ;
EXTRA("081") = YES ;
EXTRA("089") = YES ;
EXTRA("091") = YES ;
EXTRA("099") = YES ;
set MANUF(S) MANUFacturing ;
MANUF(S) = NO ;
*MANUF("100") = YES ;
MANUF("101") = YES ;
MANUF("102") = YES ;
MANUF("103") = YES ;
MANUF("104") = YES ;
MANUF("105") = YES ;
MANUF("106") = YES ;
MANUF("107") = YES ;
MANUF("108") = YES ;
MANUF("109") = YES ;
MANUF("110") = YES ;
MANUF("120") = YES ;
MANUF("131") = YES ;
MANUF("132") = YES ;
MANUF("133") = YES ;
MANUF("139") = YES ;
MANUF("141") = YES ;
MANUF("142") = YES ;
MANUF("143") = YES ;
MANUF("151") = YES ;
MANUF("152") = YES ;
*MANUF("157") = YES ;
MANUF("161") = YES ;
MANUF("162") = YES ;
MANUF("171") = YES ;
MANUF("172") = YES ;
*MANUF("173") = YES ;
MANUF("181") = YES ;
MANUF("182") = YES ;
MANUF("191") = YES ;
MANUF("192") = YES ;
MANUF("201") = YES ;
MANUF("202") = YES ;
MANUF("203") = YES ;
MANUF("204") = YES ;
MANUF("205") = YES ;
MANUF("206") = YES ;
MANUF("211") = YES ;
MANUF("212") = YES ;
MANUF("221") = YES ;
MANUF("222") = YES ;
MANUF("231") = YES ;
MANUF("232") = YES ;
MANUF("233") = YES ;
MANUF("234") = YES ;
MANUF("235") = YES ;
MANUF("236") = YES ;
MANUF("237") = YES ;
MANUF("239") = YES ;
MANUF("241") = YES ;
MANUF("242") = YES ;
MANUF("243") = YES ;
MANUF("244") = YES ;
MANUF("245") = YES ;
MANUF("251") = YES ;
MANUF("252") = YES ;
MANUF("253") = YES ;
MANUF("254") = YES ;
MANUF("255") = YES ;
MANUF("256") = YES ;
MANUF("257") = YES ;
MANUF("259") = YES ;
MANUF("261") = YES ;
MANUF("262") = YES ;
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MANUF("263") = YES ;
MANUF("264") = YES ;
MANUF("265") = YES ;
MANUF("266") = YES ;
MANUF("267") = YES ;
MANUF("268") = YES ;
*MANUF("269") = YES ;
MANUF("271") = YES ;
MANUF("272") = YES ;
MANUF("273") = YES ;
MANUF("274") = YES ;
MANUF("275") = YES ;
MANUF("279") = YES ;
MANUF("281") = YES ;
MANUF("282") = YES ;
MANUF("283") = YES ;
MANUF("284") = YES ;
MANUF("289") = YES ;
MANUF("291") = YES ;
MANUF("292") = YES ;
MANUF("293") = YES ;
*MANUF("299") = YES ;
MANUF("301") = YES ;
MANUF("302") = YES ;
MANUF("303") = YES ;
MANUF("304") = YES ;
MANUF("309") = YES ;
MANUF("310") = YES ;
MANUF("321") = YES ;
MANUF("322") = YES ;
MANUF("323") = YES ;
MANUF("324") = YES ;
MANUF("325") = YES ;
MANUF("329") = YES ;
MANUF("331") = YES ;
MANUF("332") = YES ;
set UTILE(S) UTILities and Energy ;
UTILE(S) = NO ;
UTILE("351") = YES ;
UTILE("352") = YES ;
UTILE("353") = YES ;
UTILE("360") = YES ;
UTILE("370") = YES ;
UTILE("381") = YES ;
UTILE("382") = YES ;
UTILE("383") = YES ;
UTILE("390") = YES ;
*UTILE("399") = YES ;
set CONST(S) CONSTruction ;
CONST(S) = NO ;
CONST("411") = YES ;
CONST("412") = YES ;
CONST("421") = YES ;
CONST("422") = YES ;
CONST("429") = YES ;
CONST("431") = YES ;
CONST("432") = YES ;
CONST("433") = YES ;
CONST("439") = YES ;
set TRADE(S) TRADE ;
TRADE(S) = NO ;
TRADE("451") = YES ;
TRADE("452") = YES ;
TRADE("453") = YES ;
TRADE("454") = YES ;
TRADE("460") = YES ;
TRADE("461") = YES ;
TRADE("462") = YES ;
TRADE("463") = YES ;
TRADE("464") = YES ;
TRADE("465") = YES ;
TRADE("466") = YES ;
TRADE("467") = YES ;
TRADE("469") = YES ;
TRADE("471") = YES ;
TRADE("472") = YES ;
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TRADE("473") = YES ;
TRADE("474") = YES ;
TRADE("475") = YES ;
TRADE("476") = YES ;
TRADE("477") = YES ;
TRADE("478") = YES ;
TRADE("479") = YES ;
set TRANS(S) TRANSport ;
TRANS(S) = NO ;
TRANS("492") = YES ;
TRANS("493") = YES ;
TRANS("494") = YES ;
TRANS("495") = YES ;
TRANS("501") = YES ;
TRANS("502") = YES ;
TRANS("503") = YES ;
TRANS("504") = YES ;
TRANS("511") = YES ;
TRANS("512") = YES ;
TRANS("521") = YES ;
TRANS("522") = YES ;
TRANS("531") = YES ;
TRANS("532") = YES ;
set PSERV(S) Personal SERVices ;
PSERV(S) = NO ;
PSERV("551") = YES ;
PSERV("552") = YES ;
PSERV("553") = YES ;
PSERV("559") = YES ;
PSERV("561") = YES ;
PSERV("562") = YES ;
PSERV("563") = YES ;
PSERV("951") = YES ;
PSERV("952") = YES ;
PSERV("960") = YES ;
set BSERV(S) Business SERVices ;
BSERV(S) = NO ;
BSERV("581") = YES ;
BSERV("582") = YES ;
BSERV("591") = YES ;
BSERV("592") = YES ;
BSERV("601") = YES ;
BSERV("602") = YES ;
BSERV("611") = YES ;
BSERV("612") = YES ;
BSERV("613") = YES ;
BSERV("619") = YES ;
BSERV("620") = YES ;
BSERV("631") = YES ;
BSERV("639") = YES ;
BSERV("641") = YES ;
BSERV("642") = YES ;
BSERV("643") = YES ;
BSERV("649") = YES ;
BSERV("651") = YES ;
BSERV("652") = YES ;
BSERV("653") = YES ;
BSERV("660") = YES ;
BSERV("661") = YES ;
BSERV("662") = YES ;
BSERV("663") = YES ;
BSERV("681") = YES ;
BSERV("682") = YES ;
BSERV("683") = YES ;
BSERV("691") = YES ;
BSERV("692") = YES ;
BSERV("701") = YES ;
BSERV("702") = YES ;
BSERV("711") = YES ;
BSERV("712") = YES ;
BSERV("721") = YES ;
BSERV("722") = YES ;
BSERV("731") = YES ;
BSERV("732") = YES ;
BSERV("741") = YES ;
BSERV("742") = YES ;
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BSERV("743") = YES ;
BSERV("749") = YES ;
BSERV("750") = YES ;
BSERV("771") = YES ;
BSERV("772") = YES ;
BSERV("773") = YES ;
BSERV("774") = YES ;
BSERV("781") = YES ;
BSERV("782") = YES ;
BSERV("783") = YES ;
BSERV("791") = YES ;
BSERV("799") = YES ;
BSERV("801") = YES ;
BSERV("802") = YES ;
BSERV("803") = YES ;
BSERV("811") = YES ;
BSERV("812") = YES ;
BSERV("813") = YES ;
BSERV("821") = YES ;
BSERV("822") = YES ;
BSERV("823") = YES ;
BSERV("829") = YES ;
set OTHER(S) other sectors ;
OTHER(S) = YES ;
OTHER(S) = OTHER(S) - AGRIC(S) - EXTRA(S) - MANUF(S) - UTILE(S) -
           CONST(S) - TRADE(S) - TRANS(S) - PSERV(S) - BSERV(S) ;

display AGRIC, EXTRA, MANUF, UTILE, CONST, TRADE, TRANS, PSERV,
        BSERV, OTHER ;


* subset of sectors
set ss(s)   subsample of sectors ;
set show(s) sectors to be displayed ;
alias (ss,ss1,ss2,ss3) ;

* subset of indicators
set ii(i) subsample of indicators ;
alias (ii,ii1,ii2,ii3) ;

*** choosing indicators
ii(i) = NO ;
*ii("C4")    = YES ;
*ii("C8")    = YES ;
ii("HHIN")  = YES ;
ii("CAPINT")= YES ;
*ii("MES")   = YES ;
ii("CHURN") = YES ;
ii("VOLAT") = YES ;
ii("DLP")   = YES ;
ii("PCM")   = YES ;
ii("IMPENE")= YES ;
ii("RD")    = YES ;
display ii ;

*** choosing sectors
ss(s) = NO ;
*ss(s)$AGRIC(s) = YES ;
ss(s)$EXTRA(s) = YES ;
ss(s)$MANUF(s) = YES ;
ss(s)$UTILE(s) = YES ;
*ss(s)$CONST(s) = YES ;
*ss(s)$TRADE(s) = YES ;
*ss(s)$TRANS(s) = YES ;
*ss(s)$PSERV(s) = YES ;
*ss(s)$BSERV(s) = YES ;
*ss(s)$OTHER(s) = YES ;
display ss ;
show(s) = NO ;
show(s)$ss(s) = YES ;
display show ;


***************************************************************************
*** end of data3.inc
***************************************************************************
```

```
$ontext
"CD_NACE3"
"MS_C4_DT_2009"
"MS_C8_DT_2009"
"MS_HHI_NORM_DT_2009"
"MS_W_CAPINT_TRN_2009"
"MES_2009"
"MS_CHURN_2009_WG"
"MS_VOLAT_IDX_2009"
"MS_W_LP_CH_2009"
"MS_W_PCM_2009"
"MS_IMPEN_2009"
"RD_INT_2009"
$offtext
TABLE indicators2009(s,i)
```

	C4	C8	HHIN	CAPINT	MES	CHURN	VOLAT	DLP	PCM	IMPENE	RD
"011"	0.06330	0.09009	0.00205	0.33589	0.00045	0.04587	0.26437	0.09228	0.10550	0.71063	9999999
"012"	0.05691	0.09306	0.00236	0.68201	0.00187	0.08307	0.62563	-.01667	0.11454	0.90669	9999999
"013"	0.16191	0.21725	0.01042	0.18814	0.00255	0.03573	0.13940	0.00191	0.05292	0.51698	9999999
"014"	0.17380	0.23831	0.01085	0.26066	0.00045	0.03808	0.21150	0.14031	0.02540	0.26377	9999999
"015"	0.01434	0.02572	0.00030	0.96864	0.00022	0.06673	0.30009	0.05576	0.16987	9999999	9999999
"016"	0.15322	0.20678	0.00900	0.44299	0.00084	0.08505	0.04931	0.59336	0.01425	9999999	9999999
"017"	0.36963	0.59513	0.03454	1.63115	0.04272	0.08021	0.18119	0.60987	0.33001	9999999	9999999
"021"	0.30822	0.40046	0.02960	0.25785	0.00676	0.05183	0.16051	0.10708	-.02115	0.16095	9999999
"022"	0.16860	0.22597	0.01027	0.25224	0.00136	0.04547	0.22736	0.07187	0.10114	0.38228	9999999
"023"	1.00000	1.00000	9999999	9999999	1.00000	1.00000	9999999	9999999	9999999	0.99963	9999999
"024"	0.21826	0.32120	0.01661	0.83407	0.00666	0.05852	0.43930	-.22195	-.18005	9999999	9999999
"031"	0.34231	0.41138	0.07843	0.28624	0.01403	0.02238	0.03605	3.34412	0.01188	9999999	9999999
"032"	0.39393	0.58482	0.04780	0.14954	0.01971	0.02916	0.18644	-.15557	0.07691	9999999	9999999
"051"	1.00000	1.00000	9999999	9999999	1.00000	0.00000	1.95016	9999999	9999999	0.99937	9999999
"072"	1.00000	1.00000	9999999	9999999	1.00000	0.00000	0.00000	0.00723	9999999	0.99803	9999999
"081"	0.32719	0.55302	0.03913	0.44345	0.01013	0.27602	0.29637	-.01716	0.12363	0.38012	0.01513
"089"	0.82492	0.98498	0.14250	0.13961	0.12411	0.00655	0.70056	1.24976	0.07309	0.98493	9999999
"091"	0.97617	0.99583	0.28547	2.40668	0.11075	0.00778	0.69420	9999999	-.32706	9999999	9999999
"099"	0.74868	0.93561	0.12686	5.04487	0.10952	0.00191	0.48380	-.13487	0.27607	9999999	9999999
"101"	0.30251	0.38728	0.03946	0.12543	0.00230	0.01561	0.55219	-.11214	0.04205	0.29337	0.00172
"102"	0.33374	0.57944	0.03492	0.16579	0.04676	0.19665	0.36365	-.11336	0.05771	0.88934	0.00140
"103"	0.22988	0.41969	0.02816	0.21295	0.01201	0.09193	0.18098	-.06548	0.06326	0.62727	0.00310
"104"	0.95863	0.98516	0.52369	0.06314	0.08287	0.00201	0.04018	1.19494	0.01927	0.50883	0.00227
"105"	0.42515	0.62463	0.06070	0.09441	0.00438	0.00143	0.07835	0.09098	0.05366	0.47135	0.00122
"106"	0.67892	0.83246	0.21613	0.09062	0.01811	0.00008	0.44208	0.36810	0.07920	0.36475	0.00427
"107"	0.18898	0.27924	0.01333	0.17633	0.00039	0.02750	0.16984	0.10769	0.06893	0.20792	0.00391
"108"	0.46920	0.58360	0.09895	0.13434	0.00219	0.03181	0.10808	0.58656	0.06362	0.31354	0.01040
"109"	0.38188	0.51971	0.05178	0.07475	0.00881	0.00576	0.06656	-.02348	0.02211	0.20935	0.00516
"110"	0.64466	0.73125	0.16258	0.30594	0.00679	0.00779	0.03982	0.14678	0.16939	0.37482	0.00138
"120"	0.88525	0.94865	0.58302	0.26107	0.06574	0.00001	0.37661	0.13268	0.10351	0.26201	0.00165
"131"	0.26505	0.42210	0.02669	0.21131	0.00963	0.14273	0.72174	0.21302	0.02756	0.69157	0.00786
"132"	0.33343	0.49775	0.03830	0.14430	0.01237	0.06533	0.26641	0.00197	-.00778	0.67861	0.01208
"133"	0.26243	0.42845	0.02959	0.28755	0.00990	0.03927	0.23368	0.10694	0.00942	9999999	0.00523
"139"	0.19834	0.27017	0.01584	0.12342	0.00221	0.17440	0.20637	0.12020	0.07912	0.58592	0.01303
"141"	0.33745	0.40052	0.05884	0.05000	0.00172	0.02632	0.51810	-.08351	0.05545	0.85028	0.00133
"142"	0.66264	0.83122	0.21723	0.19943	0.06518	0.00050	0.43859	-.01130	-.13251	0.26017	9999999
"143"	0.42429	0.60934	0.04212	0.15429	0.04498	0.01297	0.20211	0.17846	0.11475	0.97132	9999999
"151"	0.60389	0.76338	0.19262	0.05517	0.01955	0.04044	0.69492	0.09223	0.06797	0.87168	0.01237
"152"	0.71287	0.86881	0.16611	0.07837	0.03823	0.06488	0.12267	0.00599	0.07127	0.96934	0.00988
"161"	0.21665	0.32238	0.02044	0.52817	0.00528	0.00448	0.17698	0.06276	0.11531	0.50799	0.00113
"162"	0.15347	0.20324	0.01412	0.21276	0.00115	0.32378	0.28753	0.00477	0.12523	0.35777	0.00132
"171"	0.69408	0.90334	0.15400	0.55390	0.02855	0.01690	0.46207	0.12095	0.04566	0.79289	0.00804
"172"	0.50838	0.61462	0.13742	0.15981	0.00719	0.00605	0.22717	0.09608	0.09161	0.41567	0.00227
"181"	0.13086	0.19545	0.00890	0.34236	0.00037	0.02895	0.07622	-.04123	0.03023	0.05852	0.00539
"182"	0.50724	0.57509	0.16148	1.35586	0.00862	0.05808	0.43549	0.36398	-.21913	9999999	9999999
"191"	1.00000	1.00000	0.99974	0.07296	0.99999	0.00000	0.03067	-.18235	0.16760	0.86240	9999999
"192"	0.97640	0.98859	0.45032	0.08330	0.05544	0.00000	0.15550	-.38796	-.00839	0.27624	0.00000
"201"	0.35701	0.49040	0.05358	0.23115	0.00686	0.01899	0.16134	-.05055	0.08002	0.73949	0.01037
"202"	0.89527	0.99149	0.31715	0.89547	0.11049	0.00044	0.30279	-.24874	0.03251	0.70678	0.48828
"203"	0.65967	0.77019	0.11064	0.09223	0.01686	0.00017	0.40289	-.07160	0.00958	0.48674	0.01398
"204"	0.61959	0.77924	0.10155	0.19871	0.01085	0.03955	0.05365	0.05851	0.04884	0.66644	0.00685
"205"	0.55579	0.69959	0.10128	0.23358	0.01270	0.00406	0.24549	0.10052	0.03477	0.66805	0.01162
"206"	0.81903	0.96478	0.25494	0.06253	0.08978	0.00698	0.11132	0.67904	0.03866	0.57946	0.00040
"211"	0.81091	0.92371	0.22648	0.17702	0.04339	0.12372	0.37832	0.41013	0.14487	0.95325	0.12744
"212"	0.70741	0.85605	0.27378	0.41687	0.01666	0.20848	0.15324	0.17043	-.08537	0.79775	0.38947
"221"	0.64250	0.74837	0.16691	0.17259	0.01831	0.05162	0.44215	-.30132	0.01229	0.80779	0.00352
"222"	0.20764	0.29041	0.01693	0.17208	0.00257	0.05066	0.08853	0.00667	0.05944	0.59331	0.01229
"231"	0.59489	0.71984	0.14845	0.27775	0.00924	0.04922	0.19026	-.13583	-.05789	0.44174	0.02507
"232"	0.56544	0.84614	0.07759	0.30228	0.05682	0.13519	0.46129	-.25133	0.01384	0.63165	0.00125
"233"	0.64831	0.84634	0.12419	0.40356	0.02123	0.16708	0.21088	0.01624	0.08521	0.57984	0.00013

"234"	0.77638	0.89984	0.25497	0.57898	0.01913	0.00919	0.42445	0.07605	0.09855	0.77749	0.00000
"235"	0.74267	0.99980	0.09283	0.39425	0.16634	0.00044	0.62701	-.01203	0.10051	0.14923	0.01201
"236"	0.17791	0.26528	0.01191	0.24639	0.00356	0.02625	0.14678	0.03987	0.07593	0.05879	0.00198
"237"	0.11283	0.17785	0.00641	0.21756	0.00265	0.01986	0.08447	-.18813	0.07511	0.24594	0.00004
"239"	0.43090	0.66156	0.05501	0.15879	0.03764	0.00388	0.13198	0.03012	0.06504	0.64277	0.00461
"241"	0.69683	0.84538	0.17183	0.21502	0.01723	0.00229	0.41931	-.65556	0.00765	0.73099	0.00391
"242"	0.64070	0.79367	0.11142	0.27544	0.03970	0.12886	0.25889	-.33027	0.02504	0.91613	0.00135
"243"	0.74079	0.86863	0.21789	0.15864	0.02930	0.05191	0.78914	-.11545	-.16233	0.52612	0.03507
"244"	0.78863	0.90059	0.22057	0.12119	0.02082	0.00470	0.74400	-.19096	-.00436	0.51888	0.00498
"245"	0.53296	0.67895	0.09536	0.21365	0.01770	0.00421	0.17588	0.23346	0.03794	0.17414	0.03923
"251"	0.22216	0.27289	0.02506	0.12186	0.00079	0.02406	0.16028	-.01243	0.07321	0.10358	0.00468
"252"	0.42775	0.61866	0.05662	0.11157	0.01367	0.08386	0.25956	-.29216	0.11576	0.39477	0.00251
"253"	0.45569	0.56823	0.11774	0.05836	0.01490	0.07784	0.19699	-.06052	0.04384	0.29686	0.00000
"254"	0.85686	0.93649	0.29413	0.18814	0.05548	0.00063	0.45111	-.03040	0.11335	0.66087	9999999
"255"	0.28549	0.37837	0.03187	0.20525	0.00244	0.00890	0.36638	-.07726	0.01341	9999999	0.00030
"256"	0.08243	0.13458	0.00378	0.26627	0.00063	0.00986	0.18784	0.04955	0.04193	9999999	0.00867
"257"	0.29779	0.40014	0.02873	0.19005	0.00520	0.02032	0.08858	0.11619	0.02484	0.77487	0.04065
"259"	0.29950	0.43346	0.03247	0.13350	0.00395	0.07767	0.18021	-.06895	0.07225	0.73605	0.00709
"261"	0.53619	0.68672	0.09492	0.19118	0.01881	0.01763	0.14825	-.10342	-.04411	0.84032	0.12224
"262"	0.49211	0.69403	0.07690	0.11951	0.01189	0.09802	0.27281	-.01948	0.01481	0.96247	0.08760
"263"	0.85127	0.91526	0.29656	0.05996	0.01264	0.00097	0.08132	-.13897	-.01915	0.48469	0.08273
"264"	0.91098	0.95332	0.31654	0.05339	0.02269	0.00489	0.48090	0.06611	-.05096	0.91032	0.11041
"265"	0.66313	0.80369	0.15811	0.07962	0.01485	0.00837	0.37264	0.22879	-.01287	0.80491	0.05527
"266"	0.92355	0.99538	0.24300	9999999	0.19005	0.56760	0.93057	9999999	9999999	0.99316	0.17999
"267"	0.90283	0.95300	0.21137	0.14654	0.06196	0.00929	0.28736	-.02005	0.00258	0.89059	0.26336
"268"	0.98772	0.99912	0.91635	9999999	0.16603	0.00368	0.51085	0.70414	9999999	0.85935	9999999
"271"	0.60307	0.77168	0.10648	0.10838	0.00810	0.01749	0.14307	0.02805	0.05377	0.60133	0.02839
"272"	0.99426	0.99981	0.43195	0.29544	0.19946	0.00387	0.38048	-.31556	0.09591	0.73468	0.00000
"273"	0.78669	0.87692	0.22632	0.09076	0.03551	0.00479	0.08014	0.15439	0.02853	0.67856	0.04472
"274"	0.57316	0.66359	0.13760	0.11582	0.00733	0.00412	0.26723	-.07735	0.07450	0.56689	0.02284
"275"	0.71372	0.79813	0.33891	0.10132	0.01946	0.00681	0.05445	-.00346	0.05931	0.79416	0.02521
"279"	0.89600	0.94752	0.36178	0.24499	0.02622	0.01245	0.43853	-.23845	0.17560	0.78484	0.06017
"281"	0.73583	0.82697	0.24722	0.14579	0.01365	0.07088	0.24494	-.10939	0.13661	0.76015	0.03180
"282"	0.36150	0.46999	0.05616	0.09707	0.00271	0.01816	0.09712	-.10270	0.07561	0.70568	0.01120
"283"	0.53156	0.62000	0.12589	0.06033	0.01480	0.00169	0.52310	-.16074	0.04022	0.72339	0.02482
"284"	0.47477	0.63677	0.06489	0.12410	0.01602	0.02427	0.34753	-.16671	0.09572	0.80740	0.01525
"289"	0.30865	0.45130	0.03180	0.09529	0.00616	0.01988	0.16261	-.02657	0.03179	0.77167	0.02102
"291"	0.83374	0.93763	0.28431	0.09959	0.04165	0.00232	0.07366	0.10234	0.01100	0.78472	0.00168
"292"	0.20265	0.32740	0.01727	0.14623	0.00671	0.03118	0.21319	0.05830	0.05239	0.51889	0.00768
"293"	0.62545	0.77156	0.17336	0.10266	0.01120	0.02219	0.21512	0.02249	0.01080	0.66417	0.01874
"301"	0.63545	0.77802	0.13788	0.12710	0.04399	0.09846	0.31443	-.11312	0.42897	0.85181	0.00000
"302"	0.88059	0.99118	0.50441	0.29011	0.15956	0.00061	1.08899	0.44719	0.13511	0.61009	0.00000
"303"	0.89437	0.97610	0.26773	0.12190	0.04994	0.00234	0.96292	0.04894	0.04749	0.82345	0.01139
"304"	1.00000	1.00000	9999999	9999999	1.00000	0.00000	0.00000	9999999	9999999	0.63092	9999999
"309"	0.38911	0.57352	0.04867	0.10988	0.01594	0.00390	0.35578	-.27047	0.00402	0.85536	0.09021
"310"	0.06327	0.11150	0.00389	0.18566	0.00077	0.01447	0.08455	0.00344	0.07432	0.51141	0.00463
"321"	0.70089	0.78548	0.25411	0.05432	0.00201	0.00583	0.11366	-.29312	0.01108	0.49112	0.00037
"322"	0.34837	0.48028	0.03779	0.35996	0.01271	0.02128	0.36963	-.09428	0.12659	0.94068	0.00000
"323"	0.62823	0.78317	0.11949	0.05239	0.03476	0.22548	0.28799	0.21165	0.04568	0.94390	9999999
"324"	0.49817	0.71205	0.07184	0.11080	0.01633	0.25418	0.70469	0.12925	0.10019	0.92080	0.01866
"325"	0.32731	0.42037	0.03505	0.12352	0.00153	0.08639	0.49223	0.09926	0.10703	0.88755	0.07508
"329"	0.29518	0.41950	0.03709	0.13657	0.00613	0.02225	0.21537	0.00510	0.03975	0.73540	0.00373
"331"	0.38991	0.48782	0.04746	0.22267	0.00144	0.03216	0.24300	0.10705	0.05583	9999999	0.02713
"332"	0.52179	0.65139	0.11002	0.07029	0.01030	0.07826	0.15770	0.01412	0.03147	9999999	0.10159
"351"	0.78172	0.84937	0.26545	0.83705	0.00934	0.00166	0.04534	0.16622	0.08331	0.01191	0.00430
"352"	0.95172	0.98905	0.68775	3.13849	0.05259	0.00844	0.20462	-.18835	0.10006	0.00000	0.00153
"353"	0.72915	0.86641	0.13572	0.21109	0.07789	0.00608	0.15963	0.08674	0.02609	9999999	9999999
"360"	0.60063	0.87730	0.10347	2.72662	0.02699	0.00273	0.05487	0.02343	0.01552	9999999	0.00346
"370"	0.81511	0.86852	0.37935	2.41564	0.00961	0.01060	0.12765	0.04410	0.36928	0.00080	0.00875
"381"	0.39615	0.58925	0.05486	1.01497	0.01413	0.00856	0.07302	-.02672	0.06812	0.71602	0.01851
"382"	0.42294	0.56258	0.06458	0.48984	0.00903	0.00732	0.07838	-.00106	0.06017	0.00206	0.01639
"383"	0.18868	0.29366	0.01482	0.22913	0.00377	0.08408	0.33872	-.14968	0.06778	0.00040	0.00309
"390"	0.80683	0.88858	0.25454	0.26392	0.03961	0.07834	0.05713	-.07245	0.15144	9999999	0.00468
"411"	0.08679	0.13042	0.00408	0.91003	0.00047	0.07967	0.93853	0.11028	0.12926	9999999	9999999
"412"	0.10726	0.14872	0.00562	0.08331	0.00015	0.03944	0.05506	-.09799	0.03846	9999999	9999999
"421"	0.34178	0.41215	0.07516	0.14247	0.00094	0.05601	0.10238	0.00883	-.05671	9999999	9999999
"422"	0.22458	0.29951	0.02195	0.13223	0.00141	0.08328	0.10995	-.00987	0.06460	9999999	9999999
"429"	0.54383	0.64646	0.09862	0.30569	0.00541	0.02935	0.20787	-.04365	0.02161	9999999	9999999
"431"	0.09164	0.12698	0.00391	0.22770	0.00045	0.04379	0.57023	-.00489	0.08504	9999999	9999999
"432"	0.08229	0.11081	0.00263	0.09910	0.00008	0.05330	0.11353	0.05848	0.04289	9999999	9999999
"433"	0.02331	0.03611	0.00048	0.15840	0.00007	0.04362	0.35005	-.07293	0.07677	9999999	9999999
"439"	0.06137	0.09321	0.00207	0.18935	0.00011	0.06392	0.17598	0.05429	0.07297	9999999	9999999
"451"	0.25366	0.38762	0.02382	0.04385	0.00025	0.01214	0.21268	-.12601	-.01096	9999999	9999999
"452"	0.05322	0.07470	0.00166	0.10198	0.00020	0.02183	0.19366	-.06519	0.01042	9999999	9999999
"453"	0.29901	0.40632	0.03632	0.06936	0.00098	0.01797	0.07291	-.04479	0.02101	9999999	9999999
"454"	0.27839	0.34540	0.03035	0.10203	0.00152	0.02461	0.13816	0.01385	-.00350	9999999	9999999

"460"	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999
"461"	0.30066	0.36453	0.04165	0.05456	0.00013	0.04474	0.19954	-.04864	-.02043	9999999	0.04263
"462"	0.18943	0.24914	0.01428	0.09033	0.00062	0.03331	0.05157	-.40385	0.02784	9999999	0.00143
"463"	0.18652	0.25301	0.01151	0.05937	0.00030	0.03484	0.12494	0.01113	-.00064	9999999	0.00216
"464"	0.21239	0.29029	0.01683	0.05439	0.00017	0.02502	0.56051	-.09524	0.02630	9999999	0.00521
"465"	0.29496	0.39094	0.03146	0.04389	0.00125	0.03857	0.10414	0.14354	-.03027	9999999	0.03020
"466"	0.19688	0.25358	0.01451	0.07557	0.00031	0.01819	0.43804	-.11399	0.03905	9999999	0.00190
"467"	0.14013	0.20110	0.01028	0.06963	0.00026	0.05611	0.18056	-.07712	0.05980	9999999	0.00230
"469"	0.41157	0.52652	0.04753	0.09529	0.00144	0.06210	0.11997	-.29265	0.03728	9999999	0.00000
"471"	0.49955	0.58976	0.07511	0.08003	0.00023	0.01313	0.03486	0.05423	0.00348	9999999	9999999
"472"	0.09637	0.11704	0.00447	0.14418	0.00015	0.04408	0.02506	-.00396	0.04919	9999999	9999999
"473"	0.28796	0.39096	0.03088	0.05952	0.00109	0.02625	0.10133	-.09275	0.01968	9999999	9999999
"474"	0.21591	0.28699	0.01837	0.08511	0.00040	0.02447	0.10596	0.14619	0.01483	9999999	9999999
"475"	0.17484	0.21719	0.01077	0.11477	0.00017	0.02047	0.02408	0.11110	0.05671	9999999	9999999
"476"	0.24178	0.33169	0.01822	0.10106	0.00029	0.03553	0.07700	0.01419	0.01970	9999999	9999999
"477"	0.06851	0.11395	0.00241	0.14376	0.00006	0.03323	0.09648	0.06091	0.05052	9999999	9999999
"478"	0.02901	0.05025	0.00089	0.17010	0.00045	0.07759	0.48821	0.06807	0.09967	9999999	9999999
"479"	0.28307	0.40676	0.03281	0.04974	0.00093	0.07045	0.05372	0.17511	-.04073	9999999	9999999
"492"	0.99591	0.99872	0.45761	0.99363	0.09997	0.00275	0.04456	0.04929	-.07062	9999999	0.01871
"493"	0.53813	0.61156	0.13334	0.75427	0.00073	0.00766	0.04843	0.01319	0.03730	9999999	0.00569
"494"	0.07784	0.11155	0.00317	0.23644	0.00023	0.02610	0.14888	-.02427	0.05507	9999999	0.00121
"495"	0.67336	0.86252	0.11722	0.74224	0.04864	0.06892	0.12023	-.25589	0.13383	9999999	9999999
"501"	0.97057	0.99787	0.63991	9999999	0.14223	1.38773	0.59345	-.61135	-.10134	9999999	9999999
"502"	0.75122	0.91425	0.29339	1.08790	0.01264	0.00089	0.21891	-.69110	0.05639	9999999	0.00000
"503"	0.39030	0.53945	0.04286	1.89502	0.02379	0.01290	0.57685	0.32615	0.12337	9999999	9999999
"504"	0.34316	0.47561	0.03566	0.97285	0.00994	0.06194	0.39498	-.08836	0.11646	9999999	0.00000
"511"	0.59084	0.72806	0.12617	0.06991	0.00847	0.01730	1.14116	-.01904	0.01693	9999999	0.00285
"512"	0.94963	0.98328	0.41645	0.21233	0.02380	0.00015	0.21622	-.06605	-.08178	9999999	0.00255
"521"	0.29495	0.40780	0.03044	0.69920	0.00346	0.03139	0.25515	0.05724	0.11735	9999999	0.00112
"522"	0.16755	0.24078	0.01356	0.69999	0.00074	0.06306	0.22686	-.17119	0.05256	9999999	0.00292
"531"	0.99587	0.99661	0.98839	0.22128	0.00909	0.00140	0.63105	0.07743	0.11237	9999999	9999999
"532"	0.51960	0.63799	0.07322	0.05952	0.00070	0.02825	0.07703	-.03763	-.01145	9999999	0.00194
"551"	0.14219	0.19133	0.01052	1.32734	0.00109	0.02941	0.15780	-.13898	0.09420	9999999	9999999
"552"	0.32154	0.43708	0.03479	1.27959	0.00291	0.04737	0.63339	0.08389	-.00771	9999999	9999999
"553"	0.12922	0.21293	0.00840	1.00763	0.00431	0.01683	0.27870	-.01122	0.14819	9999999	9999999
"559"	0.85796	0.89521	0.59701	0.21209	0.01067	0.00128	0.07457	-.15461	0.01515	9999999	9999999
"561"	0.04494	0.06223	0.00077	0.30099	0.00006	0.06649	0.02672	-.01666	0.03084	9999999	9999999
"562"	0.31739	0.38308	0.04098	0.07064	0.00049	0.05096	0.03779	0.15875	-.00246	9999999	9999999
"563"	0.01675	0.02853	0.00031	0.28458	0.00010	0.10475	0.18163	0.08619	0.07013	9999999	9999999
"581"	0.33394	0.45457	0.03564	0.10351	0.00124	0.01286	0.05154	-.05603	0.05357	0.21549	0.01553
"582"	0.17943	0.28334	0.01334	0.09549	0.00373	0.05887	0.31733	-.02168	0.02722	0.80263	0.00426
"591"	0.15139	0.25779	0.01314	0.30111	0.00083	0.02762	0.10943	0.01221	0.16644	0.10578	9999999
"592"	0.32613	0.48294	0.03791	0.19861	0.00289	0.02530	0.30594	-.09722	0.08951	0.31532	9999999
"601"	0.75067	0.85186	0.30809	0.05794	0.00833	0.03115	0.19673	0.47018	0.09845	9999999	9999999
"602"	0.89948	0.96652	0.42034	0.15157	0.01149	0.00078	0.01154	-.02158	0.25085	9999999	9999999
"611"	0.83914	0.94069	0.35084	0.74319	0.00628	0.00291	0.12852	0.09539	0.39373	9999999	0.00000
"612"	0.87189	0.92431	0.39453	0.55317	0.00383	0.00390	0.03603	0.04526	0.23045	9999999	0.00133
"613"	0.97277	0.98757	0.83837	0.33751	0.02082	0.00267	0.22281	0.07430	0.35235	9999999	0.00005
"619"	0.77244	0.85679	0.23763	0.19598	0.00322	0.02641	0.13532	0.16979	0.08082	9999999	0.00475
"620"	0.18525	0.23984	0.01537	0.08660	0.00011	0.06648	0.09436	0.00640	0.04406	9999999	0.08427
"631"	0.34872	0.47445	0.04228	1.06500	0.00139	0.05817	0.07511	0.20346	0.15420	9999999	0.03243
"639"	0.64400	0.69410	0.15298	0.30466	0.00174	0.03841	0.10003	0.24342	0.02689	9999999	0.02670
"641"	0.72851	0.80459	0.19015	0.14564	0.00132	0.04343	0.19883	0.11881	0.08751	9999999	0.00222
"642"	0.40057	0.47487	0.05798	0.33466	0.00036	0.04452	0.48903	0.07260	0.21602	9999999	0.10918
"643"	0.93301	0.98384	0.38230	0.03637	0.04536	0.00322	0.27049	-.26123	0.02692	9999999	0.00000
"649"	0.29878	0.44140	0.03614	1.04513	0.00332	0.01768	0.79129	-.12586	0.12450	9999999	0.00919
"651"	0.66507	0.79206	0.18155	0.17245	0.02381	0.03331	0.24659	0.27435	0.00801	9999999	0.00199
"652"	1.00000	1.00000	0.49322	9999999	0.49945	0.00410	0.37392	0.05392	0.11913	9999999	0.00000
"653"	1.00000	1.00000	0.99935	9999999	0.99984	0.13867	1.07397	-.77877	0.01680	9999999	9999999
"660"	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999
"661"	0.77045	0.82499	0.19346	0.06578	0.00229	0.02245	0.23296	0.16019	0.19076	9999999	0.01151
"662"	0.13479	0.18602	0.00627	0.12666	0.00049	0.06522	0.05395	0.02235	0.12683	9999999	0.00261
"663"	0.79038	0.84510	0.35911	0.28978	0.00655	0.01848	0.22459	-.30289	0.08249	9999999	0.01197
"681"	0.13015	0.18184	0.00715	1.33961	0.00083	0.14218	0.16369	-.01828	0.24041	9999999	9999999
"682"	0.08871	0.13542	0.00413	2.16367	0.00043	0.05281	0.13123	-.02155	0.32113	9999999	9999999
"683"	0.04606	0.08278	0.00184	1.15465	0.00021	0.06495	0.68735	-.03716	0.11731	9999999	9999999
"691"	0.11460	0.17164	0.00540	0.08113	0.00064	0.12399	0.17682	0.00966	0.17407	9999999	9999999
"692"	0.17475	0.24867	0.01281	0.23558	0.00014	0.02685	0.56469	-.06429	0.05742	9999999	9999999
"701"	0.42453	0.53030	0.07800	0.04797	0.00108	0.03507	0.18369	-.02325	0.00792	9999999	9999999
"702"	0.30420	0.35778	0.03351	0.16387	0.00006	0.04517	0.08836	-.00765	0.04023	9999999	9999999
"711"	0.12778	0.18723	0.00668	0.12153	0.00008	0.08336	1.20364	0.06389	0.05917	0.00017	0.09951
"712"	0.35398	0.44988	0.04319	0.21696	0.00237	0.03238	0.69655	0.00302	0.05232	9999999	0.07651
"721"	0.37735	0.53153	0.04891	0.40656	0.00450	0.02750	0.06359	-.04355	-.01971	9999999	0.47351
"722"	0.65615	0.79596	0.28010	0.40697	0.01128	0.01829	0.47864	0.30386	0.24495	9999999	0.73283
"731"	0.16500	0.29079	0.01415	0.09713	0.00029	0.01575	0.12682	-.10642	0.02173	9999999	9999999
"732"	0.88870	0.89955	0.75653	0.04800	0.00046	0.00330	0.16695	0.87516	-.02508	9999999	9999999

"741"	0.07921	0.14002	0.00481	0.41543	0.00086	0.12812	0.99928	0.19700	0.09941	9999999	9999999
"742"	0.15628	0.24619	0.01044	0.15759	0.00063	0.03684	0.38467	0.27615	0.07177	0.02235	9999999
"743"	0.18108	0.26766	0.01193	0.12804	0.00070	0.04220	0.11774	0.00436	0.06298	9999999	9999999
"749"	0.31991	0.52750	0.04044	0.54572	0.00153	0.02383	0.12722	0.05815	0.07111	9999999	9999999
"750"	0.06158	0.08541	0.00163	0.49078	0.00043	0.05247	0.05587	0.00370	-.09849	9999999	9999999
"771"	0.32434	0.51809	0.04263	1.56291	0.00258	0.00394	0.04500	0.03474	0.39049	9999999	9999999
"772"	0.31984	0.41888	0.04101	0.43670	0.00098	0.02875	0.40748	0.01283	0.16177	9999999	9999999
"773"	0.32291	0.44771	0.04403	1.03771	0.00114	0.02215	0.83842	-.08107	0.10356	9999999	9999999
"774"	0.82084	0.93688	0.14473	9999999	0.10576	0.60454	0.67443	9999999	9999999	9999999	9999999
"781"	0.16416	0.24338	0.01169	0.07744	0.00163	0.04512	0.32523	-.00378	0.02095	9999999	9999999
"782"	0.39527	0.59080	0.05677	0.01593	0.00446	0.01562	0.05053	0.05078	-.00033	9999999	9999999
"783"	0.62968	0.82331	0.12130	0.04626	0.04038	0.27764	0.32722	0.54063	0.02279	9999999	9999999
"791"	0.35991	0.51454	0.04992	0.05472	0.00153	0.03813	0.15062	0.08943	-.01648	9999999	9999999
"799"	0.44160	0.61904	0.05707	0.27093	0.00650	0.06726	0.60289	0.14955	0.01776	9999999	9999999
"801"	0.58262	0.74367	0.11345	0.06242	0.00295	0.01422	0.03943	-.01161	0.00239	9999999	9999999
"802"	0.59252	0.68380	0.14070	0.05782	0.00615	0.02682	0.15476	0.09285	0.00791	9999999	9999999
"803"	0.38262	0.50770	0.04529	0.10720	0.01961	0.03066	0.44838	-.29426	-.05571	9999999	9999999
"811"	0.35850	0.57423	0.04492	0.93160	0.00807	0.05261	0.39770	-.21616	0.17722	9999999	9999999
"812"	0.19560	0.28332	0.01760	0.10844	0.00039	0.04477	0.02575	0.04978	0.03809	9999999	9999999
"813"	0.04646	0.06674	0.00135	0.46930	0.00016	0.05944	0.25537	-.03064	0.14787	9999999	9999999
"821"	0.27804	0.43985	0.03331	0.33653	0.00063	0.02999	0.07616	-.07453	-.05450	9999999	9999999
"822"	0.59347	0.72805	0.13360	0.18708	0.02293	0.08932	0.11053	0.13161	0.04987	9999999	9999999
"823"	0.40141	0.49769	0.05589	0.20141	0.00131	0.03029	0.15122	0.03474	-.01895	9999999	9999999
"829"	0.20582	0.32172	0.01923	0.18696	0.00043	0.07152	0.21776	0.02189	0.01343	9999999	9999999
"841"	0.52060	0.64460	0.09732	2.99532	0.00471	0.00523	0.65957	0.04495	0.19724	9999999	9999999
"842"	0.98775	0.99176	0.85052	0.02467	0.03443	0.00036	0.13899	0.06742	-.09606	9999999	9999999
"843"	0.44360	0.63531	0.06232	0.05397	0.03541	0.00918	0.34883	-.21775	0.01735	9999999	9999999
"851"	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999
"852"	0.33819	0.50510	0.03391	2.58082	0.02505	0.14699	0.27524	-.13848	0.09579	9999999	9999999
"853"	0.32475	0.44890	0.03337	1.39353	0.00577	0.06589	0.49763	0.00438	-.01948	9999999	9999999
"854"	0.43864	0.61431	0.06977	1.09618	0.03066	0.03351	0.58915	0.36075	-.01393	9999999	9999999
"855"	0.15661	0.22652	0.01145	0.68252	0.00048	0.12949	0.11670	-.01650	0.01707	9999999	9999999
"856"	0.32114	0.43281	0.03197	0.68674	0.00690	0.02798	0.55717	0.16350	0.27875	9999999	9999999
"861"	0.30777	0.52508	0.03774	0.65564	0.01629	0.29221	0.03378	0.19664	-.00507	9999999	9999999
"862"	0.12339	0.18131	0.00558	0.30481	0.00042	0.14863	0.18567	0.08590	0.03323	9999999	9999999
"869"	0.20897	0.33751	0.02029	0.17112	0.00073	0.05758	0.10553	0.07894	0.09547	9999999	9999999
"871"	0.90837	0.99992	0.49241	0.08459	0.18937	0.19786	0.20681	9999999	-.02240	9999999	9999999
"872"	0.54119	0.63099	0.19643	0.79375	0.01106	0.05199	0.02010	0.06385	0.02143	9999999	9999999
"873"	0.09111	0.11968	0.00355	1.03593	0.00168	0.20037	0.23348	0.02242	-.05728	9999999	9999999
"879"	0.16977	0.23104	0.01281	1.14487	0.00593	0.05081	0.04271	0.03536	-.02969	9999999	9999999
"881"	0.18749	0.30595	0.01629	0.80353	0.00830	0.15677	0.11221	0.01776	-.17575	9999999	9999999
"889"	0.12371	0.19098	0.00747	0.67775	0.00144	0.12891	0.12547	0.03587	-.40457	9999999	9999999
"900"	0.29160	0.36445	0.03649	0.33585	0.00027	0.10924	0.19068	0.00288	0.09567	0.03364	9999999
"910"	0.31362	0.39184	0.04237	1.12962	0.00567	0.03922	0.17749	0.02538	0.09750	0.11984	9999999
"920"	0.88147	0.91010	0.56685	0.03685	0.00674	0.01443	0.19978	0.06212	0.24797	9999999	9999999
"931"	0.09626	0.16550	0.00522	0.55729	0.00031	0.07421	0.19166	-.14382	0.02651	9999999	9999999
"932"	0.24427	0.33289	0.02159	0.54758	0.00073	0.03908	0.04817	0.01511	0.27685	9999999	9999999
"941"	0.08905	0.14480	0.00491	0.47002	0.00193	0.08012	0.45738	-.05436	-.11680	9999999	9999999
"942"	0.80278	0.93047	0.21783	0.06449	0.08145	0.23513	0.20912	-.44214	0.29091	9999999	9999999
"949"	0.21616	0.29653	0.01808	0.46737	0.00137	0.07900	0.36473	-.01271	-.05884	9999999	9999999
"951"	0.64680	0.80776	0.14537	0.03465	0.00271	0.00477	0.08901	-.02314	-.03937	9999999	9999999
"952"	0.32671	0.39304	0.05247	0.07966	0.00060	0.03048	0.25578	-.03070	-.00598	9999999	9999999
"960"	0.04264	0.06899	0.00107	0.54373	0.00006	0.04294	0.07290	0.03203	0.14724	0.00003	9999999
"970"	0.27648	0.40130	0.02212	0.16242	0.01886	0.06177	0.16104	-.24611	0.13766	9999999	9999999
"981"	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999
"982"	1.00000	1.00000	0.84786	9999999	0.96040	0.84159	1.71682	1.44243	9999999	9999999	9999999
"990"	1.00000	1.00000	0.22538	9999999	0.37975	0.04199	0.14923	0.01938	9999999	9999999	9999999

;

Referee report on the AGORA-MMS project

Marcel Canoy
Chief Economist Ecorys
Marcel.canoy@ecorys.com

This report reflects on different contributions that measure competition in the context of the AGORA-MMS project executed by a team headed by Professor Johan Eyckmans (HUBrussel) commissioned by the FOD Economie.

The aim of the whole project is to provide methodologies that serve as ‘early warnings’ or screening devices that in some sectors there could be a problem. The exercise is similar to the Market monitoring exercise of the European Commission. Thus, the focus is on methodologies that serve that purpose (unlike methods that directly try to measure competition or abuse of a dominant position in a legal context).

One important consequence is that the methods are not geared to measure competition at the aggregation level of a relevant market (in its legal definition) but at a sectoral level.

For most indicators it holds that their a priori theoretical basis is vulnerable. Often there is a ‘correlation’ between competition and the indicator. This holds e.g. for Lerner index, price cost margins, Herfindahl indexes, churn etc. What this means is that often if there is a problem with the indicator (high or low compared to some appropriate benchmark) that there could be a competition problem, but there need not to be. This does not disqualify the usage of the indicators at all (there is no perfect measure that is both theoretically sounds and empirically useful for this purpose) but it is important to keep this in mind.

This less than perfect correlation between the used indicators and theoretical notions of competition has several consequences. First of all, one has to use more than one indicator. Second, one should interpret the conclusions with some care. Since the purpose is screening, a conclusion of the type: ‘this sector needs further scrutiny’ is often the appropriate conclusion. Third, there is merit in looking at composite indicators that try to use information from various sources.

Contribution 1: Entry and Competition in differentiated products markets

This contribution looks at a very specific type of market (sector), namely a sector that is characterized by local competition. The aim is again to check which sectors that are characterized by local competition seem to call for a closer scrutiny, i.e. the method is not geared towards accurate measures of competition in a relevant market. For local sectors traditional methods are indeed not very insightful, as is mentioned on slide 2. The advantage of the method suggested is that it is well tested and is low on data requirements (often an important bottleneck as this project also demonstrated). The contribution of the researchers is that they want to use the Bresnahan and Reiss method also for heterogeneous goods (whereas it was designed originally - at least implicitly - for homogeneous goods).

The way the researchers want to use the method also for heterogeneous goods is to separate the business creation effect from the competitive conduct. I quite like the basic idea from this. The only real drawback I see is that the method is very blackbox natured, in the sense that one often has considerable difficulties interpreting the results. The examples of 7 sectors on slide 12 prove the point. In many cases it is not clear why certain sectors score in certain ways. Are these data anomalies, technical issues or real economic effects?

Going into the detail of bakeries and real estate agencies (slide 16): the slide concludes that 'this is a clear signal of a problem concerning competition in the bakery market', but this seems extremely unlikely since that sector is likely to be very competitive (unlike the real estate agency market). So I conclude that while the method looks promising, it needs detailed institutional knowledge of the sector or the local differences within the sector to become of real value.

Contribution 2: Persistence of profits

The basic idea of looking at persistence of profits is that the measure is first of all more dynamic in nature than traditional static measures and second that whilst profits themselves say preciously little about competition, persistence of profits hints at a lack of entry or other disciplining devices.

I have two questions in relation to this measure. The first one is that profits are notoriously difficult to measure. Reported profits rarely say much about real economic profits, inter alia because of accounting and tax rules. The slides do not address this issue. I am not sure therefore how to interpret the results form slides 13-15.

A second question is whether (in the light of the first problem) other measures of capturing dynamics are not able to produce similar results without the data problems associated with profits. One can measure entry exit in a dynamic way.

Contribution 3: Composite Indicators

Whilst there is a comprehensive literature on composite indicators in general (e.g. the OECD JRC Handbook) the application to competition has been fairly limited so far. The most important thing with composite indicators is that the results can be traced back to their origin. I.e., if a certain sector shows a problematic number, one should be able to trace back why this number has been high (or low). Otherwise it becomes a black box again. Slides 15-17 shows that the authors are aware of this issue.

The contribution of the authors is that they suggest a solution for the black box issue sketched above by the benefit of doubt (BoD) approach, where weights are endogenously determined by the data using linear programming techniques. Whilst I see merit in the approach I cant make much of the conclusions on the basis of the slides alone. It would have helped the reader if more efforts are put in explaining the results. Which sectors are picked up by this method that would not have been picked up by traditional methods? For me it remains high brow technique the merits of which I cannot judge at this stage.

Contribution 4: Decision Tree

This contribution aims to come up with a decision tree based on well-known indicators of competition such as entry rate or HHI. On the basis of a limited set of questions it aims to point at high risk or low risk sectors. The first question is whether entry barriers exist or not. If entry barriers are deemed high (the slides do not report how exactly this is measured) the second question is whether the sector faces international competition. If the answer is no there a third question is whether the market is concentrated or not. If yes the sector is deemed to be a high risk sector.

Of all the methods employed I am least convinced by this one. International competition is not a great measure by itself, and I am not sure how this improves over simple composite indicator methods. Also some measures (HHI) are better calculated at the relevant market level rather than sectoral level. Also reading the draft paper, it becomes apparent that one of the merits of the approach could be to group sector into four different groups (i) potential and internal competition; (ii) potential but no internal competition; (iii) no potential but internal competition; (iv) no potential and no internal competition. Assumption is that if sectors are grouped in this way it will provide information on the risk of competitive problems. I am not convinced yet that this method will yield better results than other methods.

Conclusions

The most important thing still to do for the research team is to see how the different contributions add up. It would e.g. be highly interesting to see and compare which sectors were chosen by one or the other methodology as high risk sectors and then to add some institutional knowledge on the sector, so to conclude what this says about the methodologies employed and their potential advantages and disadvantages. The overall conclusion can then be: in this or that situation use method A, in other employ method B, in others C and D together. The researchers mention the following priorities for the FOD Economie: Priorities for further research at FOD Economie:

- Data work (Import penetration: scale up sample to Belgian economy, Labor productivity: real instead of nominal terms, R&D data integration)
- Other synthetic indicators (Boone’s profit elasticities)
- Econometric estimation of PCM
- Future data access for researcher (Data safe center project)

I don’t deny that these issues are important, but I would like to add a priority, perhaps even suggesting this to be more important than the ones mentioned above. In my view an approach where existing indicators and methods are grouped according to their usefulness in particular situations with particular sector and data characteristics is vital and is likely to yield more than ‘never ending’ data and technique improvements.

Referee Commentaren op MMS-AGORA project

Jan Bouckaert (Universiteit Antwerpen)

Ik vind deze oefeningen/analyses heel waardevol voor het beleid. In elk geval is duidelijk, en dit staat ook in de Intro, er is geen "one size fits all". Elke methode heeft voor- en nadelen.

Mijn indruk is dat inzicht in de werking van lokale markten specifieke inzichten geeft die maximaal rekening houden met de lokale marktcondities. Vanuit beleidsoogpunt is dit interessant, denk ik.

"Quickscan"

Deze studie gaat uit van nationale of internationale sectoren. Je zou kunnen zeggen dat dit een arbitrair uitgangspunt is. Ik verwijs hierbij naar de Schaumans/Verboven analyse die kijkt naar lokale markten, maar ook naar het algemeen concept van relevante markten die (inter)nationale grenzen niet noodzakelijk als enige criterium neemt. In de presentatie zie ik weliswaar een verwijzing naar HHI en MS maar geen vermelding naar de manier waarop een relevante antitrust markt bepaald wordt (bv. via SSNIP test, …). De vraag is hoe dus de relevantie van de markt bepaald wordt. Slide 12 vermeldt bijvoorbeeld "electric generation, transmission and distribution" in één adem terwijl dit drie verschillende relevante markten zouden kunnen zijn.

"CASE_POP"

Slide 4: het is voor mij niet duidelijk hoe "winst" gedefinieerd/gemeten wordt (zie ook slide 7: is "total assets" de boekwaarde of marktwaarde), en als er winst is waarom die zou moeten geïnterpreteerd worden als abnormaal. De interpretatie kan wel iets zeggen over persistentie van winst over de tijd, maar de hoogte van de winst is niet noodzakelijk "abnormaal" te noemen. Misschien is er wel een grotere persistentie over de tijd wanneer de winsten niet supranormaal maar economisch zijn. Er wordt ook impliciet verondersteld dat alle bedrijven op basis van zelfde classificatie met elkaar concurreren; competitie kan lokaal zijn of breder/smaller dan de classificatie. Ik vind dit wel een belangrijke oefening maar de vraag is ook hoe interpreteer je de geschatte parameters: welke theorie of harm heb je onderliggend. Een lage persistentie kan het gevolg zijn van roterende winsten in een collusieve omgeving, maar ook van echte concurrentie. Hoe kan je dit identificeren van elkaar?

“entry_tresholds”

Zeer gefundeerde analyse (heb de paper ook gelezen) maar wel een (te?) voorzichtige conclusie.

De presentaties over “indicators” en “composite indicators” zijn voor mij moeilijker om commentaar op te geven.

International Expert Workshop
Market Monitoring Indicators

Friday, March 26, 2010

Hogeschool-Universiteit Brussel

	Program
9:15-9:45h	Welcome coffee
9:45-10:00h	*The AGORA program and MMS project* Aziz Naji, Federal Public Service Science Policy *Introduction: goals and set-up of the MMS project* Marie-Thérèse Peeters, Federal Public Service Economy
10:00-11:00h	*Revised methodology of the screening stage of the Market Monitoring* Dominique Simonis, Head of Sector, DG ECFIN, European Commission
11:00-11:15h	Coffee break
11:15-12:00h	*Experiences of the Office of Fair Trading in using empirical indicators for market investigations* John Gibson, Deputy Director Strategy and Planning, Office of Fair Trading, UK
12:00-13:15h	Lunch
13:15-14:00h	*Composite Indicators: Methodology & Guidelines* Tom Van Puyenbroeck, HUBrussel
14:00-15:00h	MMS Project: *Preliminary Findings for the composite Market Functioning Indicator* *Choice of Indicators* Stijn Kelchtermans, HUBrussel
15:00-15:15	Coffee break
15:15-16:15h	MMS Project: *Preliminary Findings for the composite Market Functioning Indicator* *Aggregation of Indicators* Johan Eyckmans, HUBrussel
16:15-17:00h	MMS Project: *Preliminary Findings of An Entry Threshold Ratio Approach for Competition in Local Markets* Frank Verboven, K.U.Leuven
17:00	Closing workshop

economie
FPS Economy, S.M.E.s, Self-employed and Energy

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FEDERAAL WETENSCHAPSBELEID POLITIQUE SCIENTIFIQUE FEDERALE

Venue

Hogeschool-Universiteit Brussel HUB
Stormstraat / Rue d'Assaut 2, B-1000 Brussels
room: 6306 (multimedia aula in EHSAL 3, 6th floor)

Travel Directions

It takes 5 minutes walking from Brussels Central Station to the HUB Stormstraat campus, see http://www.hubrussel.be/eCache/IEE/13/250.html for more information how to reach us.

If you want to come by car, please let us know in advance by email so that we can make reservations. (we need your licence plate number and car brand / color)

Registration

Participation is free but please confirm your participation by email to yolande.degroote@hubrussel.be

This workshop is organised by Hogeschool-Universiteit Brussel in collaboration with the Federal Public Service Economy. Financial support by the AGORA program of Belgian Federal Science Policy Office is gratefully acknowledged.

AGORA MMS project

Debriefing International Expert Workshop,
March 26, 2010

Main comments and conclusions to be incorporated in our future work

- AIM OF THE SCREENING TOOL
  After the presentation of J. Gibson (OFT), it is clear that the aim of our market screening tool is not the detection of abuses of market power by individual firms or cartels. The aim of the tool is rather to foster understanding of the importance and specific nature of different <u>sectors</u> (not markets!). The monitoring tool should be kept simple and transparent and always, we should go back to the raw data, i.e. the values of the original underlying indicators. The monitoring tool is rather an information transmission device than a surveillance and detection system.
- DYNAMICS
  Several participants stressed the importance of looking at evolution over time of indicators. This should be an important priority in our future data work. For some indicators, we can consider taking up both the absolute level and the rate of change of the indicator. The Persistence of Profits approach that we proposed earlier is a good way to incorporate dynamics in our screening tool.
- CHOICE OF INDICATORS
  We have heart little negative comments on the set of indicators that we selected. There were however detailed comments on the computation of particular indicators (for instance concentration should account for imports/exports and churn should be take into account mergers & acquisitions). No suggestions were made to include additional indicators compared to the set of indicators that we proposed earlier.
- AGGREGATION OF INDICATORS
  Workshop participants were interested in the results of the alternative aggregation method of Benefit of the Doubt. For the MMS project, we will do both types of aggregations: classical linear aggregation with fixed (and mostly equal) weights AND more sophisticated benefit of the doubt approach (but using different subgroups of sectors as peers: manufacturing and services separately for instance).

Detailed comments by participants

SIMONIS (DG ECFIN):

- DG ECFIN's new methodology for Market Monitoring (part of assessing the Single Market) has two dimensions: economic importance and market performance.
- This approach doesn't rank sectors anymore, but plots them onto a 2-way axis with 4 "importance" zones – A, B, C, D. Automatically screened sectors are in A, and some in B.
- Services and manufacturing are analyzed separately and have different benchmarks (Construction is under services, as it was an outlier under manufacturing).
- DG checked for correlations between different indicators in order to keep the most relevant ones.
- Regulation on services could be used to choose sectors in quadrant B that should make the subject of further investigation.
- OECD has just revised their product-market regulation index in order to make use of a better weighting scheme.

GRILO (DG ECFIN):

- Dynamics could be used for some indicators within the CI or for the CI itself; this has not been done so far by the DG.
- The indicator "investment share" measures the share in total investments that the sector supplies to other sectors.
- DG ECFIN's tool is not for competition analysis, but for market monitoring.

MOLLEN (DG ECFIN):

- Regarding Johan's question about looking at both dynamic and static levels for the composite indicator, she suggested we could combine both, if relevant.
- OFT 's study is similar to their DG study but there are some differences. The DG study has two stages to screening of sectors.

GIBSON (OFT):

- OFT's scope was different than the Commission's – the office's role is to take into court cases of abuse of market power. Therefore, market definition is very important.
- The 2004 exercise tried to combine indicators into a CI, but the OFT dropped this approach due to the very different results they got when changing the weights used.
- Weighting should be aligned to economic policies.
- Comparison between sectors could be redundant.
- SIC4 data was too heterogeneous to correspond to actual markets.
- Issues with large firms having only one SIC (NACE) code and many secondary activities (issue gets worse at SIC 3-4-5 digits).
- The 2006 exercise used only two dimensions – competition and productivity.
- Churn was measured among the bottom firms (by market share).
- The benchmark used was EU15 average, not cross-sectoral.
- Sectors that comprised too many markets have been filtered out.

- Different database was used to check the robustness of their analysis.
- The 2004 study's conclusion was that a bottom-up or case-by-case approach would have worked better for the OFT's goals in order to understand the sector better.
- The top-down approach is useful as an additional source, when other sources signal problems on some markets such as consumer complaints.

CANOY (ECORYS):

- The CI should only be used to send a simpler message, not as an analysis tool, so we should always refer to the raw data as well.
- When computing churn, mergers should also be taken into account.
- Regarding our study, we should exclude non-business sectors.
- Using the composite indicator to see the sector performance, we can for example use a 10 point scale for each S-C-P and see how each sector scores.
- For PCM, we should look at the dynamic level and see how it influences competition in the sector.

DRESSE (NATIONAL BANK):

- Before aggregating the firm level data to NACE 2 level, we should kick out the outliers first.

BOUCKAERT (UNIVERSITEIT ANTWERPEN):

- Using HHI based on market share as an indicator itself would be misleading; we should take the openness into account and look into whether it is local or international competition.
- HHI is not based on actual market shares, as it does not capture the results of foreign firms.

BRAMATI (FOD):

- When computing the import penetration using the PRODCOM database, what do we do with the service sector?
- Regarding to our study, how do we put weight with the negative PCM, do we put positive weight or not. Johan answered that before weighting, we adjust the values so that each indicator would point in the same direction and all numbers are positive.

OTHERS:

- CI's are also used beyond communication purposes (e.g. as budgeting tools).
- Theoretical benchmarks could be used on some indicators instead of empirical benchmarks.

[thanks to Daniel Neicy and Cherry Cheung for taking note of these detailed comments by workshop participants]

Expert Workshop
Market Monitoring Indicators

Friday, May 20, 2011

Hogeschool-Universiteit Brussel

	Program
9:15-9:45h	Welcome coffee
9:45-10:00h	*The AGORA program and MMS project* Aziz Naji, Federal Science Policy *Introduction: goals and set-up of the MMS project* Luc Mariën, Federal Public Service Economy
10:00-11:00h	*Sectoral indicators for market functioning* HUBrussel team
11:00-11:15h	Coffee break
11:15-12:30h	*Results for the composite Market Functioning Indicator:* *aggregated indicators and benefit of the doubt* HUBrussel team
12:30-13:30h	Sandwich lunch
13:30-14:15h	*Results for the composite Market Functioning Indicator:* *a quick scan* HUBrussel team
14:15-15:00h	*Case study:* *Entry and Competition in Differentiated Products Markets* Catherine Schaumans (UTilburg) and Frank Verboven (K.U.Leuven)
15:00-15:15	Coffee break
15:15-16:00h	*Case study:* *Persistence of Profits: sectoral approach for the Belgian Economy 2000-2009* HUBrussel team
16:00-17:00h	Feedback and discussion
17:00	Closing

economie
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FEDERAAL WETENSCHAPSBELEID POLITIQUE SCIENTIFIQUE FEDERALE

Venue

Hogeschool-Universiteit Brussel HUB
Stormstraat / Rue d'Assaut 2, B-1000 Brussels
room: 6306 (multimedia aula in Hermes building, 6th floor)

Travel Directions

It takes 5 minutes walking from Brussels Central Station to the HUB Stormstraat campus, see http://www.hubrussel.be/eCache/IEE/13/250.html for more information how to reach us.

If you want to come by car, please let us know in advance by email so that we can make reservations. (we need your license plate number and car brand / color)

Registration

Participation is free but please confirm your participation by email to yolande.degroote@hubrussel.be

This workshop is organised by Hogeschool-Universiteit Brussel in collaboration with the Federal Public Service Economy. Financial support by the AGORA program of the Belgian Federal Science Policy Office is gratefully acknowledged.

AGORA MMS project

Debriefing Expert Workshop,
May 20, 2011

Comments by participants[1], ordered by the workshop agenda

Introduction

NAJI (Federal Science Policy)

- It is important that the final data set-up is easily accessible and that a guide/manual for accessing the data is in place.

Indicators

VAN DER LINDEN (FEDERAL PLANNING BUREAU)

- Bear in mind the ambiguity in interpretation of the indicators
    - *Multiple indicators are used; each has been carefully defined in terms of 'good' vs 'bad'*

VERMEULEN (EUROPEAN CENTRAL BANK)

- Selected turnover: why not combine method 3 & 4?
- pcm: should in principle also subtract capital return to obtain the true profit rate. See for example pharma: high pcm (in our definition) but high capital expenses.
    - *The FPB has been working on this (see report by Glenn Rayp), but no data for recent years[2]. More sophisticated methods of pcm estimation (Hall, Roeger) would also be an option.*

[1] Replies and clarifications to participants' comments that were already given during the workshop are printed in italics.

[2] Federal Planning Bureau (2010). Competition and regulation in Belgium, 1997-2004, Working paper 3-10. -> see section 2.2 (average profitability), p6. Data sources were EUKLEMS and (for the cost of capital since for Belgium this information is not in EUKLEMS) the FPB.

Composite indicator

MALEK MANSOUR (FEDERAL SCIENCE POLICY)

- A currently ongoing composite indicator exercise at the OECD involves a principal component (PC) analysis. Such a PC-analysis could be considered in the MMS-project as a robustness check.

VAN DEN CRUYCE (FEDERAL PLANNING BUREAU)

- Bootstrapping method: careful with the interpretation of a wide confidence interval of the composite indicator score. A sector may be particularly 'unlucky' with respect to its position in the data cloud. One should be careful not to suggest that a wide confidence interval equals a strangely behaving and thus malfunctioning sector.
- Note that even within sectors, the included firms may offer very heterogeneous products.

SIMONIS (EUROPEAN COMMISSION)

- The analysis has been split into manufacturing vs services. Another way to make that split is based on factor intensity i.e. consider the sectors with low capital intensity separately from the sectors with high capital intensity.

VERMEULEN (EUROPEAN CENTRAL BANK)

- BoD seems to smoothen out the outliers while these could be the most interesting data points. Therefore, an alternative (or additional) approach could be to pay special attention to those sectors that behave as an outlier for one or more indicators.

Quick scan

VERMEULEN (EUROPEAN CENTRAL BANK)

- Clarify whether import data is really available at NACE 3-digit level.
- Check how 'high-risk sectors' perform on other indicators.

PEPERMANS (HUBRUSSEL)

- Heterogeneity within sectors is still a major issue even at the 3-digit level. E.g. sector 351 covers generation, transmission and distribution of electricity.
  - *Whenever possible, an analysis at the 4-digit level is preferred.*

<u>Entry threshold ratios</u>

VERMEULEN (EUROPEAN CENTRAL BANK)

- The identification in your model is based on cross-sectional variation. Could variation over time also be exploited?
    - *In principle yes (see dynamic entry models), but in practice this is a major challenge due to the occurrence of multiple equilibria i.e. it is very hard to make these models converge.*
- Does this approach assume constant returns to scale?
    - No explicit assumption is made, although it should indeed be clarified how returns to scale are accommodated in the model. In particular, whether these are picked up by the revenue equation or the entry equation.
- What is the data source for establishment data?
    - *The KBO-data lists the number of establishments of firms. This was merely used for the <u>selection</u> of sectors to analyze since revenues are not split out per establishment. In the future, revenues per establishment would be available.*

VAN DER LINDEN (FEDERAL PLANNING BUREAU)

- Analyzing retail trade is tricky. E.g. bakeries: should also include the supermarket establishments.
    - In principle this would require separate sales data on the bakery departments within supermarket establishments, which is infeasible in practice. Alternatively, a dummy could be added to indicate the presence of a supermarket establishment in the zip code, but this would result in very little variation in the data since many zip codes will have a supermarket.

CORNILLE (NBB)

- Watch out which NACE codes to include when, for example, analyzing bakeries. There are “bakery-shops” and “bakery-manufacturing units”, which are in different NACE codes.
    - *This was verified and bakeries are consistently classified into one NACE code only (both shops and manufacturers), which is the one used in the analysis.*

VAN DEN CRUYCE (FEDERAL PLANNING BUREAU)

- What’s the explanation for the real estate agents (where no competitive effect is found)?
    - *The model does not provide a final judgment; it is merely a first step i.e. a signal for further investigation involving detailed sector knowledge.*

Persistence of profits

MALEK MANSOUR (FEDERAL SCIENCE POLICY)

- Is the measure used normal or supranormal profits?
    - *Supranormal profits i.e. after deduction of labor, materials…*

VERMEULEN (EUROPEAN CENTRAL BANK)

- An extension of the analysis could be to run regressions at NACE 3-digit level rather than at the firm level. This would make it more robust, e.g. you would always have the full 10 years of observations. Could then also add the other sector indicators so the analysis would become more informative.
- Clarify whether the analysis controls for sector-level business cycle effects.

VAN DEN CRUYCE (FEDERAL PLANNING BUREAU)

- Note that dropping firms that exit the market may bias the results.

<table>
<tr><th colspan="3">SECTOR / MARKET INDICATOR FORM</th></tr>
<tr><td colspan="2">1. Name</td><td>Capital Intensity</td></tr>
<tr><td colspan="2">2. Description</td><td>Capital intensity has an impact on industry profitability (Schepherd (1972), Schmalensee, Willig,(1989),Tirole (1988)). Capital requirements are identified by Bain (1956) as an element of market structure that affects the ability of established firms to prevent supra-normal profits from being eroded by entry. The intuition is that entrants may have trouble finding financing for their investments because of the risk to the creditors. One argument is that banks are less eager to lend to entrants because they are less well known than incumbents. Besides, entrants may be prevented from growing as existing players inflict losses on them in the product market in order to reduce their ability to find financing for new investments (Tirole, 1988).
$$CAPINT_i^t = \sum_{i \in S} m_i^t \frac{K_i^t}{y_i^t}$$
where K_i^t stands for firm i's capital stock value in period t, y_i^t for its turnover and $m_i^t = y_i^t / y_s^t$ for its share in total sector turnover (i.e. its market share). The capital intensity for sector s is defined as the weighted sum of the ratio of individual firms' capital stock value over turnover. The weights are typically based on firm's share in the sector total turnover or value added of the sector.</td></tr>
<tr><td colspan="2">3. Result tables in sectoral database</td><td>ID_CAPINT_NACE&NACE (NACE2, NACE3 and NACE4)</td></tr>
<tr><td colspan="2">4. Source data used</td><td>TU_NBB_&YEAR (2000 - 2009), containing data on:
a) Tangible Fixed Assets (code 27) = raw material, consumables, services and other goods
b) Total Assets (code 20/58)
c) Turnover (code 70)</td></tr>
<tr><td colspan="2">5. Availability</td><td>2000-2009</td></tr>
<tr><td rowspan="4">6. 1 Variable1</td><td>Name</td><td>CD_NACE&NACE</td></tr>
<tr><td>Label</td><td></td></tr>
<tr><td>Formula</td><td></td></tr>
<tr><td>Comments</td><td>NACE 2, NACE3 or NACE4</td></tr>
<tr><td rowspan="4">6. 3 Variable3</td><td>Name</td><td>MS_W_CAPINT_TOTASS_&YEAR</td></tr>
<tr><td>Label</td><td></td></tr>
<tr><td>Formula</td><td>W_CAPINT (weighted average capital intensity in the sector using total assets)
1) W_CAPINT=sum(each firm's tangible fixed assets in the sector)/sum(each firm's total assets in the sector)</td></tr>
<tr><td>Comments</td><td></td></tr>
<tr><td rowspan="4">6. 4 Variable4</td><td>Name</td><td>MS_NO_OF_FIRMS_TOTASS_&YEAR</td></tr>
<tr><td>Label</td><td></td></tr>
<tr><td>Formula</td><td>No of firms= counting the number of firms in corresponding sector based on firms which have tangible fixed assets and total assets data.</td></tr>
<tr><td>Comments</td><td></td></tr>
<tr><td rowspan="4">6. 6 Variable6</td><td>Name</td><td>MS_W_CAPINT_TRN_&YEAR</td></tr>
<tr><td>Label</td><td></td></tr>
<tr><td>Formula</td><td>W_CAPINT (weighted average capital intensity in the sector using turnover)
1) W_PCM=sum(each firm's tangible fixed assets in the sector)/sum(each firm's turnover in the sector)</td></tr>
<tr><td>Comments</td><td></td></tr>
<tr><td>6. 7 Variable7</td><td>Name</td><td>MS_NO_OF_FIRMS_TRN_&YEAR</td></tr>
</table>

	Label	
	Formula	No of firms= counting the number of firms in corresponding sector based on firms which have tangible fixed assets and turnover data
	Comments	
7. Methodology		See the Final Report for details
8. Literature		Refer to the Final Report
9. Last exercise		June 20, 2011
10. Responsible		Cherry Cheung
11. Coverage		All NACE 2-3-4 digit sectors over 2000-2009
12. Reliability		
13. Annexe(s)		
14. Remarks(s)		Only those companies are included that have a NACE code of at least 4 digits (>=4). All other firms (including those with missing NACE code) are dropped. Further analysis on the NACE can be made, e.g. which sector has the most missing NACE.

SECTOR / MARKET INDICATOR FORM		
1. Name		Economic Churn Rate
2. Description		The churn rate is an indicator that reflects the presence of entry and exit barriers in a non-extensive way. We define the churn ratio in year *y* and on sector *s* as the ratio of the number of firms that enter or exit the industry to the number of active firms. $$\mathrm{CHURN}_s^t = \frac{\sum_{i \in s} \left[\mathrm{EN}_i^t + \mathrm{EX}_i^t \right]}{\sum_{i \in s} \mathrm{AF}_i^t}$$ The variables EN_i^t and EX_i^t are dummy variables taking value one if firm i was entering or exiting the industry respectively. AF_i^t takes value one for firms that can be considered active in the industry during the time frame considered. Gross entry and exit rates are defined by the ratio's $\mathrm{EN}_i^t / \mathrm{AF}_i^t$ and $\mathrm{EX}_i^t / \mathrm{AF}_i^t$. A second definition, taking into account the relative importance of each company, weights entries, exits and active firms by their respective market shares, which is the preferred choice, as it allows to measure the importance of entry and exit relative to the active companies. The formula for this (preferred) method is as follows: $$\mathrm{WCHURN}_s^t = \frac{\sum_{i \in s} \left[\mathrm{EN}_i^t \cdot \mathrm{m}_i^t + \mathrm{EX}_i^t \cdot \mathrm{m}_i^t \right]}{\sum_{i \in s} \mathrm{AF}_i^t \cdot \mathrm{m}_i^t}$$ where m_i^t denotes the market share of company i in year t. A company is considered an entry only once in the selected period (2001-2009); this is so for the first year it recorded positive turnover. Also, a company is considered an exit only once in the selected period (2001-2009); this is so for the first year after the last year it recorded positive turnover. Firms with positive turnover in the selected year are defined as active firms. Due to this dynamic definition, churn rates for the first year for which there is data available (here 2000) cannot be calculated (as we need one period before to determine exits). Furthermore, due to the way we define active firms (see sections 6.4 and 14 below), we define “sleeping firms” as those that are inactive in year y, but have been active before and after year y (in sector s). Thus, the relationship between the different variables is as follows: $$active_s^y = active_s^{y-1} + sleeping_s^{y-1} - sleeping_s^y + entries_s^y - exits_s^y$$
3. Result tables in sectoral database		ID_CHURN_NACE2, ID_CHURN_NACE3, ID_CHURN_NACE4
4. Source data used		TU_SEL_TRNOV_&YEAR (2000 - 2009), containing data on domestic Turnover (DT) = an estimation of the turnover in Belgium, calculated as the difference between Selected Turnover and Total Exports (based on data from the NBB). TU_BR_ACTIVE_&YEAR (2000-2009) from the Sectoral DB, containing active companies within the selected period.
5. Availability		2001-2009
6. 1 Variable1	**Name**	CD_NACE&nace
	Label	x-digit sector of activity

	Formula	First x digits of the NACE sector
	Comments	The number of digits of the NACE code can be defined via a parameter &nace
6. 2 Variable2	**Name**	MS_ENTRIES_&year
	Label	Number of entries in selected year
	Formula	Count of firms switching from inactivity to activity in the selected year
	Comments	A company is considered an entry only once in the selected period (2001-2009); this is so for the first year it recorded positive turnover. See general remarks further down
6. 3 Variable3	**Name**	MS_EXITS_&year
	Label	Number of exits in selected year
	Formula	Count of firms switching from activity to inactivity in the selected year
	Comments	A company is considered an exit only once in the selected period (2001-2009); this is so for the first year it starts recording zero or negative turnover (or is deregistered) after the last year it recorded positive turnover. See general remarks further down
6. 4 Variable4	**Name**	MS_ACTIVE_&year
	Label	Number of active companies in selected year
	Formula	Count of firms with positive turnover in selected year
	Comments	See comments in section 14
6. 5 Variable5	**Name**	MS_ENT_RT_&year
	Label	Entry rate in selected year
	Formula	Number of entries divided by number of active firms for selected year
	Comments	The entry rate (MS_ENT_RT) is to be used in the **quick scan** method.
6. 6 Variable6	**Name**	MS_CHURN_&year
	Label	Churn rate for selected year
	Formula	Churn rate = (Number of entries + Number of exits) / Number of active co.
	Comments	
6. 7 Variable7	**Name**	MS_WG_ENTRIES_&year
	Label	Weighted entries in selected year
	Formula	Sum of market shares of entrants in selected year
	Comments	

<table>
<tr><td rowspan="4">6. 8 Variable8</td><td>Name</td><td>MS_WG_EXITS_&year</td></tr>
<tr><td>Label</td><td>Weighted exits in selected year</td></tr>
<tr><td>Formula</td><td>Sum of market shares of exiting firms in selected year</td></tr>
<tr><td>Comments</td><td></td></tr>
<tr><td rowspan="4">6. 9 Variable9</td><td>Name</td><td>MS_CHURN_&year_WG</td></tr>
<tr><td>Label</td><td>Weighted churn rate</td></tr>
<tr><td>Formula</td><td>Wg churn rate = Wg entries + Wg exits</td></tr>
<tr><td>Comments</td><td>Captures the relative importance of exits and entries</td></tr>
<tr><td colspan="2">7. Methodology</td><td>Please refer to the final report</td></tr>
<tr><td colspan="2">8. Literature</td><td>Please refer to the final report</td></tr>
<tr><td colspan="2">9. Last exercise</td><td>December 10 2010</td></tr>
<tr><td colspan="2">10. Responsible</td><td>Daniel Neicu</td></tr>
<tr><td colspan="2">11. Coverage</td><td>All NACE 2-3-4 digit sectors over 2001-2009 (results for 2001 are based on data for 2000)</td></tr>
<tr><td colspan="2">12. Reliability</td><td>See comments under section 14</td></tr>
<tr><td colspan="2">13. Annexe(s)</td><td>Stats_nr_companies.xls – summary of total number of companies in sample across years, including statistics on negative turnover and missing NACE codes.</td></tr>
<tr><td colspan="2">14. Remarks(s)</td><td>Our definition of churn does not directly capture the fact that companies change their sector of activity. Thus, if a company is active in year y in sector s and in year y+1 in sector t, it will not be counted as an exit from sector s and an entry in sector t. However, it will be counted as an active firm in sector s in year y and in sector t in year y+1. We argue that capturing this type of event is not possible given the current data, which are unreliable insofar as some companies seem to switch back and forth between 2 or 3 different NACE sectors over longer periods of time. The code to calculate churn rates can be adjusted to capture this issue if the data will become more reliable.
Companies with NACE codes composed of less than 4 digits are recoded as having missing NACE codes.
We do not take into account mergers & acquisitions for our calculation of churn because of data constraints. Extensive literature suggests that these events are important for churn rates and relate strongly to competition within a sector (horizontal mergers).
Firms with negative, missing or zero turnover are considered inactive (FL_ACT=0), but not necessarily exits from the market (see conditions for exit dummies above). Therefore, the sum of active firms in sector N in year Y is not equal to the sum of active firms in sector N in year Y-1 plus entries minus exits, because we define “sleeping firms” in the manner described above.</td></tr>
</table>

SECTOR / MARKET INDICATOR FORM

1. Name		Market Concentration
2. Description		The Herfindahl-Hirschman Index (HHI) is a traditional indicator for measuring market concentration. The HHI is calculated as the sum of squared market shares of all firms in the sector or market. $HHI_i^t = \sum_{i \in s} \left[m_i^t \right]^2$ Non-aggregated data on a measure of economic activity, for instance production in physical units or turnover, of all firms in the sector is needed to compute the market shares. One of the traditional indicators for measuring market concentration is the Herfindahl Index, which is widely used both by policy makers, as well as policy analysts or courts of law. C4 and C8 are calculated for robustness checking purpose.
3. Result tables in sectoral database		ID_CONCRT_NACE&NACE (NACE2, NACE3 and NACE4)
4. Source data used		TU_SEL_TRNOV_&YEAR (2000 - 2009), containing data on: a) Selected Turnover (ST) = an estimation of the total turnover, based on three sources with their respective priorities: 1° Company Accounts, 2° SBS (Structural Business Survey) and 3°VAT b) Domestic Turnover (DT) = an estimation of the turnover in Belgium, calculated as the difference between Selected Turnover and Total Exports (based on data from the NBB).
5. Availability		2000-2009
6. 1 Variable1	**Name**	CD_NACE&NACE
	Label	
	Formula	
	Comments	NACE 2, NACE3 or NACE4
6. 2 Variable2	**Name**	MS_C4_ST_&YEAR
	Label	
	Formula	C4 (Concentration Ratio for top 4 firms in the sector) 1) Rank each firm in each NACE sector according to its market share, based on ***Selected Turnover*** 2) Pick the **top 4** firm with highest market share in each NACE. 3) C4 is the total market share of the 4 largest firms in the sector.
	Comments	
6. 3 Variable3	**Name**	MS_C4_DT_&YEAR
	Label	
	Formula	C4 (Concentration Ratio for top 4 firms in the sector) 1) Rank each firm in each NACE sector according to its market share, based on ***Domestic Turnover*** 2) Pick the **top 4** firm with highest market share in each NACE. 3) C4 is the total market share of the 4 largest firms in the sector.
	Comments	
6. 4 Variable4	**Name**	MS_C8_ST_&YEAR
	Label	
	Formula	C8 (Concentration Ratio for top 8 firms in the sector) 1) Rank each firm in each NACE sector according to its market share, based on ***Selected Turnover*** 2) Pick the **top 8** firm with highest market share in each NACE. 3) C8 is the total market share of the 4 largest firms in the sector.
	Comments	

6. 5 Variable5	**Name**	MS_C8_DT_&YEAR
	Label	
	Formula	C8 (Concentration Ratio for top 8 firms in the sector) 1) Rank each firm in each NACE sector according to its market share, based on ***Domestic Turnover*** 2) Pick the **top 4** firm with highest market share in each NACE. 3) C4 is the total market share of the 4 largest firms in the sector.
	Comments	
6. 6 Variable6	**Name**	MS_HHI_ST_&YEAR
	Label	
	Formula	HHI (Herfindahl-Hirschman Index) based on ***Selected Turnover*** 1) Take out the observations with negative or zero turnover 2) Calculate the market share of each firm in the particular sector =turnover of the firm / total turnover of the particular sector (tot/sum tot) 3) HHI is calculated by squaring the market share of each firm in each NACE, and then summing the resulting numbers by NACE.
	Comments	
6. 7 Variable7	**Name**	MS_HHI_DT_&YEAR
	Label	
	Formula	HHI (Herfindahl-Hirschman Index) based on ***Domestic Turnover*** 1) Take out the observations with negative or zero turnover 2) Calculate the market share of each firm in the particular sector =turnover of the firm / total turnover of the particular sector (tot/sum tot) 3) HHI is calculated by squaring the market share of each firm in each NACE, and then summing the resulting numbers by NACE.
	Comments	
6. 8 Variable8	**Name**	MS_HHI_NORM_ST_&YEAR
	Label	
	Formula	HHI NORM=(HHI-1/N)/(1-1/N)
	Comments	HHI Normalization calculation is based on ***Selected Turnover***
6. 9 Variable9	**Name**	MS_HHI_NORM_DT_&YEAR
	Label	
	Formula	HHI NORM=(HHI-1/N)/(1-1/N)
	Comments	HHI Normalization calculation is based on ***Domestic Turnover***
6. 10 Variable 10	**Name**	MS_NO_OF_FIRMS_ST_&YEAR
	Label	
	Formula	
	Comments	No. of Firms in corresponding sector (counting is based on Firms which have "***selected turnover***" Data
6. 11 Variable11	**Name**	MS_NO_OF_FIRMS_DT_&YEAR
	Label	
	Formula	No. of Firms in corresponding sector (counting is based on Firms which have "***domestic turnover***" Data
	Comments	Based on Domestic Turnover
7. Methodology		See the Final Report for details
8. Literature		Refer to the Final Report
9. Last exercise		June 20, 2011
10. Responsible		Cherry Cheung, validated by Jean-Yves Jaucot and Luc Mariën
11. Coverage		All NACE 2-3-4 digit sectors over 2000-2009

12. Reliability	
13. Annexe(s)	
14. Remarks(s)	1) Only those companies are included that have a NACE code of at least 4 digits (>=4). All other firms (including those with missing NACE code) are dropped. Further analysis on the NACE can be made, e.g. which sector has the most missing NACE… 2) Alternative Calculation of HHI based on other literatures can be done in the future. 3) Firms with positive turnover are included in the calculations; further adjustment will be taken into account.

<table>
<tr><th colspan="3">SECTOR / MARKET INDICATOR FORM</th></tr>
<tr><td colspan="2">1. Name</td><td>Import penetration</td></tr>
<tr><td colspan="2">2. Description</td><td>The indicator import penetration IP for a given sector in a selected period is computed by dividing the total imports of products included in that sector (CN8 – CPA codes) by the sum of total turnover of companies included in the sector (NACE codes) plus the total imports of products in that sector (CN8 – CPA codes) in a given year.

Formula:

$$IP_s^t = \frac{\sum_{p\in s} IMP_p^t}{\sum_{i\in s}\left[y_i^t - EXP_i^t\right] + \sum_{p\in s} IMP_p^t}$$

where i denotes a firm in sector s, p the product(s) in the corresponding sector and t the time period, IMPpt denote imports of product p in year t, EXPit denotes exports of firm i in year t, and yit denotes the total turnover of firm i in year t.</td></tr>
<tr><td colspan="2">3. Result tables in sectoral database</td><td>ID_IMPEN_NACE&nace</td></tr>
<tr><td colspan="2">4. Source data used</td><td>TU_NBB_IMPEXP_&year. (2000-2010) from the Sectoral DB, containing data on imports and exports by product type from the NBB.

TU_CNVN_CN_CPA2008 from the Sectoral DB: conversion table between yearly CN8 codes and CPA 2008 codes.</td></tr>
<tr><td colspan="2">5. Availability</td><td>2000-2010</td></tr>
<tr><td rowspan="4">6. 1 Variable1</td><td>Name</td><td>CD_NACE&nace</td></tr>
<tr><td>Label</td><td>x-digit sector of activity</td></tr>
<tr><td>Formula</td><td>First x digits of the NACE sector</td></tr>
<tr><td>Comments</td><td>The number of digits of the NACE code can be defined via a parameter &nace.

The NACE code has been substracted as the first x digits of the NACE codes (for turnover) and the first x digits of CPA 2008 codes (for imports).</td></tr>
<tr><td rowspan="4">6. 2 Variable2</td><td>Name</td><td>MS_IMPEN_&year</td></tr>
<tr><td>Label</td><td>Import penetration</td></tr>
<tr><td>Formula</td><td>The import penetration indicator, calculated with the formula above</td></tr>
<tr><td>Comments</td><td></td></tr>
<tr><td colspan="2">7. Methodology</td><td>Please refer to the final report</td></tr>
<tr><td colspan="2">8. Literature</td><td>Please refer to the final report</td></tr>
<tr><td colspan="2">9. Last exercise</td><td>June 2011</td></tr>
<tr><td colspan="2">10. Responsible</td><td>Daniel Neicu</td></tr>
<tr><td colspan="2">11. Coverage</td><td>All NACE 2-3-4 digit sectors over 2000-2010</td></tr>
<tr><td colspan="2">12. Reliability</td><td>See comments under section 14</td></tr>
</table>

13. Annexe(s)	
14. Remarks(s)	

<table>
<tr><th colspan="3">SECTOR / MARKET INDICATOR FORM</th></tr>
<tr><td colspan="2">1. Name</td><td>Volatility of market shares</td></tr>
<tr><td colspan="2">2. Description</td><td>A company's individual volatility index for a given year is the difference in market shares of that company from the year before, divided by the average market share of the company over the two years (year of analysis and the year before).

An individual company's market share in a given year is its domestic turnover for that year, divided by the total domestic turnover for that year of all the companies in that sector.

The sectoral indicator VI for a given sector in a selected year is computed by summing, for those companies that have been in the top4 (by market shares) in a sector in the selected period, their individual volatility indexes for the selected period and dividing this by the total number of companies involved (that were in the top4 by market shares). Note that there can be less than four companies in the top four in sectors with less than four companies in total.

Formula:

$$VOLAT_s^t = \frac{1}{\sum_{i \in S} \delta_i^t} \sum_{i \in S} \delta_i^t \frac{\left| m_i^t - m_i^{t-1} \right|}{\left[\frac{m_i^t + m_i^{t-1}}{2} \right]}$$

where m_i^t is the share of company i in the sector turnover in period t and δ_i^t is a dummy variable taking value one for company i if this company belongs to the top 4 in sector s in year t.

*Note: Companies' missing market shares (in periods of inactivity) are not taken into consideration in the formula.

Refer to row 14 – Remarks for further information on the use of this indicator.</td></tr>
<tr><td colspan="2">3. Result tables in sectoral database</td><td>ID_VOLAT_IDX_Yr_NACE&nace</td></tr>
<tr><td colspan="2">4. Source data used</td><td>TU_SEL_AGGREGATES_&YEAR (2000 - 2009), containing data on domestic Turnover (DT) = an estimation of the turnover in Belgium, calculated as the difference between Selected Turnover and Total Exports (based on data from the NBB).

TU_BR_ACTIVE_&YEAR (2000-2009) from the Sectoral DB, containing active companies within the selected period.</td></tr>
<tr><td colspan="2">5. Availability</td><td>2001-2009</td></tr>
<tr><td rowspan="4">6. 1 Variable1</td><td>Name</td><td>CD_NACE&nace</td></tr>
<tr><td>Label</td><td>x-digit sector of activity</td></tr>
<tr><td>Formula</td><td>First x digits of the NACE sector</td></tr>
<tr><td>Comments</td><td>The number of digits of the NACE code can be defined via a parameter &nace.</td></tr>
<tr><td rowspan="4">6. 2 Variable2</td><td>Name</td><td>ID_MAX_VOLAT_IDX_CO_&year</td></tr>
<tr><td>Label</td><td>Maximum company volatility index</td></tr>
<tr><td>Formula</td><td>See above</td></tr>
<tr><td>Comments</td><td></td></tr>
</table>

6. 3 Variable3	**Name**	ID_MIN_VOLAT_IDX_CO_&year
	Label	Minimum company volatility index
	Formula	See above
	Comments	
6. 4 Variable4	**Name**	ID_STDEV_VOLAT_IDX_&year
	Label	Standard deviation of company volatility index
	Formula	See above
	Comments	
7. Methodology		Please refer to the final report
8. Literature		Please refer to the final report
9. Last exercise		May 3 2011
10. Responsible		Daniel Neicu
11. Coverage		All NACE 2-3-4 digit sectors over 2001-2009
12. Reliability		See remarks under section 14
13. Annexe(s)		
14. Remarks(s)		• This indicator is to be included in the **composite indicator** calculation; it is different from the fixed period volatility in the sens that it uses a two-year moving computational period, so that the Volatility Index in year *t* is based on data from years *t* and *t-1*. • Companies with NACE codes composed of less than 4 digits are recoded as having missing NACE codes.

<table>
<tr><th colspan="3">SECTOR / MARKET INDICATOR FORM</th></tr>
<tr><td colspan="2">1. Name</td><td>Volatility of market shares</td></tr>
<tr><td colspan="2">2. Description</td><td>A company’s individual volatility index for a selected period (range of years) is the sum of the difference in market shares of that company between two consecutive years within that period, divided by the average market share of the company over the selected period.

An individual company’s market share in a given year is its domestic turnover for that year, divided by the total domestic turnover for that year of all the companies in that sector.

The sectoral indicator VI for a given sector in a selected period is computed by summing, for those companies that have been at least once in the top4 (by market shares) in a sector in the selected period, their individual volatility indexes for the selected period and dividing this by the total number of companies involved (that were ever in the top4 by market shares).

Formula:

$$\mathrm{VOLAT}_s^t = \frac{1}{\sum_{i \in S} \delta_i^t} \sum_{i \in S} \delta_i^t \frac{\left| m_i^t - m_i^{t-1} \right|}{\left[\frac{m_i^t + m_i^{t-1}}{2} \right]}$$
where m_i^t is the share of company i in the sector turnover in period t and δ_i^t is a dummy variable taking value one for company i if this company belongs to the top 4 in sector s in year t.

*Note: Companies’ missing market shares (in periods of inactivity) are not taken into consideration in the formula.

Refer to row 14 – Remarks for further information on the use of this indicator.</td></tr>
<tr><td colspan="2">3. Result tables in sectoral database</td><td>ID_VOLAT_IDX_&firstyear_&lastyear_NACE&nace,
ID_TRANSITION_MATRIX_NACE_&nace (optional summary)</td></tr>
<tr><td colspan="2">4. Source data used</td><td>TU_SEL_TRNOV_&YEAR (2000 - 2009), containing data on domestic Turnover (DT) = an estimation of the turnover in Belgium, calculated as the difference between Selected Turnover and Total Exports (based on data from the NBB).

TU_BR_ACTIVE_&YEAR (2000-2009) from the Sectoral DB, containing active companies within the selected period.</td></tr>
<tr><td colspan="2">5. Availability</td><td>2000-2009 (one indicator per sector for the entire period)</td></tr>
<tr><td rowspan="4">6. 1 Variable1</td><td>Name</td><td>CD_NACE_&nace</td></tr>
<tr><td>Label</td><td>x-digit sector of activity</td></tr>
<tr><td>Formula</td><td>First x digits of the NACE sector</td></tr>
<tr><td>Comments</td><td>The number of digits of the NACE code can be defined via a parameter &nace.

As the indicator is dynamic, companies are assigned to the same sector during the entire selected period in order to avoid misleading data on differences in market shares only resulting from changes in NACE codes. The NACE code is assigned by determining the most frequently assigned NACE code for each company during the selected period.</td></tr>
<tr><td>6. 2</td><td>Name</td><td>NR_COMP</td></tr>
</table>

Variable2	**Label**	Number of companies
	Formula	Count of firms appearing in the top4 in a sector within the selected period
	Comments	
6. 3 Variable3	**Name**	VOLAT_IDX_SECT
	Label	Sectoral volatility index
	Formula	See above
	Comments	
6. 4 Variable4	**Name**	MAX_VOLAT_IDX_CO
	Label	Maximum company volatility index
	Formula	See above
	Comments	
6. 5 Variable5	**Name**	MIN_VOLAT_IDX_CO
	Label	Minimum company volatility index
	Formula	See above
	Comments	
6. 6 Variable6	**Name**	STD_VOLAT_IDX
	Label	Standard deviation of company volatility index
	Formula	See above
	Comments	
7. Methodology		Please refer to the final report
8. Literature		Please refer to the final report
9. Last exercise		January 21 2011
10. Responsible		Daniel Neicu
11. Coverage		All NACE 2-3-4 digit sectors over 2000-2009
12. Reliability		See comments under section 14
13. Annexe(s)		
14. Remarks(s)		• This indicator is to be included in the **quick scan** methodology; it is different from the moving periods volatility in the sens that it uses the entire available period (2000-2009) as computational basis, so that the Volatility Index in year *t* is based on data from years *t-n* to *t*. • Our definition of volatility does not directly capture the fact that companies change

	their sector of activity. Indeed, as the volatility of market shares is a dynamic indicator capturing changes over time, we choose for each company its most frequent atributed NACE code over the selected period. • Companies with NACE codes composed of less than 4 digits are recoded as having missing NACE codes.

<table>
<tr><th colspan="3">SECTOR / MARKET INDICATOR FORM</th></tr>
<tr><td colspan="2">1. Name</td><td>Price-cost Margin (PCM)</td></tr>
<tr><td colspan="2">2. Description</td><td>Profitability measures the difference between the revenues obtained from output and the expense associated with consumption of inputs. Price-cost margin is the difference between price (p) and marginal cost (mc) as a fraction of price ([p-mc]/p). It is usually taken as an indicator of market power because the larger the margin, the larger the difference between price and marginal cost, that is, the larger the distance between the price and the competitive price. The price-cost margin depends on the elasticity of demand and it is also called the Lerner index of market power.
Formula:
$L_S = \sum_{i \in s} w_i \frac{p_i - MC_i}{p_i}$ for sector s with $w_i = \frac{q_i}{\sum_{k \in s} q_k} = \frac{q_i}{q_S}$</td></tr>
<tr><td colspan="2">3. Result tables in sectoral database</td><td>ID_PCM_NACE&NACE (NACE2, NACE3 and NACE4)</td></tr>
<tr><td colspan="2">4. Source data used</td><td>TU_NBB_&YEAR (2000 - 2009), containing data on:
a) Raw materials (code 60/61, 60, 61) = raw materials, consumables, services and other goods
b) Labour costs (code 62) = remuneration, social security costs and pensions
c) Turnover (code 70)</td></tr>
<tr><td colspan="2">5. Availability</td><td>2000-2009</td></tr>
<tr><td rowspan="4">6. 1 Variable1</td><td>Name</td><td>MS_W_PCM_&YEAR</td></tr>
<tr><td>Label</td><td></td></tr>
<tr><td>Formula</td><td>W_PCM (weighted average price-cost margin in the sector)
1) Calculate each firm's variable cost=raw materials + social security
2) Calculate each firm's profit= turnover-variable costs
3) W_PCM=sum(each firm's profit in the sector)/sum(each firm's turnover in the sector)</td></tr>
<tr><td>Comments</td><td></td></tr>
<tr><td rowspan="4">6. 2 Variable2</td><td>Name</td><td>MS_NO_OF_FIRMS_&YEAR</td></tr>
<tr><td>Label</td><td></td></tr>
<tr><td>Formula</td><td></td></tr>
<tr><td>Comments</td><td>No of firms= counting the number of firms in corresponding sector based on firms which have raw materials, social security and turnover data.</td></tr>
<tr><td colspan="2">7. Methodology</td><td>See the Final Report for details</td></tr>
<tr><td colspan="2">8. Literature</td><td>Refer to the Final Report</td></tr>
<tr><td colspan="2">9. Last exercise</td><td>June 20, 2011</td></tr>
<tr><td colspan="2">10. Responsible</td><td>Cherry Cheung</td></tr>
<tr><td colspan="2">11. Coverage</td><td>All NACE 2-3-4 digit sectors over 2000-2009</td></tr>
<tr><td colspan="2">12. Reliability</td><td></td></tr>
<tr><td colspan="2">13. Annexe(s)</td><td></td></tr>
</table>

14. Remarks(s)	1) Only those companies are included that have a NACE code of at least 4 digits (>=4). All other firms (including those with missing NACE code) are dropped. Further analysis on the NACE can be made, e.g. which sector has the most missing NACE… 2) Alternative Calculation of PCM based on other literatures can be done in the future.

SECTOR / MARKET INDICATOR FORM		
1. Name		Labor Productivity
2. Description		Labor productivity LP_s in sector s at time t is calculated as the sum of the value-added VA_j (Euros/hour) of each firm j in the sector at time t over the total number of hours worked H_s in the sector at time t, including both employees and independents: $$LP_{st} = \frac{\sum_{j \in s_t} VA_{jt}}{H_{st}}$$ In order to allow for increased comparability across heterogeneous sectors, growth in labor productivity $\Delta LP_{st} = \left(LP_{st} - LP_{s,t-1}\right)/LP_{s,t-1}$ is preferred as a measure over absolute levels. Besides the labor productivity in nominal terms, the indicator is also calculated in real terms by using price deflators for NACE 2 digit from 2001 to 2009
3. Result tables in sectoral database		ID_LP_NACE&NACE (NACE2, NACE3 and NACE4)
4. Source data used		TU_NBB_&YEAR (2000 - 2009), containing data on: a) Value added (code 9800) b) Number of hours actually worked: total (full-time and part-time) (code 1013) TU_RSZ_EMPLOYEES_&YEAR (2000-2009), containing data on: a) Number of paid days for full-time workers b) Number of paid hours for part time workers
5. Availability		2000-2009
6. 1 Variable1	**Name**	MS_W_LP_&YEAR
	Label	
	Formula	Sum of value added of each firms in the sector /total number of worked hours in the sector including both employees and independents
	Comments	
6. 1 Variable3	**Name**	MS_W_ LP_CH_&YEAR
	Label	
	Formula	MS_CH_LP (Changes of the Labor Productivity)= (MS_W_LP in year i – MS_W_LP in year i-1)/MS_W_LP in year i
	Comments	
6. 2 Variable4	**Name**	MS_W_LP_RVA
	Label	
	Formula	Sum of value added of each firms in the sector in real term /total number of worked hours in the sector including both employees and independents
	Comments	
7. Methodology		See the Final Report for details
8. Literature		Refer to the Final Report
9. Last exercise		June 20, 2011
10. Responsible		Cherry Cheung
11. Coverage		All NACE 2-3-4 digit sectors over 2000-2009
12. Reliability		
13. Annexe(s)		
14. Remarks(s)		

DECISION TREE STRUCTURE AS SCREENING TOOL FOR MARKET MALFUNCTIONING

CHERRY CHEUNG
HU Brussels

KRISTIEN COUCKE
HU Brussels and Catholic University of Leuven

DANIEL NEICU
HU Brussels and Catholic University of Leuven

Abstract: This paper constructs a decision tree structure to screen industries for possible malfunctioning using a strategic set of indicators reflecting potential, internal and international competition. Based on this conditional combination of market characteristics and taking into account the life cycle of industries, we classify industries into different groups with a low or high probability that market malfunctioning is present.

I. Introduction

The aim of this paper is to generate an appropriate structural framework which can be used for screening manufacturing industries to detect possible competition problems like for instance collusive behavior. In the first part, we will focus on the structural framework that will be used for screening. The second part applies this framework using extensive Belgian micro-level data covering all manufacturing industries. The contribution of this paper is twofold. Instead of using an extensive list of relevant indicators (see for instance Office of Fair Trading, 2004; European Commission, 2007) we use a decision tree structure based on a limited strategic set of indicators to select possible problem markets. Our selected set of indicators will focus on the presence of potential, internal and international competition within industries. The advantages of using this decision tree is first that some industries are immediately classified as markets with no competition problems, so no further in-depth study is necessary for these industries. Second, the possible cause of market failure in the selected industries can be more easily detected by using this structural framework of strategic indicators rather than a listing of all possible relevant indicators.

Going back from the oldest literature in industrial organization, including the Structure Conduct Performance Paradigm (Mason, 1939; Bain, 1951), to more recent work, it is remarkable that so little is known about the relation between the different industry characteristics that determine market functioning and market dynamics within sectors. Since results obtained in empirical studies depend on the type of industry that is focused on (see for instance Gibrat, 1931; Mansfield, 1962; Sutton, 1997; Machado and Mata, 2000), the importance of industry characteristics became clear (Schmalensee, 1989). Therefore, recent literature focuses rather on 'single industry studies' or more popular 'structural estimation' where one specific industry is studied providing estimates for the specific model's parameters.

Our paper has a different set up and tries to understand the underlying dimensions of industry structure and industry dynamics by focusing on a limited set of important indicators and their interdependence. In the existing literature a discussion between antitrust economists is going on when considering which kind of competition is most important; static competition which is directly related to market structure or dynamic competition which takes into account rivalry behavior of firms. We consider both concepts of competition, taking into account the life cycle of industries and use a rather conditional relationship structure classifying industries into different groups with a low or high probability that market malfunctioning is present.

The remainder of the paper is structured as follows. Section II focusses on the importance of the different concepts of competition within our decision tree. Section III discusses the use of a strategic set of indicators to measure dynamic and static competition performances of industries which will lead to the classification into four groups of industries. The outcome of this strategic set of indicators will lead to propositions characterizing the four groups of industries. Section IV describes the data issues. Section V presents the data results of our screening tool for anticompetitive behavior in manufacturing industries and finally, section VI concludes.

II. Decision tree structure

Different sectors will reflect different competitive market systems, so in order to detect possible competition problems within sectors, the underlying drivers of these competitive market processes should be studied. Therefore our decision tree structure should be seen as a screening tool to study if the possible conditions of competitive behavior are present and reflected through the observation of a strategic set of indicators which focus mainly on the presence of dynamic (behavior of firms) and static (market structure) competition. If not, meaning that the conditions of competitive behavior are not present within some industries, these industries will be classified as industries to be considered for further investigation taking into account a more elaborate set of other indicators reflecting for instance profits of firms within these industries, productivity growth and the importance of innovative activities (which is not the aim of this paper and therefore not studied here).

Potential competition

Competition should be seen as a process that is evolving constantly rather than a static outcome. Following this view of the Austrian school of economics, competition can be improved and sustained when new firms or entrepreneurs want to engage in competitive behavior. In his work, Schumpeter (1942) emphasized the importance of dynamic competition and called this continuous process of new firms entering the market a process of creative destruction, driving incumbent firms towards efficiency, innovation or upgrading of their products otherwise they will be pushed out by more efficient or more innovative younger firms.

In our screening tool we use indicators that can be easily measured with national firm-level data provided by federal institutions (NIS/ADSEI/NBB). Therefore, we will focus on the level of new entrepreneurial activity within industries, rather than on the reason of this new entrepreneurial activity (for instance through innovative or upgraded products). As such, the level of creative destruction is in the first place directly related to the contestable market theory (Baumol, Panzar and Willig, 1982). The most important insight of the contestable market theory is that if entry is easy because no barriers to enter are present, incumbent firms have to fear the continuous pressure of possible new competition (Bain, 1956; Baumol et al., 1983). This - what we will call - "potential competition"[1] drives these incumbent firms towards lower profit margins, more productive efficiciency, more innovative activities or product differentiation, otherwise they will be forced to exit the industry. Secondly, the level of creative destruction is also related to the life cycle of industries (Jovanovic and Chung-Yi Tse, 2006). When entry and exit dynamics are changing substantially over the observation period, it could reflect an evolution of the industry moving to the next stage of its life cycle.

Since we want to analyze the impact of this potential competition on the structure of each specific industry over the observation period, we first measure potential competition related to the market contestability and the industry life cycle. Therefore, potential

[1] We will not use "dynamic competition" since in the existing literature this concept is strongly related to innovation, namely that innovation is one of the most important drivers of dynamic competition (Klein, 1977; Abernathy and Utterback, 1978; Klepper and Grady, 1990). Our data does not contain this information.

competition will be the first strategic indicator in our decision tree structure reflecting entry dynamics of firms[2]. When potential competition is observed in an industry, there is a threat of new competition.

Internal competition

The relevant market to study the market power of firms is the set of products and geographical areas to which the products of the firms belong. The focus of our screening tool is the market functioning in a national context. The first outcome of potential competition is measured on a national base, namely the flow of firms that started a VAT-registration in Belgium. We secondly measure a concept of static competition within industries to analyze the level of actual competition within that industry during the observation period. This "internal competition"[3] will reflect the possible dominance of some incumbent firms in an industry measured by domestic concentration ratios. Given the relevant geographical area, exports will be excluded in the analysis otherwise the market shares of heavily exporting firms will overestimate the domestic market power of these firms.

International competition

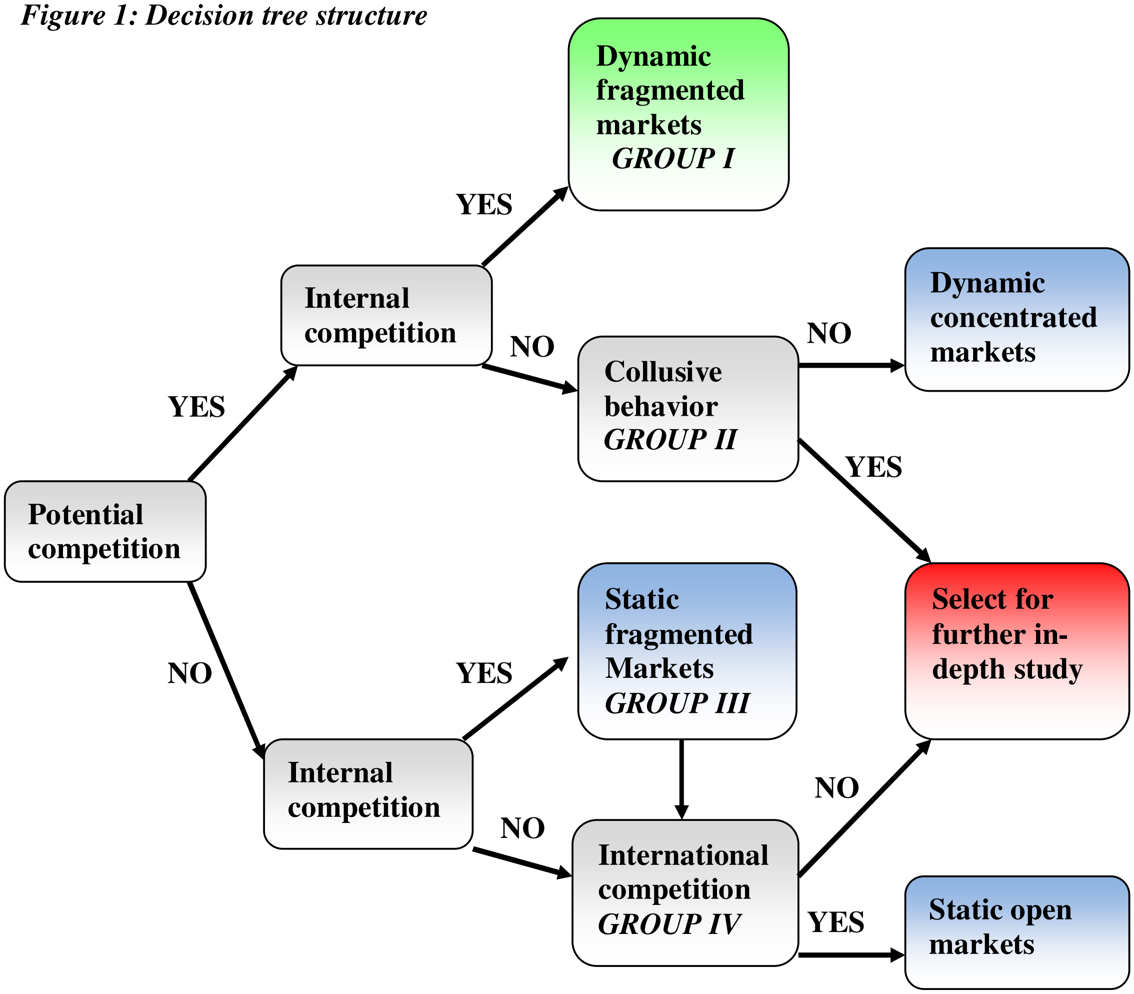
Belgium is an open economy where national competition is more and more influenced by the presence of increased imports and dominant strategies of multinational firms (Coucke and Sleuwaegen, 2008). So, to take into account the international structure of industries, our screening tool will control for international competition reflected by the presence and evolution of imports.

Classification into four groups of firms:

- <u>Potential and internal competition</u> **(GROUP I)**: In the first group of industries potential competition is present, reflecting the absence of structural and regulatory entry barriers. Structural entry barriers are characteristic to production conditions in the sector or to the way services are provided (Caves and Porter, 1976; Baumol et al, 1986; Eaton and Lipsey, 1980). In many industries, firms have to bear large fixed sunk costs to enter a sector (Sutton, 1998). Other possible structural barriers are economies of scale, network effects, economies of scope or the presence of know how (Hopenhayn, 1992; Lambson, 1991). Regulatory barriers could be the existence of legal requirements such as licensing procedures, territorial restrictions, safety or environmental conditions as regulatory barriers. At the same time given the presence of internal competition in this first group of industries, no strategic barriers seem to distort the market functioning since no dominance is observed by incumbent firms. Strategic barriers are generated by the behavior of incumbent firms for the purpose of deterring entry or the purpose of pushing new entrants out. In this way, strategic barriers are seen in a dynamic way since incumbent firms can easily adapt their strategic behavior in the short run. Exclusive dealing arrangements, high advertising expenditures, building in overcapacities or the threat of price cuts are a few examples of strategic barriers (Aghion and Bolton, 1987; Rasmusen et al., 1991; Segal and Whinston, 2000).

[2] For the specific indicator, see the description in the data section.
[3] We will not use "static competition" since internal competition is one specific issue of market structure.

Figure 1: Decision tree structure



- <u>Potential but no internal competition</u> (**GROUP II**): In the second group of industries potential competition is present but this outcome is not reflected in the market structure during the observation period. The lack of structural and regulatory entry barriers gives firms opportunities to enter the market and to stimulate competition. However, industries with low structural and regulatory entry barriers do not always reflect competitive markets where the most productive firms survive but could reflect the presence of strategic barriers. More specifically, the behavior and actions of dominant incumbent firms could distort the competitive process giving entering firms no chance to survive. So while structural and regulatory entry barriers are absent, the importance of strategic barriers should be investigated since substantial dominance could be observed by some incumbent firms over the observation period.

- <u>No potential but internal competition</u> (**GROUP III**): In the third group of industries potential competition is absent but this outcome is not reflected in the market structure. So while structural and/or regulatory entry barriers seems to be present, there seems not to be a competition problem. This situation could reflect heavy regulated markets where many incumbent firms are operating decentralized but where the establishment of a new firm is very limited. Since such a regulated market is more typically for services than for industries, we do not expect many industries to be classified in group III. Industries classified into this group could also be mature industries where potential competition, measured on a national level, is less relevant since the most important share of the production activities are already relocated abroad and replaced by imports reflecting the situation that those industries have come to the last stage of their life cycle. Since we have to take into account the life cycle of industries, also international competition will be taken into account.

- No potential and no internal competition **(GROUP IV)**: The combination of no potential and no internal competition, clearly points to the strong presence of structural (or regulatory) entry barriers related to production conditions in the industry. The presence of these structural entry barriers could result in market failures. The most common structural entry barrier is the presence of large fixed costs where firms make use of increasing returns to scale by producing on a global or European scale in order to stay competitive. Therefore, there is a high probability that the selection of industries based on this combination of indicators leads to a group of industries characterized by the presence of export driven large firms that compete not in a national but rather European or worldwide market. Since the data on industry level reflects only the production of national firms, international competition is taken into account within these industries to focus on the relevant market by controlling for the openness of the sector.

III. Relevant indicators and propositions

In this section, we define the indicators related to potential, internal and international competition. Based on our decision tree structure we include propositions directly related to the classification of industries within four different groups.

Potential competition: ENTRY RATE

The entry rate is defined as the ratio of the number of firms that enter an industry in a specific year to the number of active firms in that industry in the same year. In the literature, a positive correlation between entry and exit is observed across different industries (Geroski, 1991). This positive correlation could be due to several possible effects. For instance, more efficient entrants replace incumbent firms (Jovanovic, 1982). Another possible effect is when entrants who experience an insufficient level of efficiency when operating in the market, are forced to abandon the market (Dunne, Roberts and Samuelson, 1988; Hopenhayn 1992). This positive correlation between entry and exit enforces the fact that the entry rate is greater in some industries than others. Geroski and Schwalbach (1991) included cross-country comparisons and found that the ranking of industries by the degree of entry turbulence is broadly similar across countries. These results suggest that there are some systematic industry-specific determinants of turbulence strongly related to the presence of entry barriers and the life cycle of industries. Potential competition is present if the entry rate has a high[4] value over the observation period.

[4] Classification into "high" or "low" churn ratio over the observation period is explained in the data section.

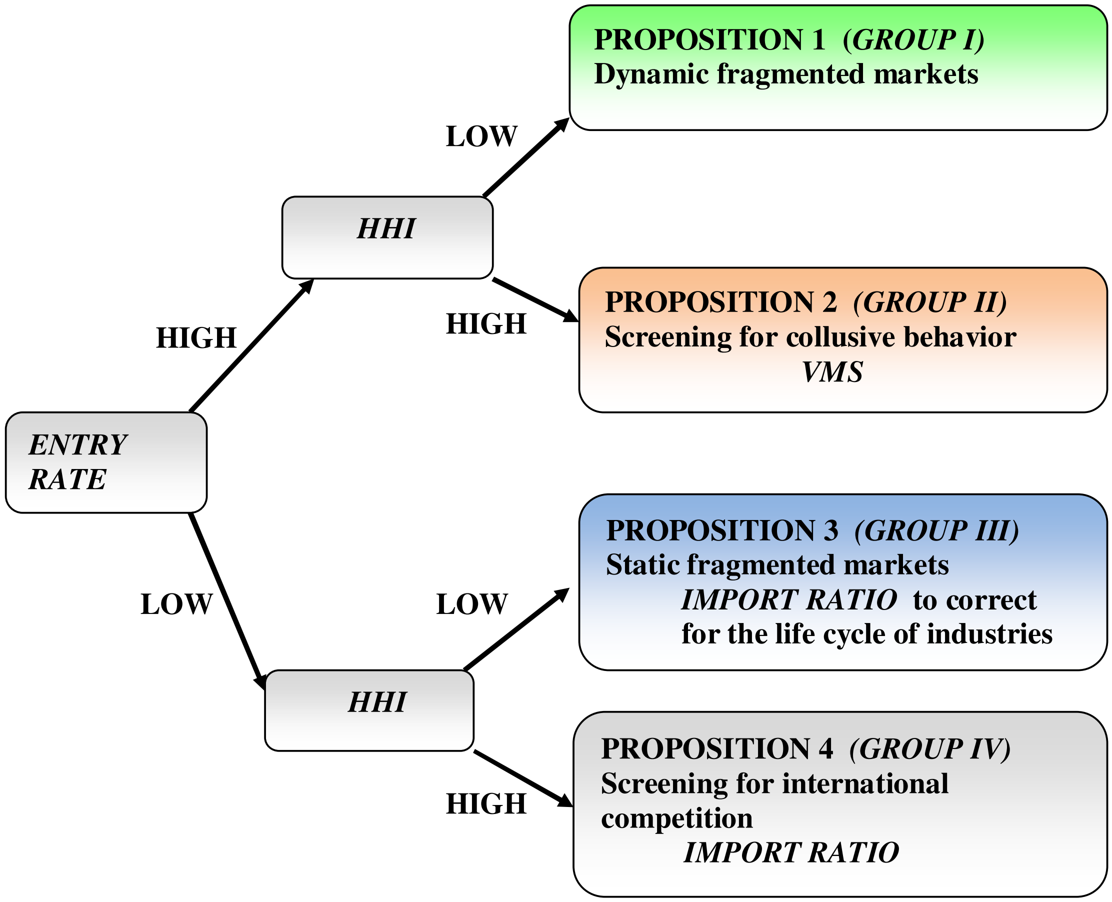
Internal competition: HERFINDAHL HIRSCH INDEX (HHI)
Possible strategic behavior of incumbent firms is directly related to the market power of these firms. A theoretical measure of market power is given by the Lerner index (Landes and Posner, 1981). However, since estimating the marginal cost of a firm is not an easy task (Neven et al, 1993), most modern econometrists concentrate on techniques to estimate the elasticity of the residual demand faced by a firm (Baker and Bresnahan, 1988; Verboven and Goldberg, 2001). Since our available data limits the use of these econometric techniques, we use a more traditional approach to assess market power by measuring the domestic market shares held by all the firms in an industry. In order to study the relevant market, especially for a small open economy like Belgium, domestic market shares are used and calculated as total domestic sales of a firm. So we correct the HHI for exports sales similar to Sleuwaegen and Van Cayseele (1998). The measuring of domestic market shares given by the HHI is a useful screening device given the positive relation between market share and market power (Dansby and Willig, 1979; Rey, 2002). Internal competition is present if the HHI has a low[5] value over the observation period.

Collusive behavior*:* VOLATILITY OF MARKET SHARES (VMS)
The volatility of market shares (VMS) is in fact an index of relative market share instability (Caves and Porter, 1978; Sakakibara and Porter, 2001; Masatoshi and Yuji, 2006) measured by the average relative changes in domestic market share of the leading firms in an industry over the observation period. The relative change in domestic market share of a leading firm is measured by the absolute value of the annual domestic market share change, divided by the average domestic market share of that firm during the observation period. We calculate the average per industry of the relative change in domestic market share for each leading firm and every year of the observation period and divide by the number of leading firms in that industry. A firm is selected as a leading firm in an industry when it belongs to the top four largest firms based on domestic market shares, in at least one year of the observation period. VMS which is directly related to market conduct, can detect possible dominance of one single player or a selected group of players when this indicator has a low[6] value.

International competition*:* IMPORT RATIO
Potential competition is measured on a national base, namely the flow of firms that started a VAT-registration in Belgium. However, Belgium is an open economy where national competition is more and more influenced by the presence of increased imports and dominant strategies of multinational firms. So, when potential competition is absent, we correct for possible international competition to take into account the international structure of these industries[7]. Exposure to international competition is measured by the import ratio of an industry defined as the ratio of the total volume of imports within that industry divided by total sales.

[5] Similar to footnote 6
[6] Similar to footnote 6
[7] The available data do not allow us to investigate the presence of international collusive behavior which should be studied with transnational data sources.

Figure 2: Relevant indicators in the decision tree and propositions



Given the classification, resulting into four groups of industries, we come to our propositions:

Proposition 1: *Industries with a high entry rate and a low HHI are dynamic fragmented markets where the probability of market malfunctioning is very low.*

Industries with a high entry rate and a low HHI are markets where incumbent firms face the continuous pressure of competition by new entrants. The high entry rate reflects only the marginal presence of entry barriers (Baldwin and Gorecki, 1991). Strategic behavior of incumbent firms which could create cost disadvantages for new entrants, is less evident since market power in these sectors is rather low reflecting the absence of dominance of one or a few leading firms. Under this continuous competitive pressure of new entrants, incumbent firms are forced to use their production inputs in the most cost efficient way. As a result of the reallocation of resources, the most productive firms will expand while less productive firms will contract or exit (Helpman, Melitz and Yeaple, 2003; Bernard, Redding and Schott, 2004; Sleuwaegen and De Backer, 2003).

Proposition 2: *Industries with a high entry rate and a high HHI are dynamic concentrated markets where a low level of volatility of market shares reflects a high probability of collusive behavior.*

A high entry rate in these markets reflects low structural and regulatory entry barriers. The combination of a high entry rate with a high HHI makes the presence of strategic entry barriers probable. With the presence of hidden strategic barriers, new firms which could easily enter the markets because of low structural and regulatory entry barriers, will face unexpected problems to compete with incumbent firms and they will face unexpected higher costs to stay active in this market. Since most of these new firms do not have the capacity to bear these unexpected higher costs, many of them will be forced to exit. Interesting to look at are the changes in market shares over time of the largest incumbent firms. If low market share volatility is observed, the market mechanisms in these industries seem not to work properly. This market malfunctioning could be the result of possible price agreements between the large incumbent firms or the presence of exclusive dealing arrangements. However, if high market share volatility is observed, competition between the largest incumbents makes price agreements less probable. Dynamic concentrated industries with a low level of VMS, will be selected as markets for further in-depth study. For these markets additional indicators could be measured to support the proposition of collusive behavior. For instance, profits in these markets are expected to be high while productivity levels and productivity growth might be limited.

Proposition 3: *Industries with a low entry rate and a low HHI are static fragmented markets where the probability of market malfunctioning is low when international competition is observed.*

Sectors with a low entry rate and a low HHI are rather exceptional since potential competition is low but this outcome is not reflected in the market structure. This combination of indicators is possible in some situations. The first and most probable situation of a static fragmented market is a heavy r egulated market. Entry is determined by legal requirements such as licensing procedures, safety or environmental conditions. Most of the firms that meet the legal requirements work on a small basis whether or not determined by territorial restrictions. Profits are expected to be high while productivity growth in these sectors is very limited. Since these characteristics are more typical for services and less typical for industries, only a few industries will be classified as a static fragmented market. A second situation concerns a market that is unable to grow due to a lack of necessary inputs such as specific skilled labour or a limited stock of commodities. Finally and more typical for industries, a static fragmented market could be due to delocalization of most labour-intensive activities abroad where only a group of small firms have survived the increased international competition by upgrading their activities or differentiating their products from imported goods (Gereffi, 1999; Coucke, 2007). This final stage of the life cycle of the industry does not reflect market malfunctioning since competition is strongly present from abroad through imports. In these sectors, local firms had to strongly increase their productivity in order to survive the increased international competition (Sleuwaegen and De Backer, 2001). Therefore, we also take into account the import ratio of the industry.

Proposition 4: *Industries with a low entry rate, a high HHI and a low import penetration ratio lack the presence of national and international competition leading to a high probability of market malfunctioning in these industries.*

The combination of low entry rate and a high HHI in these industries reflects the presence of substantial entry barriers which could be structural, strategic or regulatory in nature.

These entry barriers prevent potential new firms to enter the market and to compete with incumbent firms. Using elementary micro-economic theory, the presence of substantial fixed costs such as infrastructure investments, R&D activities or high advertising expenditures lead to economies of scale in favour of large and/or multinational firms and in the disadvantage of small firms (Baumol and Willig, 1981; Sutton, 2001; Maskin and Tirole, 1982). Also a decrease in average variable production costs as a result of increased organizational efficiency, lower switching costs, network effects or quantity discounts, lead to economies of scale in favour of these large and/or multinational firms. However, competition in these industries with a low entry rate and a high HHI is not threatened when substantial import penetration is observed since firms in these industries do not compete on a national but rather on an international market (Colantone, Coucke and Sleuwaegen, 2010).

V. References

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Entry and Competition in Differentiated Products Markets

Catherine Schaumans and Frank Verboven*

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Abstract

We propose a methodology for estimating the competition effects from entry when firms sell differentiated products. We first derive precise conditions under which Bresnahan and Reiss' entry threshold ratios (ETRs) can be used to test for the presence and to measure the magnitude of competition effects. We then show how to augment the traditional entry model with a revenue equation. This revenue equation serves to adjust the ETRs by the extent of market expansion from entry, and leads to unbiased estimates of the competition effects from entry. We apply our approach to seven different local service sectors. We find that entry typically leads to significant market expansion, implying that traditional ETRs may substantially underestimate the competition effects from entry. In most sectors, the second entrant reduces markups by at least 30%, whereas the third or subsequent entrants have smaller or insignificant effects. In one sector, we find that even the second entrant does not reduce markups, consistent with a recent decision by the competition authority.

Keywords: competition, entry, local services sectors, entry threshold ratios
JEL codes: K21,L13, L41

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* *Catherine Schaumans*: CentER, TILEC, Tilburg University. E-mail: catherine.schaumans@uvt.nl. *Frank Verboven*: Catholic University of Leuven and C.E.P.R. (London). E-mail: Frank.Verboven@econ.kuleuven.be. We are grateful to Michelle Goeree, Pasquale Schiraldi, Philipp Schmidt-Dengler, Johan Stennek, Jo Van Biesebroeck and participants at workshops at the FOD Economie, Tilburg University, and the Annual C.E.P.R. conference in Toulouse and for helpful comments and discussions. The project was financed by the Belgian Federal Science Policy Office (Agora) and realized in collaboration with the Federal Public Service Economy (Sector and Market Monitoring Department). We thank the FPS Economy for its contribution in setting-up the dataset and Daniel Neicu for excellent research assistance.

1 Introduction

An important question in industrial organization is how market structure affects the intensity of competition. To address this question a variety of empirical approaches have been developed, each with different strengths and weaknesses depending on the available data.[1] Bresnahan and Reiss (1991) developed an innovative approach applicable to local service sectors: they infer the effects of entry on competition from the relationship between the number of entrants and market size. The intuition of their approach is simple. If market size has to increase disproportionately to support additional firms, entry can be interpreted to intensify the degree of competition. Conversely, if market size increases proportionally with the number of firms, then additional entry is interpreted to leave the degree of competition unaffected. To implement their approach, Bresnahan and Reiss propose the concept of the entry threshold ratio (henceforth ETR). The ETR is the percentage per-firm market size increase that is required to support an additional firm. An estimated ETR greater than 1 indicates that entry leads to stronger competition, whereas an ETR equal to 1 indicates that entry does not intensify competition.

A major strength of Bresnahan and Reiss' methodology is that it can be applied with relatively modest data requirements. One basically needs data on a cross-section of local markets, with information on the number of firms per market, population size and other market demographics as control variables. No information on prices or marginal costs is required. This also makes their approach potentially appealing from a competition policy perspective. It can be used as a first monitoring tool to assess which sectors potentially face competition problems and require more detailed investigation.

A central assumption of Bresnahan and Reiss' methodology is that firms produce homogeneous products: holding prices constant, an additional entrant only leads to business stealing and does not create market expansion. This assumption is potentially problematic since new entrants may be differentiated from existing firms, either because they offer different product attributes or because they are located at a different place. In both cases, additional entry would raise demand (holding prices constant).

In this paper we develop a more general economic model to assess the competition effects from entry. The model allows for the possibility that firms sell differentiated products, i.e. additional entry can create market expansion. We first derive precise conditions under which Bresnahan and Reiss' ETRs can be used as a test for the *presence* of competition effects from entry. We find that this is only possible if products are homogeneous, i.e. additional

[1] For detailed overviews see, for example, Bresnahan (1989), Ackerberg, Benkard, Berry and Pakes (2007) and Reiss and Wolak (2007).

entry only entails business stealing and no market expansion. We then ask when ETRs can be used as a measure for the *magnitude* of competition entry effects. We show that ETRs are generally a biased measure for the percentage markup effect due to entry, except in the special case where products are homogeneous and the price elasticity of market demand is unity. More generally, if products are sufficiently differentiated, ETRs typically tend to underestimate the percentage markup effects from competition.

Our theoretical framework also provides a natural way to extend the Bresnahan and Reiss' approach to obtain an unbiased measure for the magnitude of the markup effects due to entry. We propose to augment the traditional ordered probit entry model with a revenue equation. The entry model specifies the equilibrium number of firms that can be sustained under free entry. The revenue equation specifies per firm revenues as a function of the number of firms and enables one to estimate the total market expansion effects (consisting of both the direct effects from increased product differentiation and any indirect effects through possible price changes). To obtain an unbiased estimate of the markup effects from entry, the traditional ETRs from the entry model should be suitably adjusted by the total market expansion effects estimated from the revenue equation.

To implement our approach, we study a variety of local service sectors, for which revenue data are increasingly becoming available.[2] More specifically, we consider architects, bakeries, butchers, florists, plumbers, real estate agents and restaurants. For each sector, we constructed a cross-section dataset of local markets (towns) in Belgium, with information on market revenues, the number of entrants, market size (population) and market demographics. Estimating the single-equation entry model yields the traditional ETRs, and we estimate these to be close to 1. This would seem to indicate that entry does not lead to intensified competition. In fact, we even estimate some ETRs to be below 1, which would be inconsistent with the hypothesis of increased competition. However, estimation of the revenue equation shows that entry may often lead to important total market expansion, especially for architects, florists and real estate agents. This implies that the traditional ETRs underestimate the competition effects from entry. Accounting for the estimated total market expansion effects leads to stronger competition effects, especially from the second entrant. Third and subsequent entrants have more limited or insignificant competition effects. In one

[2]The increased access to revenue data has recently also been exploited in a variety of other settings. For example, Syverson (2004) uses plant-level revenue data in the ready-mixed concrete industry, to assess how demand factors affect the distribution of productivity. Campbell and Hopenhayn (2005) consider the relationship between market size and the size distribution of establishments. They find that establishments tend to be larger in large markets, consistent with models of large-group competition. Konings, Van Cayseele and Warzynski (2005) and De Loecker and Warzynski (2010) extend Hall's (1988) approach to estimate markups using plant-level data on revenues in combination with variable input expenditures.

sector, bakeries, we find no significant competition effects, not even from the second entrant. Incidentally, this sector has recently been investigated by the local competition authority because of price fixing concerns.

Our paper relates to the growing empirical literature on static entry models. Bresnahan and Reiss (1991) proposed their ordered probit model of free entry to infer competition effects from entry by doctors, dentists, car dealers and plumbers. Asplund and Sandin (1999) and Manuszak (2002) are examples of applications of this model to other sectors. Berry (1992) considered a more general model of entry with heterogeneous firms. Mazzeo (2002), Seim (2006) and Schaumans and Verboven (2008) allow for multiple types of firms or endogenize the choice of type. Other recent work on static entry models has focused on different ways of addressing the multiplicity problem in entry games with firm heterogeneity; see Berry and Reiss (2007) for a recent overview of the literature. In contrast with this recent literature, we maintain the basic entry model that can be applied to market-level data and we focus on the interpretation of ETRs. We show how to augment the entry model with a revenue equation to draw more reliable inferences about the competition effects from entry.

Section 2 presents the theoretical framework, showing under which conditions ETRs can be used as a test for the presence and a measure for the magnitude of competition effects. Section 3 presents the econometric model and Section 4 the empirical analysis. Finally, Section 5 concludes.

2 Theoretical framework

We first describe the model. We then introduce the concept of the ETR, and derive conditions under which ETRs can be used to test for the *presence* of competition effects from entry. Finally, we show how to incorporate revenue data to adjust ETRs to measure the *magnitude* of competition effects from entry in an unbiased way.

2.1 The model

There are N firms, competing in a local market with a population size S. Each firm has the same constant marginal cost $c > 0$ and incurs a fixed cost $f > 0$ (independent of the number of firms).

Demand Firms do not necessarily produce homogeneous products, but in equilibrium they charge the same industry price p. The demand per firm and per capita as a function of this common price p and the number of firms N is $q(p, N)$. This is the traditional

Chamberlinian DD curve (in per capita terms). Similarly, industry demand per capita is $Q(p,N) = q(p,N)N$. Denote the price elasticity of industry demand by $\varepsilon = -Q_p \frac{p}{Q} = -q_p \frac{p}{q}$. We ignore the fact that N can only take integer values here, but we take this into account in the empirical analysis.

We make the following three assumptions about demand.

Assumption 1 $q_p \leq 0$, *or equivalently,* $Q_p = q_p N \leq 0$.

Assumption 2 $q_N \leq 0$.

Assumption 3 $Q_N = q + q_N N \geq 0$.

The first assumption simply says that per-firm or industry demand is weakly decreasing in the common industry price p. The second assumption says that per-firm demand is weakly decreasing in the number of firms N: holding prices constant, additional entry either leads to business stealing (if products are substitutes) or does not affect per-firm demand (if products are independent). Finally, the third assumption says that industry demand is weakly increasing in N: holding prices constant, entry either leads to market expansion because of product differentiation, or leaves industry demand unaffected if products are homogeneous.

These assumptions clearly cover the special case in which products are homogeneous, as in Bresnahan and Reiss (1991). In this case, industry demand per capita can be written as $Q(p,N) = D(p)$, so that $q(p,N) = \frac{D(p)}{N}$. It immediately follows that $q_N = -q/N < 0$ and $Q_N = q + q_N N = 0$. Hence, with homogeneous products entry leads to full business stealing and no market expansion (holding prices constant).

More generally, the assumptions allow for product differentiation with symmetric firms. To illustrate, consider Berry and Waldfogel's (1999) symmetric nested logit model used to study product variety: the first nest includes all firms' products, and the second nest contains the outside good or no-purchase alternative. With identical firms and identical prices, the nested logit per firm and per capita demand function is:

$$q(p,N) = \frac{N^{-\sigma}}{e^{\alpha p} + N^{1-\sigma}},$$

where $\alpha > 0$ is the price parameter and $0 \leq \sigma \leq 1$ is the nesting parameter. It can easily be verified that:

$$\begin{aligned} q_p &= -\alpha(1-Nq) < 0 \\ q_N &= -\left(\sigma + (1-\sigma)q\right)\frac{q}{N} < 0 \\ Q_N &= (1-\sigma)q(1-q) \leq 0. \end{aligned}$$

If $\sigma = 1$, then $q_N = -q/N$ and $Q_N = 0$, so all firms' products are perceived as homogeneous (relative to the outside good).

Profits and prices Now consider profits and the symmetric equilibrium price in the market. For a common industry price p a firm's profits are

$$\pi = (p-c)\, q(p,N)S - f.$$

Suppose first that all N firms behave as a cartel. In this case, the equilibrium price as a function of N is $p^m(N)$, defined by the first-order condition

$$q(p,N) + (p-c)\, q_p(p,N) = 0.$$

More generally, let the symmetric equilibrium price as a function of the number of firms N be given by $p(N) \leq p^m(N)$. In many oligopoly models, including the Cournot and Bertrand models, this equilibrium price is weakly decreasing in N, $p' \leq 0$. We can then write a firm's equilibrium profits as a function of the number of firms N as:

$$\pi(N) = (p(N)-c)\, q(p(N),N)S - f. \tag{1}$$

In the next two subsections we will decompose profits in two different ways. Define the variable profits per firm and per capita by $v(N) \equiv (p(N)-c)\, q(p(N),N)$, the revenues per firm and per capita by $r(N) \equiv p(N)q(p(N),N)$, and the Lerner index or percentage markup by $\mu(N) \equiv \frac{p(N)-c}{p(N)}$. We can then write

$$\begin{aligned} \pi(N) &= v(N)S - f. && (2) \\ &= \mu(N)r(N)S - f. && (3) \end{aligned}$$

The expression on the first line contains variable profits per firm and per capita, similar to Bresnahan and Reiss (1991). The expression on the second line rewrites variable profits as markups times revenue per firm and per capita. As we will show in the next two subsections, this second expression provides useful additional information to assess the effects of competition on markups, provided that data on revenues are available.

2.2 ETRs to test for the presence of competition effects

Bresnahan and Reiss (1991) introduce the concept of the entry threshold and entry threshold ratio as a test for the presence of competition effects from entry. The entry threshold is the critical market size required to support a given number of firms, and is derived from the zero-profit condition $\pi(N) = 0$. Using (2), this gives

$$S = \frac{f}{v(N)} \equiv S(N).$$

Bresnahan and Reiss argue that entry does not lead to increased competition if the entry threshold increases proportionally with the number of firms. For example, entry would not lead to more competition if a doubling of the market size is required to support twice as many firms. Conversely, entry creates intensified competition if the entry threshold increases disproportionately with the number of firms. For example, competition intensifies if a tripling of the market size would be required to support twice as many firms.

Based on this intuition, Bresnahan and Reiss propose the entry threshold *ratio*, or ETR, as a unit-free measure to test for the presence of competition effects. The ETR is defined as the per-firm entry threshold required to support N firms, relative to the per-firm entry threshold to support $N-1$ firms, i.e.

$$ETR(N) \equiv \frac{S(N)/N}{S(N-1)/(N-1)}. \tag{4}$$

One can then test the null hypothesis, $ETR(N) = 1$, that the N-th entrant does not lead to more competition.

We now assess this interpretation formally, starting from our more general model where products are not necessarily homogeneous, i.e. allowing for market expansion upon entry. Substituting $S(N) \equiv \frac{f}{v(N)}$ in (4), we can write the ETR in a simple form:

$$\begin{aligned} ETR(N) &= \frac{v(N-1)(N-1)}{v(N)N} \\ &\equiv \frac{V(N-1)}{V(N)}. \end{aligned} \tag{5}$$

where $V(N) = v(N)N$ is per capita industry variable profits. The ETR is therefore just the ratio of industry variable profits with N and $N-1$ firms.

It follows immediately from (5) that the $ETR(N) > 1$ if and only if $V'(N) < 0$, i.e. if and only if industry variable profits are strictly decreasing in N. To see under which circumstances this is the case, differentiate $V(N) = v(N)N$ using (1), and rearrange to obtain

$$\begin{aligned} V' &= (q + (p-c)q_p)\, p' N + (p-c)\,(q + q_N N) \\ &= (1 - \mu\varepsilon)\, p' N q + (p-c)\,(q + q_N N)\,. \end{aligned} \tag{6}$$

Suppose first that products are homogeneous, which is the special case considered by Bresnahan and Reiss. In this case, $q + q_N N = 0$ so that the second term in (6) vanishes. Since $1 - \mu\varepsilon \geq 0$, it follows that $V' < 0$ (and hence $ETR(N) > 1$) if and only if $p' < 0$. Similarly, $V' = 0$ if and only if $p' = 0$. We can therefore confirm, and make more precise, Bresnahan and Reiss' justification for using ETRs as a test for the presence of competition effects from entry, when products are homogeneous:

Proposition 1 *Suppose that products are homogenous. $ETR(N) > 1$ if and only if entry leads to a price decrease ($p' < 0$). $ETR(N) = 1$ if and only if entry does not affect the price ($p' = 0$).*

Bresnahan and Reiss also provide examples from oligopoly models to argue that the ETRs are declining in N. Intuitively, entry may be expected to have larger effects on competition if one starts off from few firms with strong market power, as can be confirmed from examples such as the Cournot model. Formally, it follows from (5) that the ETRs are declining if and only if the industry variable profits are convex in N, $V'' > 0$. While this may often be the case, it is not generally true, not even if products are homogeneous. A simple counterexample is a repeated game with price setting firms: profits are monopoly profits for sufficiently low N, and then drop to zero above a critical level for N.[3]

Suppose now that products are differentiated. This means that additional entry implies market expansion (holding prices constant), i.e. $q + q_N N > 0$, so that the second term in (6) becomes positive. It follows immediately that $V' > 0$ (and hence $ETR(N) < 1$) if $p' = 0$. Furthermore, $V' > 0$ is also possible if $p' < 0$, provided products are sufficiently differentiated (since then p approaches p^m or μ approaches $1/\varepsilon$, so that the first term in (6) vanishes and the second term dominates). We can conclude the following about the use of entry thresholds when products are differentiated:

Proposition 2 *Suppose products are differentiated. $ETR(N) < 1$ if entry does not affect the price ($p' = 0$) or even if entry leads to a price decrease ($p' < 0$) provided products are*

[3] In fact, with homogeneous products one can verify that for small N the function V is concave ($V'' < 0$), while for sufficiently large N the function V is convex. In a linear demand Cournot model, the function is convex for $N \geq 2$. So ETRs appear to be increasing for N very small. Yet accounting for the fact that N is an integer, the ETR already drops when moving from 1 to 2 firms.

sufficiently differentiated.

Product differentiation can thus explain occasional findings in applied work of ETRs less than 1. (For example, Bresnahan and Reiss report $ETR(3) = 0.79$ for dentists.) Intuitively, if entry leads to substantial market expansion and does not intensify competition by very much, it is possible that market size increases less than proportionately with the number of firms.

To summarize, Propositions 1 and 2 identify conditions under which the null hypothesis $ETR(N) = 1$ is reasonable as a test for the presence of competition effects. It turns out that this approach is reasonable only if products are homogeneous, but not more generally if products are differentiated.

2.3 ETRs to measure the magnitude of competition effects

Having identified conditions under which ETRs form a reasonable basis to test for the presence of the competition effects from entry, we now ask under which conditions ETRs provide an unbiased measure for the magnitude of the competition effects. Define this magnitude as the percentage drop in the Lerner index, $\mu(N-1)/\mu(N)$.

To address this question, we now start from (3) instead of (2) to rewrite the entry threshold as

$$S(N) = \frac{f}{\mu(N)r(N)}.$$

This can be substituted in the definition of the ETR (4) to rewrite it as:

$$\begin{aligned} ETR(N) &= \frac{\mu(N-1)}{\mu(N)} \frac{r(N-1)(N-1)}{r(N)N} \\ &\equiv \frac{\mu(N-1)}{\mu(N)} \frac{R(N-1)}{R(N)} \end{aligned} \tag{7}$$

where $R(N) = r(N)N$ is the per capita industry revenue function.

It immediately follows that the ETR is an exact measure for the magnitude of the percentage markup drop if and only if industry revenues do not vary with the number of firms, $R(N) = R(N-1)$, i.e. if and only if $R' = 0$ (ignoring that N only takes integer values). Similarly, the ETR underestimates (overestimates) the percentage markup drop if and only if $R' > 0$ ($R' < 0$). To see when this is the case, use $R(N) = p(N)q(p(N), N)N$ to compute

$$\begin{aligned} R' &= (q + pq_p)\, p'N + p\,(q + q_N N) \\ &= (1-\varepsilon)\, p'Nq + p\,(q + q_N N)\,. \end{aligned} \tag{8}$$

As before, suppose first that the products are homogeneous, as in Bresnahan and Reiss. We have that $q + q_N N = 0$, so that the second term in (8) vanishes. For $p' < 0$, we then obtain that $R' < 0$ if $\varepsilon < 1$, $R' = 0$ if $\varepsilon = 1$ and $R' > 0$ if $\varepsilon > 1$. We can conclude the following:

Proposition 3 *Suppose that products are homogeneous. The ETR is a correct measure of the percentage markup drop due to entry,* $ETR(N) = \mu(N-1)/\mu(N)$, *if and only if* $\varepsilon = 1$. *It underestimates (overestimates) the percentage markup drop if and only if* $\varepsilon > 1$ ($\varepsilon < 1$).

For example, consider an estimated $ETR = 1.3$, as roughly found for entry by the second and third firm in Manuszak's study of the 19th century U.S. brewery industry. Assuming homogeneous products, this can be interpreted as a markup drop by 30% following the introduction of a second and third competitor, if and only if the price elasticity of market demand is unity.

Proposition 3 shows that it is difficult to draw general conclusions about the direction of bias, since one needs to know the level of the price elasticity of industry demand. But the direction of bias is clear in the special case where industry behaves close to a perfect cartel. In this case, we have that $\varepsilon > 1$ (since marginal cost $c > 0$). Hence, if the industry behaves close to a perfect cartel, the entry threshold would underestimate the magnitude of the markup drop following entry.

Now suppose that products are differentiated, $q + Nq_N > 0$. The second term in (8) is then positive, so that the ETR is more likely to underestimate the markup drop. More precisely, define ε^* as the critical elasticity such that $R' = 0$, i.e.

$$\varepsilon^* \equiv 1 + \frac{q + q_N N}{p' N q / p}$$

For $q + q_N N > 0$ and $p' < 0$, we have that $\varepsilon^* < 1$, so that the ETR would also underestimate the markup drop for an elasticity below 1 but sufficiently close to 1. More precisely, we have:

Proposition 4 *Suppose products are differentiated. The ETR underestimates (overestimates) the percentage markup drop* $\mu(N-1)/\mu(N)$ *if and only if* $\varepsilon > \varepsilon^*$ ($\varepsilon < \varepsilon^*$), *where* $\varepsilon^* < 1$.

To summarize, Propositions 3 and 4 imply that the ETR is more likely to underestimate the percentage markup drop from entry if the industry behaves close to a cartel (so that $\varepsilon > 1$) and/or if products are strongly differentiated (substantial market expansion from entry).

To obtain this conclusion we made use of the (per capita) industry revenue function. Provided that revenue data are available, it also suggests a natural way to obtain an unbiased measure of the competition effect from entry. Indeed, using (7) we can write the percentage markup drop as

$$\frac{\mu(N-1)}{\mu(N)} = ETR(N)\frac{R(N)}{R(N-1)}.$$

The markup drop due to entry is thus equal to Bresnahan and Reiss' ETR, multiplied by the percentage industry revenue effects from entry. In the next section, we develop an empirical model that augments the traditional entry model with a revenue function. This leads to the "adjusted ETR" as an unbiased estimate of the competition effects from entry. The approach requires market-level revenue data, in addition to data on the number of entrants and market demographics used in standard entry models.

Remark: absolute margins The above discussion focused on how to obtain an unbiased measure for the magnitude of the competition effect from entry as defined by percentage drop in the Lerner index (or percentage margin), $\mu(N-1)/\mu(N)$. One may also ask this question for the percentage drop in the *absolute* margin, $(p(N-1)-c)\,/\,(p(N)-c)$.[4] One can easily verify that (7) can be rewritten as

$$ETR(N) = \frac{p(N-1)-c}{p(N)-c}\frac{Q(N-1)}{Q(N)}.$$

The bias of the ETR as a competition measure now depends on the reduced form demand function $Q(N)$ instead of the reduced form revenue function $R(N)$. The ETR is an unbiased measure of the percentage drop in absolute margins if and only if $Q' = 0$. Similarly, the ETR underestimates (overestimates) the percentage drop in absolute margins if and only if $Q' > 0$ ($Q' < 0$). We can use $Q(N) = q(p(N), N)N$ to compute

$$Q' = -\varepsilon p' N q/p + (q + q_N N)\,.$$

The counterparts of Proposition 3 and 4 are simple. The ETR is an unbiased estimated of the percentage drop in absolute margins only if products are homogeneous ($q + q_N N = 0$) *and* demand is perfectly inelastic ($\varepsilon = 0$). If either condition is violated, we have $Q' > 0$, so that the ETR will generally underestimate the percentage drop in absolute margins.

This discussion also shows that the appropriate measure of competition depends on data availability. With revenue data (as in most application) it is natural to focus on the percentage drop in the Lerner index $\mu(N)$. With quantity data it is natural to focus on the percentage drop in the absolute margin $p(N) - c$.

[4] We thank Johan Stennek for suggesting us to also look at this measure.

3 Econometric model

We first specify a standard empirical entry model without revenue data in the spirit of Bresnahan and Reiss (1991). We show how to estimate this model and compute ETRs, based on a dataset with the number of firms and market characteristics for a cross-section of local markets. We then show how to extend the standard entry model with a revenue equation, and how to compute adjusted ETRs as an unbiased measure of competition effects from entry.

In both cases the empirical entry model assumes that firm profits are an unobserved, latent variable. But bounds can be inferred based on the assumption that there is free entry, i.e. firms enter if and only if this is profitable.

3.1 Simple entry model

If revenue data are not available, we start from the profit function (2)

$$\pi(N) = v(N)S - f,$$

where $v' < 0$. Both the (per capita) variable profits and the fixed costs component are unobserved. However, bounds can be inferred based on the assumption that there is free entry. Upon observing N firms, we can infer that N firms are profitable, whereas $N+1$ firms are not:

$$v(N+1)S - f < 0 < v(N)S - f,$$

or equivalently

$$\ln \frac{v(N+1)}{f} + \ln S < 0 < \ln \frac{v(N)}{f} + \ln S. \tag{9}$$

Consider the following logarithmic specification for the ratio of variable profits over fixed costs

$$\ln \frac{v(N)}{f} = X\lambda + \theta_N - \omega, \tag{10}$$

where X is a vector of observable market characteristics X, θ_N represents the fixed effect of N firms, and ω is an unobserved error term.[5] Assume that $\theta_{N+1} < \theta_N < \ldots$, i.e. additional firms reduce the variable profits over fixed cost ratio (because of reduced demand and/or reduced markup). We can write the entry conditions as

$$X\lambda + \theta_{N+1} + \ln S < \omega < X\lambda + \theta_N + \ln S.$$

[5] To avoid possible confusion, in the empirical specification we use the subscript N to denote the fixed effect for the N-th firm (as in θ_N). This differs from the previous section where we used the subscript N for the partial derivative with respect to N (as in q_N).

Estimation To estimate the model by maximum likelihood, assume ω is normally distributed $\mathcal{N}(0, \sigma)$. The probability of observing N firms is

$$P(N) = \Phi\left(\frac{X\lambda + \ln S + \theta_N}{\sigma}\right) - \Phi\left(\frac{X\lambda + \ln S + \theta_{N+1}}{\sigma}\right). \quad (11)$$

This is a standard ordered probit model, where the θ_N are the "cut-points" or entry effects. Note that the variance is identified because of the assumption that variable profits increase proportionally with market size S.[6] See Berry and Reiss (2008) for a more general discussion on identification in entry models.

Constructing ETRs Based on the estimated parameters one can compute the entry threshold, i.e. the critical market size to support N firms. Using (9) and (10), evaluated at $\omega = 0$, the entry threshold to support N firms is

$$S(N) = \exp\left(-X\lambda - \theta_N\right). \quad (12)$$

The ETR is the ratio of the per-firm market size to support N versus $N-1$ firms. Using (4), this is

$$ETR(N) = \exp\left(\theta_{N-1} - \theta_N\right)\frac{N-1}{N}. \quad (13)$$

So in our logarithmic specification the ETRs only depend on the differences in the consecutive "cut-points" of the ordered probit model; they do not depend on the market characteristics X.

As shown in the previous section, the ETRs are no good measure of the competitive effects from entry if products are differentiated. Furthermore, even if products are homogenous, ETRs can only be used to test the null hypothesis of no competition effects, but not to measure the magnitude of the competition effects. These considerations motivate augmenting the entry model to include revenue data in the analysis. We turn to this next.

3.2 Simultaneous entry and revenue model

If we observe revenues per firm and per capita $r = r(N)$, we can disentangle the variable profits per capita into a percentage markup and a revenue component, $v(N) = \mu(N)r(N)$. We can then start from the profit function (3):

$$\pi(N) = \mu(N)r(N)S - f,$$

[6] Our specification differs from Bresnahan and Reiss (1991) and more closely resembles Genesove (2000). In contrast with Bresnahan and Reiss, our specification only identifies the ratio of variable profits over fixed costs and not the levels. However, we also identify the variance of the error term.

Upon observing N firms, we can now infer that

$$\mu(N+1)r(N+1)S - f < 0 < \mu(N)r(N)S - f,$$

or equivalently

$$\ln \frac{\mu(N+1)}{f} + \ln r(N+1) + \ln S < 0 < \ln \frac{\mu(N)}{f} + \ln r(N) + \ln S. \tag{14}$$

This again gives rise to the ordered probit model. But since we observe per-firm revenues $r = r(N)$, we can separately specify an equation for revenues and markups (rather than only for variable profits).

We specify revenues per capita to depend on observed market characteristics X, the number of firms N and an unobserved market-specific error term ξ. We consider both a constant elasticity and a fixed effects specification:

$$\ln r = \ln r(N) = X\beta + \alpha \ln N + \xi \tag{15}$$

$$\ln r = \ln r(N) = X\beta + \alpha_N + \xi \tag{16}$$

where X are observed market demographics ξ is an unobserved error term affecting revenues, α is the (constant) elasticity of per-firm revenues r with respect to N, and α_N are fixed entry effects.

To interpret the effect of N on r, one should bear in mind that $r(N) \equiv p(N)q(p(N), N)$. Hence, the elasticity α or the fixed effects α_N capture both the direct effect through increased product differentiation and the indirect effect through a possible price change. More formally, using (8) we can write the elasticity of r with respect to N as:

$$r' \frac{N}{r} = (1 - \varepsilon)\, p' \frac{N}{p} + q_N \frac{N}{q}.$$

The second term $q_N(N/q)$ is the direct effect through increased product differentiation. By assumptions 2 and 3, $q_N(N/q) \in (-1, 0)$: if $q_N(N/q) = -1$, products are homogeneous and there is only business stealing. If $q_N(N/q) = 0$, products are independent and there is only market expansion. The first term is the indirect effect through a possible price change. If the first term is small (because of a modest price effect $p'(N/p)$ and ε relatively close to 1), then we can interpret our estimate of $r'(N/r)$ as the extent of business stealing versus market expansion. For example, in the constant elasticity specification, an estimate of α close to –1 would indicate that entry mainly involves business stealing (homogeneous products), and α close to 0 would indicate that entry mainly involves market expansion (independent products). It will be convenient to follow this interpretation when discussing the empirical results. However, we stress that this interpretation only holds approximately, since α also captures indirect revenue effects through price changes.

Next, we specify the ratio of markups over fixed costs as a function of observed market characteristics X, the number of firms and an unobserved market-specific error term η:

$$\ln \frac{\mu(N)}{f} = X\gamma + \delta_N - \eta. \tag{17}$$

where $\delta_N > \delta_{N+1} > \ldots$, i.e. markups are decreasing in the number of firms.

Substituting the revenue specification (15) or (16) and the markup specification (17) in (14), we can write the entry conditions as

$$X\lambda + \ln S + \theta_{N+1} < \omega < X\lambda + \ln S + \theta_N,$$

where we define

$$\begin{aligned} \lambda &\equiv \beta + \gamma \\ \omega &\equiv \eta - \xi, \\ \theta_N &\equiv \alpha \ln N + \delta_N \quad \text{(constant elasticity revenue specification)} \\ &\equiv \alpha_N + \delta_N \quad \text{(fixed effects revenue specification)} \end{aligned}$$

This gives rise to the following simultaneous model for revenues and the number of firms:

$$\begin{aligned} &\text{for } N = 0: && r \quad \text{unobserved} \\ & && X\lambda + \ln S + \theta_1 < \omega \\ &\text{for } N > 0: && \ln r = X\beta + \alpha_N + \xi \\ & && X\lambda + \ln S + \theta_{N+1} < \omega < X\lambda + \ln S + \theta_N. \end{aligned}$$

Estimation This is a simultaneous ordered probit and demand model. It has a similar structure as in Ferrari, Verboven and Degryse (2010), although they derive it from a rather different setting with coordinated entry. The model has the following endogeneity problem. We want to estimate the causal effect of N on r, but N is likely to be correlated with the demand error ξ. Econometrically, the error terms ξ and $\omega \equiv \eta - \xi$ are correlated because they contain the common component ξ. Intuitively, firms are more likely to enter in markets where they expect demand to be high, leading to spurious correlation between the number of firms and total revenues per capita $N \cdot r$, or a bias towards too much market expansion and too little business stealing. Since we will use the estimated market expansion effects to obtain a proper estimate of the competition effects, it is crucial that we do not overestimate market expansion. Fortunately, population size S serves as a natural exclusion restriction to identify the causal effect of N on r. It does not directly affect per capita revenues, yet it is correlated with N, since firms are more likely to enter and cover their fixed costs in large markets. In different contexts, Berry and Waldfogel (1999) and Ferrari, Verboven and Degryse (2010) have used similar identification strategies.

To estimate the model by maximum likelihood, suppose that ξ and η are normally distributed, so that $\omega \equiv \eta - \xi$ is also normally distributed. We then obtain the following likelihood contributions. For markets with $N = 0$ we have

$$P(0) = 1 - \Phi\left(\frac{X\lambda + \ln S + \theta_1}{\sigma_\omega}\right),$$

and for markets with $N > 0$ we have

$$f(\ln r)P(N|\ln r) = \frac{1}{\sigma_\xi}\phi\left(\frac{\xi}{\sigma_\xi}\right) \times \left(\Phi\left(\frac{X\lambda + \ln S + \theta_N - \left(\sigma_{\omega\xi}/\sigma_\xi^2\right)\xi}{\sqrt{\sigma_\omega^2 - \sigma_{\omega\xi}^2/\sigma_\xi^2}}\right) - \Phi\left(\frac{X\lambda + \ln S + \theta_{N+1} - \left(\sigma_{\omega\xi}/\sigma_\xi^2\right)\xi}{\sqrt{\sigma_\omega^2 - \sigma_{\omega\xi}^2/\sigma_\xi^2}}\right)\right), \quad (18)$$

where $\xi = \ln r - X\beta - \alpha_N$.

Constructing ETRs and percentage markup drops When the entry model is augmented with revenue data, we can still compute the ETR as before. It is given by

$$ETR(N) = \exp\left(\theta_{N-1} - \theta_N\right)\frac{N-1}{N}.$$

Furthermore, it is now also possible to directly compute the percentage markup drop following entry. Using (17), we can write this percentage markup drop as

$$\frac{\mu(N-1)}{\mu(N)} = \exp\left(\delta_{N-1} - \delta_N\right).$$

To express this in terms of the estimated parameters for the fixed effects revenue specification, we can substitute the definition $\theta_N \equiv \alpha_N + \delta_N$ to obtain:

$$\begin{aligned}\frac{\mu(N-1)}{\mu(N)} &= \exp\left(\theta_{N-1} - \theta_N\right)\exp\left(-\left(\alpha_{N-1} - \alpha_N\right)\right) \\ &= ETR(N)\frac{N}{N-1}\exp\left(-\left(\alpha_{N-1} - \alpha_N\right)\right), \quad (19)\end{aligned}$$

where the second equality follows from the definition of the ETR. Similarly, for the constant elasticity revenue equation, we can substitute the definition $\theta_N \equiv \alpha \ln N + \delta_N$ to obtain

$$\begin{aligned} \frac{\mu(N-1)}{\mu(N)} &= \exp\left(\theta_{N-1} - \theta_N\right) \left(\frac{N-1}{N}\right)^{-\alpha} \\ &= ETR(N) \left(\frac{N}{N-1}\right)^{1+\alpha}. \end{aligned} \tag{20}$$

Consistent with the discussion in Section 2, this shows for both specifications how the ETRs should be adjusted by the estimated revenue parameters to obtain an unbiased estimate for the markup drop after entry. The simple ETRs can only be used as an unbiased measure in the special case where

$$\exp\left(-\left(\alpha_{N-1} - \alpha_N\right)\right) = \frac{N-1}{N},$$

in the flexible specification, and $\alpha = -1$ in the restricted specification. Intuitively, in both cases this requires that entry only leads to business stealing and not to any market expansion.

4 Empirical analysis

We organize the discussion of the empirical analysis as follows. We first present the dataset for the various local service sectors. Next, we discuss the results from estimating the entry model and the revenue model separately. This leads to the construction of traditional Bresnahan and Reiss entry threshold ratios. They do not yet take into account the existence of market expansion from entry, and can be used as a benchmark for our subsequent results. Finally, we present the results for the simultaneous model of entry and demand, leading to estimates of competition effects or "adjusted entry threshold ratios" that take into account market expansion effects.

4.1 Dataset

We analyze seven different local service sectors: architects, bakeries, butchers, florists, plumbers, real estate agents and restaurants. For each sector, we have constructed a cross-sectional data set of more than 800 local markets (towns) in Belgium in 2007. The main variables are firm revenues per capita r, the number of firms N, population size S and other market demographics X.[7]

[7] Firm revenues and the number of firms come from V.A.T. and Business register data from the sectoral database, set up by the Federal Public Service Economy (Sector and Market Monitoring Department). Population size and other market demographics are census data from the FPS Economy (Statistics Belgium).

Selection of sectors Based on our research proposal, the Belgian Federal Ministry of Economic Affairs made available a list of local service sectors at the 4-digit or 5-digit NACE code for empirical analysis. From this list we first eliminated sectors where the relevant market is clearly not local, such as TV-production houses. Furthermore, to avoid possible complications stemming from multi-market competition, we restricted attention to sectors where the average number of establishments per firm is less than 3. Sectors with many chains, such as travel agencies and clothes stores, were therefore also eliminated from the analysis. This resulted in a list of seven local service sectors: architects, bakeries, butchers, florists, plumbers, real estate agents and restaurants. For all these sectors the median number of establishments per company is 1, the 75-percentile is no larger than 2 and the 90-percentile is no larger than 5.

Geographic market definition For each sector, we define the geographic market at the level of the ZIP-code. This roughly corresponds to the definition of a town in Belgium, and it is more narrow than the administrative municipality, which on average consists of about 5 towns. The market definition appears reasonable for the considered sectors, as they relate to frequently purchased goods or to services where local information is important. The extent of the geographic market may of course vary somewhat across sectors. Nevertheless, for simplicity and consistency we decided to use the same market definition for all sectors. To avoid problems with overlapping markets, we only retain the non-urban areas, i.e. towns with a population density below 800 inhabitants per km^2 and a market size lower than 15,000 inhabitants.

Construction of the variables and summary statistics The number of firms N is the number of companies in the market, as constructed from the business registry database. Revenues per firm and per capita r are computed at the company level from the V.A.T. sectoral database. Ideally, we would want to use data at the establishment level but this information is incomplete. As discussed above, we therefore focus on sectors with a low number of establishments per firm (no chains). Furthermore, we restrict attention to companies with at most two establishments in the country.[8]

The data on the number of firms N and revenues r are specific to each of the seven different sectors. In addition to these endogenous variables, we also observe the common variables population size S and a vector of other market demographics X. This vector consists of the market surface, personal income/capita, the demographic composition of the population (%

[8] The results of our analysis are robust when we use alternative selection criteria, e.g. retain companies with at most five establishments.

women, % foreigners, % unemployed and % in various age categories), and a regional dummy variable for Flanders. The vector X enters both the revenue and entry equation. In contrast, population size S only enters the entry equation and therefore serves as an exclusion restriction for the revenue equation to identify the causal effect of N on r.

Table 1 gives a complete list of the variables and their definitions, and presents basic summary statistics for the common variables S and X, as observed for the cross-section of 835 non-urban markets. Table 2 provides more detailed summary statistics for the sector-specific variables, revenues per firm and per capita r and the number of firms N. The top panel shows the number of markets with 0, 1, 2, 3, 4, 5 or more firms. Most sectors have broad market coverage with a common presence of at least one firm per market. This is most notable for restaurants, since there are only 93 markets without a restaurant. The middle and bottom panels of Table 2 show the means and standard deviations for the number of firms N and revenues r across markets.

4.2 Preliminary evidence

We now discuss the results from estimating the entry model and the revenue model separately. This leads to traditional Bresnahan and Reiss entry threshold ratios. It also provides a first indication on the extent of market expansion (as opposed to business stealing) following entry, yet without accounting for endogeneity of N for now.

Entry model Table 3 shows the empirical results per sector from estimating the ordered probit entry model. Consistent with other work, population size $\ln S$ is the most important determinant of firm entry, with a positive and highly significant parameter for all sectors.[9] Several variables of the age structure also tend to have a positive and significant effect across sectors, in particular the %young and %old, relative to the reference group of young adults with age between 25–40 years. The effect of several other variables differs across sectors, both in sign and magnitudes. For example, markets with a high income per capita tend to have more architects, florists and real estate agents, but fewer bakeries. Generally speaking, it is not straightforward to interpret these parameters, as the variables may capture several effects (variable profits, fixed costs) and may be collinear with other variables (e.g. income and unemployment). While the control variables are not of direct interest, it is still important to control for them to allow for different sources of variation across markets.

The ordered probit model also includes the entry effects or "cut-points" θ_N. We transform

[9] Based on (11), the parameter of $\ln S$ can be interpreted as $1/\sigma$, and the parameters of the other demographics as λ/σ.

these parameters to construct the entry thresholds (for a representative market with average characteristics) and the per firm entry threshold ratios (which are independent of the other characteristics). This is based on the expressions (12) and (13) derived earlier.

Table 4 shows the computed entry thresholds and entry threshold ratios. To illustrate, first consider butchers (third column). The entry threshold, i.e. the minimum population size to support one butcher in a town, is 1,166. It increases to 2,736 to support a second butcher and to 4,905 to support a third butcher. The pattern is slightly disproportional, i.e. the minimum population size to support a given number of firms increases disproportionately with the number of firms. This is reflected in the ETRs. For example, $ETR(2) = 1.17$, which means that the minimum population size per firm should increase by an extra 17% to support a second firm. Under the homogeneous goods assumption of the Bresnahan and Reiss model, this can be interpreted as an indication that entry intensifies competition between butchers.

Now consider all sectors. Table 4 shows that the ETRs for the third, fourth or fifth entrant are significantly greater than 1 in about half of the cases, and insignificantly different from 1 in the remaining half. In the traditional Bresnahan and Reiss' framework, this would indicate mixed evidence on the competitive effects of entry from the third entrant onwards. Table 4 also shows that the ETR for the second entrant is only significantly greater than 1 for one sector, butchers; it does not differ significantly from 1 for four sectors; and it is even significantly less than 1 for the remaining two sectors, architects and real estate agents. The latter finding contradicts the competition interpretation of ETRs, as it would suggest that competition becomes weaker when a second firm enters the market. As we will show below, an alternative interpretation is the presence of significant market expansion when a second firm enters the market.

Revenue model Table 5 shows the empirical results per sector from simple OLS regressions of the restricted revenue specification (15), i.e. regressions of $\ln r$ on $\ln N$ and X. Since the model is estimated with OLS, we do not yet account for the endogeneity of N so we should be cautious at this point in drawing causal inferences on market expansion versus business stealing from entry. First, consider the control variables X. In contrast with the entry equation, the parameters are significant for most variables and usually have the same sign across the various sectors. Per capita revenues tend to be larger in markets with a low surface area, a low personal income, a low fraction of unemployed, and a high fraction of kids/young or old (relative to the base young adult group).

Now consider the parameter on $\ln N$. The parameter is negative and significant for five out of seven sectors, and insignificantly different from zero for the remaining two sectors (florists and real estate agents). For the five sectors where the parameter is negative, it is relatively small, varying between –0.15 and –0.39. Overall, this preliminary evidence would suggest that additional entry implies some business stealing but more important market expansion. This would in turn indicate that the ETRs are not a good measure of competition, as this is only the case when entry only leads to business stealing (coefficient for $\ln N$ of –1). However, as already mentioned, we have not yet accounted for the endogeneity of N. Firms tend to locate in markets where they expect demand to be high, leading to a spurious correlation between the number of firms and total market demand and an overestimate of the extent of market expansion. Our full model accounts for this, by estimating the revenue model simultaneously with the entry model, using market size as an exclusion restriction to identify the market expansion effect.

4.3 Results from the full model

We now discuss the main empirical results, from estimating the entry and revenue model simultaneously. We first look at the case of butchers in detail, to give a comparison of the different specifications and methods. We then give a broader overview of all sectors, focusing on the estimated competition effects or adjusted ETRs, which take into account the market expansion effects from entry.

Comparison of different specifications and methods: butchers As discussed in section 3, we consider two specifications for the revenue equation. In the constant elasticity specification (15), the number of entrants appears logarithmically, so $\alpha_N = \alpha \ln(N)$. In the fixed effects specification (16), we estimate the effect of entry α_N on revenues for each market configuration. For both specifications, we compare the results from simultaneous estimation of the demand and entry model with those from estimating the models separately. We focus the comparison on the revenue equation, since the results for the entry equation are very similar across specifications and methods (and given in Table 3 for the single equation estimation).

Table 6 shows the results. The estimated effects of the control variables X are very similar across different specifications, so we do not discuss them further. Our main interest is in the effects of entry on revenues. First consider the constant elasticity specification. When the revenue equation is estimated separately using OLS, we estimate $\alpha = -0.24$ (as already reported in Table 5). In sharp contrast, when the revenue equation is estimated simultaneously with the entry equation, we estimate $\alpha = -0.72$. Hence, accounting for the endogeneity of N implies a considerably higher estimate of business stealing. The market expansion elasticity, $1 + \alpha$, correspondingly drops from 0.76 to 0.28. Intuitively, OLS gives a spurious finding of market expansion, since it does not take into account that entrants tend to locate in markets where the unobserved demand error is high.[10] Nevertheless, the simultaneous model still implies there is some market expansion: an increase in N by 10% tends to raise market revenues by 2.8%. The bottom part of Table 6 shows how α translates into percentage revenue effects $R(N)/R(N+1)$. We see a declining pattern, where the effect on total revenue per capita is 21% for the second entrant, 12% for the third entrant, 8% for the fourth entrant and 6% for the fifth entrant. This smooth pattern is evidently driven by the restricted functional form of the logarithmic specification.

Now consider the unrestricted fixed effects specification. We do not report the different α_N, but immediately discuss the implied percentage revenue effects $R(N)/R(N+1)$. As before, we find large market expansion effects from single equation estimation (e.g. 85% market expansion for the second entrant) and much lower effects when we account for the endogeneity of N (26% for the second entrant). Furthermore, the flexible specification no longer gives a smooth pattern for the entry effects. Only the second butcher leads to significant market expansion. For additional entrants, the extent of market expansion becomes insignificant.

In sum, this discussion shows that both the specification and the method are important to correctly estimate the extent of market expansion. First, it is necessary to account for the endogeneity of entry since otherwise the extent of market expansion will be overestimated. Second, it may be important to consider the possibility of a flexible specification for the entry effects, though this comes at the cost of reduced precision. These conclusions do not just hold for butchers but also for the other sectors we have studied. They will therefore be highly relevant when estimating the competition effects based on the adjusted ETRs.

Competition effects from entry: all sectors Table 7 shows the competition effects from additional entry, as estimated from the simultaneous entry and revenue model. As is clear from (19) and (20), the competition effects can be interpreted as adjusted ETRs: they adjust the traditional ETRs for the extent of market expansion induced by entry. Only if market expansion is small, the competition effects will be close to the traditional ETR's.

The top panel of Table 7 shows the results for the constant elasticity revenue specification. The first row shows the estimated business stealing effects α from the revenue equation. For six out of seven sectors, the estimates are much closer to -1 than in the earlier OLS estimates

[10] More formally, the simultaneous model differs from the single equation model because it accounts for the correlation between the demand and profit error. Table 5 shows that $\sigma_{\omega\xi} = -0.43$, which is negative as expected because the structural error in the entry equation contains the structural error in the demand equation.

of Table 5. This means that the necessary adjustments of the ETRs are much smaller as earlier suggested. Nevertheless, the market expansion elasticity $1+\alpha$ is still important, varying from 0.08 for bakeries to 0.72 for florists.[11]

Based on (20), we can use the α's and the ETRs (very similar to those in Table 4) to compute the markup effects or "adjusted ETRs". For most sectors and market configurations we find significant competition effects from entry. The adjusted ETRs are typically significantly greater than 1, also for entry by the second firm, and they are never significantly below 1. For example, entry by a second restaurant reduces markups by 17% ($\mu(1)/\mu(2) = 1.17$). This contrasts with our earlier estimated simple ETRs, which were often significantly less than 1 for the second entrant (e.g. $ETR(2) = 0.87$ for restaurants). The reason is, of course, that we now adjust for the extent of market expansion. Bakeries are the only sector without significant competition effects from entry in the constant elasticity specification. We already found the traditional ETRs to be close to 1 in this sector. Moreover, it turns out that entry by bakeries largely entails business stealing ($\alpha = -0.92$), so that the adjusted ETRs remain close to and not significantly different from 1.

The bottom panel of Table 7 shows whether these conclusions are confirmed using the more flexible fixed effects revenue specification. The estimated competition effects of the second entrant are broadly similar. In five out of seven sectors, the second entrant has a significant effect on competition. The two exceptions are bakeries (as before) and real estate agents where $\mu(1)/\mu(2)$ does not differ significantly from 1. However, the conclusions regarding competition from the third, fourth or fifth entrant are different from the restricted specification. With the exception of restaurants, we no longer estimate significant competition effects from the third entrant onwards. Note, however, that the standard errors of the estimated $\mu(N-1)/\mu(N)$ have become larger (because of the increased flexibility), so that the competition tests have less power.

Combining the results from the restricted constant elasticity specification (with more precise estimates) and the more flexible fixed effects specification (with larger standard errors), we conclude that in most sectors the second entrant appears to reduce markups by at least 30%, whereas further entrants may not necessarily promote competition further. Bakeries and real estate agents are exceptions to this conclusion. For real estate agents, the fixed effects specification does not estimate significant competition effects from the second entrant, though the standard errors are rather large here.[12] For bakeries, the lack of

[11] Only for real estate agents α is not significant. This suggests considerable market expansion, perhaps capturing that market definition is broader than the town level for this sector.

[12] A lack of competition effects from entry in the real estate sector is consistent with the common practice of more or less uniform percentage commissions. This has also been documented elsewhere, for example

competition effects appears more strongly: both the constant elasticity and the fixed effects specification indicate that the second entrant does not promote competition. Incidentally, this is consistent with a recent decision by the Belgian Council of Competition. In January 2008, the Council convicted the Association of Bakeries for continuing its price fixing policies after prices for bread had been liberalized in 2006.

5 Conclusions

We have proposed a methodology for estimating the competition effects from entry in differentiated products markets, and illustrated how to implement it using datasets for seven different local service sectors. We started from Bresnahan and Reiss' ETRs, and provided conditions under which they can be used as a test for the presence and a measure for the magnitude of competition effects from entry. We subsequently showed how to augment the traditional entry model with a revenue equation. This revenue equation serves to adjust the traditional ETRs by the extent of market expansion due to entry, leading to an unbiased estimate of the competition effects from entry.

Our empirical results show that traditional ETRs are close to one, suggesting limited competition effects, and in some cases even significantly below 1, suggesting entry would reduce competition. Furthermore, we find that entry leads to significant market expansion, which implies that the traditional ETRs underestimate the effects of entry on competition. Accounting for the estimated market expansion, we no longer find adjusted ETRs that are significantly below 1. In most sectors, the second entrant reduces markups by at least 30%, whereas the third or higher entrants have smaller or insignificant effects. In at least one sector, bakeries, we have found that even the second entrant does not create competition, which is consistent with a recent decision by the competition authority.

Our empirical analysis stressed the importance of several specific issues that should be taken into account. First, it is important to account for the endogeneity of the number of entrants in estimating market expansion effects from entry. Failure to do so would result in an overestimate of market expansion effects, and hence an overestimate of the competition effects (adjusted ETRs), as opposed to an underestimate from the traditional ETRs. In our setting, population size arises as a natural instrument, and we found the bias from ignoring the endogeneity issue can be substantial.

Second, it is potentially important to consider a flexible revenue specification to estimate the market expansion effects. Our restricted constant elasticity specification (with $\ln N$) imposes market expansion effects to be declining in N, whereas our more flexible fixed effects

Hsieh and Moretti (2003), who draw implications for the efficiency of entry.

specification allows the effects to vary per consecutive entrant. The flexible specification suggested that the main market expansion effects (and hence required adjustment to the ETRs) come from the second entrant, and less so from the additional entrants. However, this specification also entails less precise parameter estimates. Future research would be desirable to shed further light on this. For example, one may collect more data, or use alternative specifications with more structure from a specific model of product differentiation.

Due to the relative simplicity of our methodology, it was possible to consider quite a number of different local service sectors. Nevertheless, more work on different sectors and different countries would be useful to further evaluate the benefits and limitations of our approach. We hope the increased availability of revenue data at the detailed company level will stimulate such research.

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Table 1: Definition of variables

Name	Definition	Mean	St. Dev.
N	Number of firms with at least one establishment	See Table 2	
r	Revenues per firm and per capita (in €)	See Table 2	
S	Population size or number of inhabitants (in 1,000)	4.53	3.89
Surface	logarithm of surface area (in km^2)	2.71	2.76
GDP	GDP per capita (in 1,000 Euro)	11.15	2.03
%women	Percentage of women	.506	.013
%foreigners	Percentage of foreigners	.043	.057
%unemployed	Percentage unemployed	.057	.028
%kid	Percentage under age of 10 years	.121	.018
%young	Percentage between age of 10 and 25 years	.187	.019
%adult	Percentage between age of 40 and 65 years	.323	.027
%old	Percentage over age of 65	.163	.028
Flanders	Dummy variable equal to 1 for market in Flanders	.398	.490

Notes: The number of observations (markets) is 835. The number of firms N and revenues per firm r are constructed from V.A.T. and Business register data from the sectoral database, set up by the Federal Public Service Economy (Sector and market Monitoring Department). The demographics are census data from the FPS Economy (Statistics Belgium), except for %unemployed which comes from Ecodata.

Table 2: Summary statistics for number of firms and firm revenues

Sector	Archit.	Baker.	Butch.	Florists	Plumb.	Real Est.	Restaur.
NACE code	7111	1071	4722	47761	4322	6831	5610
	Number of markets with						
$N = 0$	144	242	236	260	139	278	93
$N = 1$	83	148	169	147	112	106	74
$N = 2$	76	126	122	130	94	95	65
$N = 3$	79	94	97	85	68	57	57
$N = 4$	68	63	71	62	68	56	37
$N = 5$	39	41	39	44	43	26	37
$N > 5$	337	111	93	94	303	168	472
	Number of firms (sample of all markets)						
mean	6.2	2.5	2.4	2.3	5.1	3.4	11.1
st.dev	7.0	2.8	2.7	2.6	5.1	5.6	12.3
	Revenues per firm (sample of markets with $N > 0$)						
mean	27.79	65.56	82.09	51.96	108.26	31.68	64.18
st.dev	51.98	76.70	117.8	106.14	231.3	63.32	132.5

Notes: The number of observations (markets) is 835.

Table 3: Ordered probit entry model

	Archit.	Baker.	Butch.	Florists	Plumb.	Real Est.	Restaur.
	Ordered probit entry model (sample of all markets)						
$\ln S$	1.40*	1.62*	1.21	1.29*	1.34*	1.35*	1.48*
Surface	0.12	-0.04	0.10	0.06	0.15	-0.09	0.24*
GDP	2.63*	-0.73*	-0.48	0.81*	0.59	2.11*	-0.28
%women	9.27*	-8.58*	-0.16	-2.16	-3.57	-0.40	3.63
%foreigners	-0.91	-2.08*	-2.53	0.18	-1.59	0.40	-0.04
%unemployed	-4.18*	-2.85	-2.45	-2.36	-2.85	-6.34*	4.95*
%kid	7.41*	0.02	-6.69	-7.07	2.44	12.99*	1.29
%young	11.49*	6.99*	7.99	0.01	1.55	13.20*	9.05*
%adult	2.69	-3.13	-3.75	-7.93*	-0.27	7.55*	9.50*
%old	4.79*	10.57*	7.70	-1.87	-0.10	13.06*	7.08*
Flanders	-0.49*	0.01	0.28	0.04	-0.05	-0.28	0.59*
θ_N	yes	yes	yes	yes	yes	yes	yes
R^2	0.25	0.29	0.26	.27	0.24	0.25	0.25

Notes: The parameter estimates are based on maximum likelihood estimation of the ordered probit model (11), where the parameters are all multiplied by the standard deviation σ. Hence, the parameter of $\ln S$ can be interpreted as $1/\sigma$, and the parameters of the other demographics as λ/σ. A "*" indicates that the parameter differs significantly from 0 at the 5% level.

Table 4: Entry thresholds and entry threshold ratios

	Archit.	Baker.	Butch.	Florists	Plumb.	Real Est.	Restaur.
	Entry thresholds						
$ET(1)$	692	1387	1166	1405	650	1699	445
$ET(2)$	1137	2610	2736	2873	1251	2818	773
$ET(3)$	1706	4326	4905	5198	2041	4458	1132
$ET(4)$	2527	6446	8027	7864	2845	5896	1572
$ET(5)$	3542	8656	12360	11171	3979	7852	1924
	Entry threshold ratios						
$ETR(2)$	0.82*	0.94	1.17*	1.02	0.96	0.83*	0.87
$ETR(3)$	1.00	1.11*	1.20*	1.21*	1.09	1.06	0.98
$ETR(4)$	1.11*	1.12*	1.23*	1.14*	1.05	0.99	1.04
$ETR(5)$	1.12*	1.07	1.23*	1.14*	1.12*	1.07	0.98

Notes: The entry thresholds (ET) are based on the cut-points θ_N and the other parameter estimates of Table 3, using expression (12) evaluated at the sample means of the variables. The entry threshold ratios (ETR) are based on the cut-points θ_N, using expression (13). All ETs are significant with standard errors varying around 150. For the ETRs, a "*" indicates that the ETR differs significantly from 1.

Table 5: Preliminary regressions for the revenue equation

	Archit.	Baker.	Butch.	Florists	Plumb.	Real Est.	Restaur.
	OLS revenue model (sample of markets with $N > 0$)						
Constant	3.82	11.89*	18.05*	19.57*	16.34*	5.20	11.20*
ln N	-0.15*	-0.39*	-0.24*	-0.02	-0.15*	0.10	-0.25*
Surface	-0.57*	-0.36	-0.53*	-0.43*	-0.50*	-0.52*	-0.45*
GDP	-0.24	-0.69*	-0.86*	-0.75	-1.23*	0.05	-0.81*
%women	-3.10	-9.97*	-15.23*	-15.6*	-11.09*	-11.16	-10.28*
%foreigners	-1.81*	-0.76	-1.50*	-1.89	-1.09	-1.20	-1.48*
%unemployed	-8.74*	-5.95*	-9.66*	-7.70*	-5.61*	-4.19	-5.09*
%kid	13.71*	6.48	7.10	5.53	11.48*	17.80*	10.24*
%young	7.78*	11.63*	6.34*	2.78	13.62*	1.33	11.61*
%adult	1.68	2.95	1.23	-4.03	3.91	2.75	6.81*
%old	10.72*	8.95*	11.42*	3.02	9.76*	6.90	10.45*
Flanders	-0.51*	-0.28*	-0.53*	-0.16	-0.12	-0.19	-0.24*
R^2	.33	.33	.37	.13	.27	.09	.40

Notes: The parameter estimates are based on OLS estimation of the restricted revenue specification (15). A "*" indicates that the parameter differs significantly from 0 at the 5% level.

Table 6: Detailed estimation results for the revenue equation: illustration with butchers

	Constant elasticity model				Fixed effects model			
	Single equation		Simultaneous		Single equation		Simultaneous	
Constant	18.05*	(2.94)	9.76	(3.40)	–		–	
$\ln N$ (α)	-0.24*	(0.06)	-0.72*	(0.09)	(fixed effects)		(fixed effects)	
Surface	-0.53*	(0.05)	-0.18	(0.07)	-0.54*	(0.05)	-0.02	(0.08)
GDP	-0.86*	(0.28)	-0.30	(0.36)	-0.89*	(0.28)	-0.12	(0.40)
%women	-15.23*	(3.83)	-6.78	(3.83)	-15.35*	(3.85)	-3.15	(4.24)
%foreigners	-1.50*	(0.71)	-1.17	(0.88)	-1.56*	(0.72)	-1.15	(0.97)
%unemployed	-9.66*	(1.87)	-7.81*	(2.19)	-9.63*	(1.88)	-7.12*	(2.42)
%kid	7.10	(3.68)	-0.16	(4.11)	7.41*	(3.70)	-3.09	(4.49)
%young	6.34*	(2.67)	5.47	(2.83)	6.51*	(2.69)	5.01	(3.12)
%adult	1.23	(2.47)	-1.72	(3.14)	1.30	(2.48)	-2.99	(3.40)
%old	11.42*	(2.22)	9.53*	(2.41)	11.38*	(2.23)	8.48*	(2.61)
Flanders	-0.53*	(0.11)	-0.14	(0.14)	-0.53*	(0.12)	0.06	(0.16)
$\sigma_{\omega\xi}$	0	(–)	-0.43*	(0.06)	0	(–)	-0.60	(0.08)
$R(2)/R(1)$	1.78*	(0.10)	1.21*	(0.07)	1.85*	(0.20)	1.26*	(0.13)
$R(3)/R(2)$	1.40*	(0.05)	1.12*	(0.04)	1.38*	(0.18)	1.05	(0.13)
$R(4)/R(3)$	1.27*	(0.03)	1.08*	(0.03)	1.29	(0.19)	1.00	(0.14)
$R(5)/R(4)$	1.20*	(0.02)	1.06*	(0.02)	1.04	(0.24)	0.82	(0.17)

Notes: Both the single equation and the simultaneous equation models are estimated by maximum likelihood of the full model (18). The single equation models are the special case in which we set $\sigma^2_{\omega\xi} = 0$, reducing to the earlier ordered probit entry equation and OLS revenue equation. In the restricted constant elasticity model, N enters the revenue equation through $\ln N$, in the flexible fixed effects model it enters through a set of fixed effects α_N. Parameter estimates and standard errors (in parentheses) are only shown for the revenue equation. For the entry equation, they are very similar to the single equation ordered probit results of Table 3. A "*" indicates that the parameter differs significantly from 0 at the 5% level.

Table 7: Markup effects or adjusted entry threshold ratios

	Archit.	Bakeries	Butchers	Florists	Plumbers	Real Est.	Restaur.
	constant elasticity model						
α	-0.48*	-0.92*	-0.72*	-0.28*	-0.53*	0.07	-0.53*
	(0.05)	(0.09)	(0.09)	(0.11)	(0.08)	(0.09)	(0.05)
$\mu(1)/\mu(2)$	1.20*	1.02	1.42*	1.57*	1.35*	1.70*	1.17*
	(0.07)	(0.06)	(0.11)	(0.16)	(0.10)	(0.14)	(0.07)
$\mu(2)/\mu(3)$	1.24*	1.17*	1.33*	1.58*	1.32*	1.58*	1.22*
	(0.06)	(0.05)	(0.07)	(0.10)	(0.07)	(0.09)	(0.06)
$\mu(3)/\mu(4)$	1.26*	1.14*	1.28*	1.37*	1.19*	1.33*	1.21*
	(0.05)	(0.04)	(0.06)	(0.07)	(0.05)	(0.06)	(0.05)
$\mu(4)/\mu(5)$	1.22*	1.07	1.24*	1.31*	1.23*	1.34*	1.08*
	(0.04)	(0.04)	(0.06)	(0.06)	(0.05)	(0.06)	(0.04)
	fixed effects model						
$\mu(1)/\mu(2)$	2.01*	1.19	1.53*	1.73*	1.82*	1.31	1.35*
	(0.19)	(0.11)	(0.16)	(0.26)	(0.25)	(0.25)	(0.13)
$\mu(2)/\mu(3)$	0.99	1.21	1.25	1.40	1.25	0.98	1.40*
	(0.11)	(0.11)	(0.15)	(0.22)	(0.18)	(0.22)	(0.16)
$\mu(3)/\mu(4)$	1.14	1.13	1.21	1.24	1.08	1.55	1.15
	(0.14)	(0.12)	(0.17)	(0.23)	(0.17)	(0.38)	(0.19)
$\mu(4)/\mu(5)$	1.09	0.98	1.01	1.02	1.63*	1.75	0.92
	(0.17)	(0.13)	(0.21)	(0.22)	(0.29)	(0.55)	(0.17)

Notes: The markup effects $\mu(N-1)/\mu(N)$ are computed from (20) for the restricted constant elasticity revenue equation, and from (19) for the more flexible fixed effects revenue specification. For the constant elasticity specification, Table 7 also shows the business stealing effect α, used to adjust the ETR. A "*" indicates that the markup effect differs significantly from 1.

Persistence of Profits in Belgium

Preliminary Version, Please Do Not Distribute

Cherry Cheung

HUBrussels

Stijn Vanormelingen

IESE Business School

HUBrussels

2011

Abstract

Determining the intensity of competition is a key interest in the field of industrial organization. Static measures such as price-cost margins or concentration ratios may inadequately reflect the intensity of competition in a number of cases. A solution is to look at the competitive dynamics and examine the degree of profits persistency. The general idea is that in an efficient market economy, supra-normal profits should quickly disappear as they attract new entrants or imitators. The increase in competitors erodes profits earned by the initially successful incumbent. However, when firms operate in a less competitive environment, profits may be persistent and do not fall back to their competitive level. In order to analyze the persistence of profits in Belgium, we use data on around 200,000 firms between 1999 and 2008, retrieved from their income statements. We apply time series analysis to the data and the results are used to rank the different sectors according to their measured persistency of profits. Several robustness checks are performed and the profits persistency is related to several factors that have an influence on competition intensity.

1 Introduction

Determining the strength of competition in a market is of direct interest to both academics as well as policy makers. They are often interested in evaluating the impact of various policy decisions or variations in the economic environment on competition. Several papers relate a change in the economic environment with a change in competition across different sectors/industries using production data. For example, in the international trade literature, many studies have been devoted to testing of the imports as market-disciplining device (Levinsohn 1993, Harrison 1994). Other studies look at the relation between competition and innovation (Aghion et al., 2005), the link between competition and productivity (Nickel 1996, Syverson 2004), etc. Often, the price cost margin at the industry (market) level is used to measure competition, either directly computed from accounting data or estimated using the Hall (1988) methodology or a variant thereof. Another strand of literature investigates one particular industry in detail and structurally estimate demand and supply in order to infer price cost margins and these price cost margins can be related to the policy change of interest. Notable examples include Porter (1983) and Genesove and Mullin (1998) for homogenous goods markets and Berry et al. (1995) and Nevo (2001) for markets of differentiated products. Other popular measures used in the literature to measure competition are concentration ratio's such as the Herfindahl-Hirschmann Index or Ck ratio's.

All these competition indicators generally focus on a snapshot of a sector taking the implicit assumption that the indicator reaches its long-run equilibrium value in every period. However, there is no guarantee for this to be the case. First, a high price-cost margin at some specific moment in time could just represent a temporary phenomena reflecting a disequilibrium state of the market. Second, these measures do not pick up underlying dynamics in the market. For example, in Schumpeter's creative destruction model, successful firms are able to realize substantial profits in a single period, but they lose their dominant position once a competitor takes over the market with a new innovation. Computing concentration ratio's or price-cost margins for these sectors will erroneously point to a lack of competition in these markets as they ignore the dynamics in the market. To correct for this problem, Mueller (1977, 1986) introduced the so-called persistence of profits concept which explicitly examines the dynamics of market processes applying time-series analysis and uses the results to draw inferences about the nature of competition in the market. The general idea is that firms with an abnormal level of profits in one period are not expected to maintain their high level of profitability in subsequent periods if they are operating in a competitive environment. This will lead to a low measured persistency of profits, for example due to the profits are competed away by imitation or entry of firms attracted by high profits. On the other hand, firms operating in a less competitive environment are more likely to maintain their high profits and profits are expected to be more persistent. This idea has been used in a number of papers and they showed deviations of profit rates from the norm to be substantially persistent. Mueller (1977, 1986) examines 472 firm with 24 years of return on assets data and finds there is persistence of supernormal profits for some firms. The idea has subsequently been used by the Geroski and Jacquemin (1988) for European firms among others. McGahan and Porter (1998) investigate the differential persistence industry, corporate and business segment shocks to profitability and find that industry shocks persist longer. More recently, Glen et al. (2001, 2003) have applied the framework to developing countries and concluded that the intensity of competition is higher compared to advanced countries. Yurtoglu (2004) analyzes the persistence of firm-level profitability on 172 largest manufacturing firms in Turkey from 1985 to 1998 and concludes that firms with the highest initial profit rate and long-run projected profit rate have the highest degree of persistence, which is consistent with the prediction that firms with the higher profit rate should have greater incentive to block entry.

In this study paper, we estimate for the first time the persistence of profits for Belgian firms active in all sectors of the economy. To this end we make use of a unique large panel dataset. Most other studies relied on large publicly listed companies to estimate the persistence of profits[1]. The richness of our dataset allows us to investigate different dimensions of the persistence of profits. First, we are able to make a distinction between large and small firms. Second, we can exploit variation in the persistence of profits across sectors, not only to rank them in terms of competition intensity, but also to explain the heterogeneity in terms of profit persistency using sector characteristics.

Our main results can be summarized as follows. First, we find profits to be persistent although persistency is lower compared to previous studies in other countries. Second, we find that small firms have a substantially lower persistence of profits compared to large firms. This finding can partly explain the difference in profit persistency compared to other studies. Third, the highest persistency is found in sectors such as Mining and Quarrying, Manufacture of Gas, Steam and Air Conditioning Supply which are known to have high entry barriers. Third, profit persistency is negatively correlated with entry and exit rates of firms while it is positively correlated with concentration although this is mainly due to differences between services and manufacturing sectors. The rest of the paper is organized as follows. Section 2 introduces the empirical model applied to measure profits persistency. The dataset is described in Section 3 and the results are presented in Section 4. The final section concludes.

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[1] For example Glen et al. (2001, 2003) uses a data set consisting of 100 largest listed manufacturing corporations in seven developing countries. Yurtoglu (2004) uses the 172 largest firms listed continuously from 1985 to 1998. Geroski and Jacquemin (1988) use a sample of 134 large European firms, including 51 from the United Kingdom, 28 from West Germany, and 55 from France and Goddard and Wilson (1999) use a sample set of 335 large survival companies from 1972 to 1991.

2 Methodology

The literature on persistence of profits owes a great deal to the work by Mueller (1986) who modeled profitability of a firm as a first order autoregressive process:

$$\pi_{it} = \alpha_i + \lambda_i \pi_{it-1} + \varepsilon_{it} \quad (1)$$

where π_{it} represents the standardized profitability rate of firm *i* in year *t*. The firm specific parameters to be estimated are α_i and λ_i. ε_{it} represent firm/year specific i.i.d. shocks to profitability. Short-run persistence of profits is picked up by the parameter λ_i and measures how fast profitability returns back to its long term equilibrium after a shock. The estimation equation used to measure persistence of profits is best regarded as a reduced form of a more sophisticated structural model. This model includes not only entry and exit of firms but also the threat of entry, which is obviously mostly impossible to observe. The advantage of the persistence of profits framework is that it does not require any unobservable variables to map competitive dynamics (Geroski 1990, Glen et al. 2003). The drawback is that the framework does not allow us to take a stand on the sources of profit persistency.

In general, one distinguishes three different possibilities for short-run persistency. First, when $\lambda_i = 0$ profitability follows a white noise process. Any abnormal profit earned in period t-1 is immediately eroded away. This can be due to either actual entry or by just the mere threat of entry and one states that firms are operating in a competitive environment. Second, when $0 < \lambda_i < 1$, current and future profitability are positively related and there exists some persistence of profits. The higher λ_i, the higher the persistence of profits and the lower the competitive forces. Ultimately, profitability converges to its long-run equilibrium value given, $\pi_{i,LR} = \frac{\alpha_i}{1-\lambda_i}$. Third, when $\lambda_i = 1$, abnormal profits earned in one period are not threatened at all by (possible) competitors. The profitability process has a unit root and profitability follows a random walk. Note that this is also not very theoretically appealing as this would mean that profitability would ultimately reach an arbitrary high or low value (Geroski and Jacquemin, 1988).

Values of λ larger than 1 would imply profitability rates of firms to blow up over time. Obviously this finding goes against common sense as well as a finding of λ smaller than -1. The same holds for values of λ between 0 and -1, which means profitability would be stationary, but implies profitability to oscillate around its long term average. However, while these values could be dismissed on theoretical grounds we do not impose any of these restrictions in our estimation procedure.

In the absence of (long-run) entry barriers, long-run profitability should be the same for all firms and there is no long-run persistence of profits as measured by $\alpha_i / (1-\lambda_i)$. When there exists long-run persistence of profits, long-run profitability will be positive for some firms and negative for others. A measure for competitive forces in a sector would be the variance of long-term profitability where a large variance points to underlying variables hampering competition. However, most of the literature has focused on the short-run persistency, probably because the easy interpretation of the parameter. We will follow this tradition and devote most of our attention our estimates of the autoregressive coefficient.

In general, equation (1) is estimated at the firm level instead of constructing a panel, assuming (some of) the parameters to be constant across firms and using standard panel data techniques. The only exception is Waring (1996) who estimates equation (1) for a large panel of US firms assuming the short run persistency to be the same for all firms in one sector. If the underlying parameters are indeed constant across firms, this approach is more efficient compared to estimating (1) for each firm separately. However, we would have to assume there is no firm specific long-term persistency in order to retrieve unbiased parameter estimates using OLS, i.e. we have to assume there are no firm fixed effects. Otherwise our estimates for the autoregression parameter will be upward biased as lagged profitability is obviously positively correlated with the firm fixed effect. Moving to a within estimator will not solve the problem as this will introduce a downward bias in the coefficient. We could correct for this by applying dynamic panel data methods (Arellano and Bond, 1991 and Blundell and Bond, 2000) and estimate equation (1) by GMM but we rather choose to follow the standard in the literature and estimate the equation for each individual firm separately.

Estimating a autoregressive model by ordinary least squares will result in consistent estimates for λ when T goes to infinity but will be downward biased in small samples. The bias is inversely proportional to the number of time periods and as we observe each firm only for a limited period of time, this small-sample bias could be important. Patterson (2000) suggests a procedure to correct the point estimates. However, most other persistence of profits studies did compute the small sample bias correction and to improve comparability, we also report the uncorrected estimates[2]. After estimating the equation at the firm level, we aggregate the short-run persistency parameter for different groups of firms. First, we compute average persistency for narrowly defined sectors. Second, we investigate heterogeneity in persistency across different firm sizes. The idea is that large firms are better

[2] Note that the bias is equal to $-(1+3\lambda)/T$ with T the number of periods in a first-order autoregressive model. If there is an equal amount of observations for all firms, the small sample bias will not alter the ranking of the firms in terms of competition intensity as correcting for the bias is a monotonic transformation of the parameter estimate, namely $\tilde{\lambda} = \hat{\lambda}T/(T-3) + 1/(T-3)$ with $\hat{\lambda}$ the estimated parameter and $\tilde{\lambda}$ the bias adjusted parameter.

able to protect their supranormal profits from competition compared to small firms[3]. Finally we explain variations in persistency by relating the parameter to different firm level as well as industry level indicators. Obvious candidates for these indicators are entry and exit rates as well as advertising spending, capital intensity, etc., which should pick barriers to entry/exit.

The framework has been used by several researchers and as mentioned before, most of them have reported a generally high value of this statistic in the range 0.4-0.5. Examples include Geroski and Jacquemin (1988), Mueller (1990) and Goddard and Wilson (1999). Glen et al. (2003) have found a slightly lower value for developing countries, namely around 0.2-0.3.4

3 Data

In order to estimate persistency of profits we use firm-level data on total assets and profits before tax are retrieved from the FOD database. The database collects company accounts data of all firms active in Belgium, except for one-man businesses and is constructed using data from the National Bank of Belgium. The result is an unbalanced panel of firms for the period 1999-2008 active in all sectors of the economy. In general, the literature defines the profit rate as the ratio of profit before taxes over either total assets or total sales. However since the smallest firms in Belgium do not have to report sales data, we use profit before taxes over total assets[5].

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[3] Shepherd (1972)has shown profit rates increase systematically with size within an industry.
[4] Detail is included in the Appendix Table A1.
[5] Total assets (code 50/58) includes all fixed assets (code 20/58) and current assets (code 29/58). Profits before tax (code 9903) includes operating incomes and charges, taken into account of depreciation, financial and extraordinary operation.

Since we do not observe economic profits, we have to use accounting profits instead. As is well known, the use of accounting profitability measures can diverge from economic profitability. For example, differences in accounting profits across sectors can be caused by different accounting conventions. However, these biases are more likely to be relevant for differences in profitability levels than for differences in the persistence of profits. Only changes in accounting practices over time that differ across industries could be problematic for a comparison of profits persistency across sectors. Moreover Kay and Mayer (1986) found persistently high accounting rates of return indicates persistently high economic rates of return. In addition, as we robustness check we also run the analysis using operating profits over total assets as our profitability measure. Since operating profits do not include depreciation, amortizations and, etc, the measure is less prone to accounting practices. We normalize the profitability ratios by subtracting the yearly average profitability ratio in the Belgian economy[6].

We perform some cleaning on the dataset. First, we restrict the analysis to firms with 5 or more consecutive observations. Second we drop the top and bottom 5 % of profit rates in order to avoid problems with outliers. In the end we are left with an unbalanced panel data set for more than 200,000 companies in Belgium operating from 1999 to 2008.

Tables

Table 1 provides some summary statistics of the profitability rate of firms active in Belgium. For the balanced panel, the average profitability rate is 3.9% and we observe a firm for on average 8.15 years. Not surprisingly, moving to the balanced panel increases the profitability rate which rises to 4.3%.[7] We divide the firms into three size categories based

[6] We also experimented with normalizing the profitability ratio with the sector/year average, but this did not change our results.
[7] This highlights one inherent problem with the profit persistency literature, namely that we are obliged to focus on the subset of firms that have survived for a number of periods. However note that

on turnover. Small firms realize a turnover of less than 2 million euros, medium firms realize a turnover between 2 million and 10 million euros and large firms have a turnover of over 10 million euros. In line with expectations and consistent with many empirical and theoretical papers, larger firms have higher profit margins (Sheperd, 1972). Finally we also compute profitability as the ratio of operating profits over total assets which is on average 5.2%.

4 Results

In this section we provide a discussion of our main results. We estimate equation (1) using our large unbalanced panel dataset of over 200,000 Belgian firms. The results for the short-run persistency parameter are reported in Table 2. The average short term persistency parameter equals 0.056, which is low especially in comparison to other studies. However, the standard deviation of the short term persistency is fairly high and equal to .39 pointing to substantial variation across firms. Moreover, it is well known that estimating an autoregressive model using ordinary least squares results in a small-sample bias which could be important since the average time period for our sample is only slightly higher than 8 years. Fortunately we know the size of the bias and can ex post correct our estimates for it. When we apply the procedure described by Patterson (2000), we obtain an unbiased estimate for the average short-run persistence parameter and we find the average λ to be equal to 0.172. This estimate points to a certain extent of short-run persistency, but still substantially lower compared to other studies (cf. Table A 1)[8]. We turn back to this issue on

in our analysis we only constrain the firm to exist for at least 5 periods while other studies focused on large firms being in business for over 15 years.

[8] Moreover, note that most of the papers mentioned do not control for the small sample bias and are as such lower bounds to the true underlying parameter. However, the bias will be lower compared to the present study as the number of observations per firm is higher.

the following pages. Due to the low number of observations per firm, the firm-level λ is often not significantly different from zero at the 10% level.

When we aggregate the short-run persistency parameter using the weighted average with sales as weight, we find a substantially higher persistence of profit which already indicates that large firms are better in insulating their profits from competition, an issue we will treat in more detail in the next section. Moving to the balanced panel, we find the average persistency to be equal to 0.123 (bias corrected: 0.230), higher than for the unbalanced panel, which is in line with our priors as firms that can protect their profits from competitive forces are more likely to survive and consequently more likely to be observed over the whole sample period. The percentage of firms with a short-run profit persistency significantly higher than zero is also higher as the number of observations per firm went up and as such the accuracy of the estimates increased. Finally we run the firm level regressions using operating profits over total assets as our profitability measure. Now, the average short run persistency is slightly higher compared to baseline profitability ratio (profit before taxes over total assets).

In a second step, we look at hetergeneity across different firms in terms of profits persistency. As can be seen from Table 3 large firms are better in protecting their competitive advantage in terms of efficieny or market power from competitive forces. The bias corrected esitmate for short-term persistency of large firms equals .289 compared to .157 for small firms where the categories are defined using the operating revenue of the firms. Note that this can explain part of the result that we find profit persistency to be lower in Belgium compared to previous studies as they used mainly large, even stock-quoted, firms. The rest of the difference is likely to be explained by the different time periods of the empirical analyses.

Third, we turn to sector heterogeneity in profit persistency. When we compute the average of the autoregression parameter for each different NACE 3 digit sector, we can see there exist substantial heterogeneity across firms as displayed in Figure 1.[9] These differences in profit persistency can be used to draw inferences about the strength of competition in a sector. First, we rank the NACE 2 digit sectors in terms of profit persistency. The results are displayed in Table 4. Not surprisingly, the Electricity and Gas sector ranks the highest in terms of profit persistency. Also other sectors which are thought off to have high entry barriers such as the Manufacture of Chemicals and Chemical Products and Manufacture of Rubber and Plastic Products have high levels of persistency. Among the sectors with the lowest persistency are the Forestry and Logging sector as well as the Sewerage and Travel Agency sector. Except for the Sewerage sector[10], these are sectors with low sunk costs and/or simple production technologies.

The ranking of the NACE 3 digit sectors is displayed in Table 5 and Table 6. Sectors with high persistence of profits include Mining and Quarrying, Manufacture of Gas, Water Transport and Steam and Air Conditioning Supply. Again the appearance of these sectors as having high persistence of profits is not surprising and builds up some confidence in the indicator. Turning to the sectors with low persistence of profits, the results are more surprising as sectors such as the Manufacture of Coke Oven Products appear in the list. However, these are typically smaller sectors and the average persistency could be less prone to measurement errors and alike. This is certainly an issue we should take up in future versions of the paper.

[9] The average measures of profit persistency displayed here and in the next paragraphs are not corrected for the small sample bias. This is not an issue as the correction of the small sample bias involves a monotone transformation of the parameter for a fixed T. Since we are now only interested in the ranking of the sectors in terms of profit persistency and the observations per firm do not substantially differ across sectors, the ranking of sectors is not altered by the small sample correction.

[10] Note that the Sewerage sector also contains publicly owned companies.

As mentioned before there are various ways to compute persistence of profits. Ideally, the inferences drawn about the competition intensity in a sector are not dependent on the metric/methodology used. In Table 7 we display rank correlations of the aggregate persistence of profits at the sector level between different metrics/methodologies. First we check whether the choice to take a weighted or unweighted average matters for the ranking of the sector. It appears from the first column, that the correlation between the unweighted and weighted average is positive albeit small, especially for the higher the level of aggregation. Second, we check whether moving from the unbalanced to the balanced panel changes results. We find the correlation between the two options to be fairly high around 0.6. Finally, we check whether the choice of the profitability definition drives results and we find this not to be the case (correlations of about 0.8).

An important question is which sector characteristics drive the differences in persistence of profits. The most obvious candidates are clearly entry barriers such as economies of scale and sunk entry costs such as R&D or advertising. Waring (1996) finds both economies of scale as well as R&D intensity to be positively correlated with profit persistency. Instead of looking at possible entry and exit barriers one can also look at the result of the presence (or absence) of these barriers, namely one can look at the churn rate. Other factors that can impact the persistence of profits include the concentration in the sector, the complexity of the production process, the unionization of the sector, capital intensity of the sector, …

We relate profit persistency at the NACE 3 digit level with the churn rate, Herfindahl-Hirschman Index and the capital intensity as measured by the ratio of capital stock over sales in the sector. The results are reported in Table 8. The churn rate is as expected negatively correlated with the persistence of profits at the sector level and thus holds true for the whole sample as well as for services and manufacturing sectors separately. So a higher churn implies lower persistence of profits. Although the HHI index is positively correlated with concentration at for the whole sample, this correlation disappears when looking at the services and manufacturing separately. Note that this is not really surprising as the HHI is not well defined for manufacturing sectors as the measure does not take into account imports which are substantial in a small open economy as Belgium. Finally, capital intensity is negatively correlated with persistency, if anything. This is at first sight a surprising result as capital intensity is expected to pick up returns to scale. However, Waring (1996) has found a similar result and attributes this to capital utilization. Firms rarely produce up t o full capacity and if a competitor earns high profits, they can easily adjust their production level by increasing their capital utilization, thereby eroding the competitors' profits.

5 Conclusion

Determining the intensity of competition is a key interest in the field of industrial organization. Static measures such as price-cost margins or concentration ratios may inadequately reflect the intensity of competition in a number of cases. A solution is to look at the competitive dynamics and examine the degree of profits persistency. The general idea is that in an efficient market economy, supra-normal profits should quickly disappear as they attract new entrants or imitators. The increase in competitors erodes profits earned by the initially successful incumbent. However, when firms operate in a less competitive environment, profits may be persistent and do not fall back to their competitive level. In order to analyze the persistence of profits in Belgium, we use data on around 200,000 firms between 1999 and 2008, retrieved from their income statements Contrary to previous persistence of profits studies we include also small firms into the analysis. We find a certain amount of persistence of profits in the Belgian economy, albeit lower compared to other countries. Furthermore, we show how the inclusion of small firms in the analysis can have important consequences as they have substantially lower persistence of profits compared to large firms.

The richness of the dataset furthermore allows us to examine the persistence of profits along various dimensions. We find Sector heterogeneity to be substantial. The highest persistency is found in sectors such as Mining and Quarrying, Manufacture of Gas, Steam and Air Conditioning Supply which are known to have high entry barriers. Furthermore we relate the persistence of profits with other competition indicators such as the churn rate, concentration and capital intensity. The strongest correlation is the one with the churn rate. Obviously in future versions of the paper we will relate the persistence of profits with other variables that for example should pick up the complexity of the production process. Moreover, this will be done in a multivariate regression framework.

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Tables

Table 1 Summary Statistics

		Average Profitability	Nr. Firms	Obs. Per Firm
Profit Before Tax/Total Assets	Full Sample	0.039	205034	8.15
	Balanced	0.043	89560	10
Size Categories	Small Firms	0.036	101397	8.13
	Medium Firms	0.047	13359	8.68
	Large Firms	0.052	6907	8.82
Operating Profits/ Total Assets	Full Sample	0.050	205376	8.17

Table 2 Results Short Term Persistency

	Average λ	Standard Deviation λ	% Significantly >0
Full Sample			
Unweighted	0.056	0.39	0.178
Weighted	0.171		-
Balanced Panel	0.123	0.36	0.215
Operating Profits/Total Assets	0.074	0.39	0.193

Table 3 Persistence of Profits over Different Size Categories

Category	Av. λ	λ Bias Corr	Nr. Obs.	Criterium
Small	0.040	0.157	97126	OR < 2 million
Medium	0.130	0.243	12689	2 mill. < OR < 10 mill.
Large	0.174	0.289	6556	10 mill. < OR

Profitability measure is profits before tax over total assets. Unbalanced panel.

Table 4 Persistence of Profits per NACE 2 Digit Sector

NACE2	NACE Description	Persistency
High Persistency		
35	Electricity, gas, steam and air conditioning supply	0.1813
22	Manufacture of rubber and plastic products	0.1696
17	Manufacture of paper and paper products	0.1588
20	Manufacture of chemicals and chemical products	0.1573
65	Insurance, reinsurance and pension funding, except compulsory social security	0.1525
36	Water collection, treatment and supply	0.1508
08	Other mining and quarrying	0.1478
14	Manufacture of wearing apparel	0.1424
60	Programming and broadcasting activities	0.1391
75	Veterinary activities	0.1217
Low Persistency		
30	Manufacture of other transport equipment	0.0293
53	Postal and courier activities	0.0268
56	Food and beverage service activities	0.0211
41	Construction of buildings	0.0179
43	Specialised construction activities	0.0156
81	Services to buildings and landscape activities	0.0086
01	Crop and animal production, hunting and related service activities	0.0070
79	Travel agency, tour operator and other reservation service and related activities	0.0062
02	Forestry and logging	-0.0220
37	Sewerage	-0.0234

Unweighted average autoregressive parameter per NACE 2 digit sector. Sectors with lowest and highest profit persistency are reported. Profit before taxes over total assets as profitability measure, unbalanced panel of firms.

Table 5 High Persistency NACE 3 digit Sectors

NACE3	NACE Description	Persistency
089	Mining and quarrying n.e.c.	0.3826
352	Manufacture of gas; distribution of gaseous fuels through mains	0.3185
501	Sea and coastal passenger water transport	0.2913
353	Steam and air conditioning supply	0.2826
152	Manufacture of footwear	0.2602
102	Processing and preserving of fish, crustaceans and molluscs	0.2344
302	Manufacture of railway locomotives and rolling stock	0.2309
104	Manufacture of vegetable and animal oils and fats	0.2202
143	Manufacture of knitted and crocheted apparel	0.2186
822	Activities of call centres	0.2122
601	Radio broadcasting	0.2114
261	Manufacture of electronic components and boards	0.1835
651	Insurance	0.1834
201	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	0.1826
274	Manufacture of electric lighting equipment	0.1820
782	Temporary employment agency activities	0.1706
222	Manufacture of plastics products	0.1706
236	Manufacture of articles of concrete, cement and plaster	0.1689
643	Trusts, funds and similar financial entities	0.1649
171	Manufacture of pulp, paper and paperboard	0.1646

Unweighted average autoregressive parameter per NACE 3 digit sector. Sectors with lowest and highest profit persistency are reported. Profit before taxes over total assets as profitability measure, unbalanced panel of firms.

Table 6 Low Persistency NACE 3 Digit Sectors

NACE3	NACE Description	Persistency
663	Fund management activities	0.0065
681	Buying and selling of own real estate	0.0057
242	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	0.0042
493	Other passenger land transport	0.0039
582	Software publishing	0.0032
431	Demolition and site preparation	0.0019
813	Landscape service activities	-0.0026
268	Manufacture of magnetic and optical media	-0.0027
291	Manufacture of motor vehicles	-0.0045
439	Other specialised construction activities	-0.0104
370	Sewerage	-0.0234
266	Manufacture of irradiation, electromedical and electrotherapeutic equipment	-0.0238
279	Manufacture of other electrical equipment	-0.0302
799	Other reservation service and related activities	-0.0539
301	Building of ships and boats	-0.0649
303	Manufacture of air and spacecraft and related machinery	-0.0658
783	Other human resources provision	-0.0741
272	Manufacture of batteries and accumulators	-0.1000
191	Manufacture of coke oven products	-0.2106
652	Reinsurance	-0.2183

Unweighted average autoregressive parameter per NACE 3 digit sector. Sectors with lowest and highest profit persistency are reported. Profit before taxes over total assets as profitability measure, unbalanced panel of firms.

Table 7 Correlation between Different Approaches

	Spearman's rho Between Different Approaches		
	Unweighted & Weighted	Unbalanced & Balanced Samples	Before Tax Profits & Operating Profits
NACE2	0.0133	0.6643	0.8015
NACE3	0.2191	0.5404	0.7843
NACE4	0.3208	0.5526	0.7211

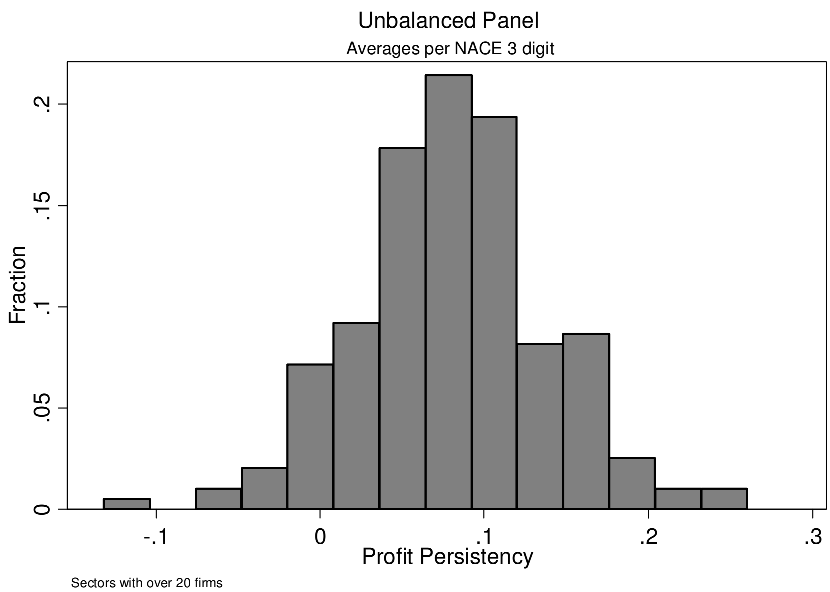
Table 8 Correlation Persistence with Other Indicators

	Churn Rate	Concentration	Capital Intensity
All	-0.283	0.193	-0.091
Manufacturing	-0.229	-0.081	0.086
Services	-0.219	0.002	-0.315

Spearman rank correlation between indicators and persistence of profits at the NACE 3 digit sector level.

Figures

Figure 1 Profit Persistency per NACE 3 digit sector



Appendices

Table A 1 Overview Studies Profit Persistency. [a]

Author	Country	Sample Period	Obs./firm	No. firms	Sample Mean (λ)
Geroski & Jacquemin (1988)	UK	1947-1977	29	51	0.488
	France	1965-1982	18	55	0.412
	Germany	1961-1981	21	28	0.410
Schwalbach et al. (1989)[b]	Germany	1961-1982	22	299	0.485
Mueller (1990)	US	1950-1972	23	551	0.183
Cubbin and Geroski (1990)	UK	1948-1977	30	243	0.482
Khemani & Shapiro (1990)	Canada	1964-1982	19	129	0.425
Odagiri & Yamawaki (1990)	Japan	1964-1982	19	376	0.465
Schohl (1990)	Germany	1961-1981	21	283	0.509
Waring (1996)	US	1970-1989	20	12, 986	0.540
Glen et al. (2001)	Brazil	1985-1995	11	56	0.013
	India	1982-1992	11	40	0.221
	Jordan	1980-1994	15	17	0.348
	Korea	1980-1994	15	82	0.323
	Malaysia	1983-1994	12	62	0.349
	Mexico	1984-1994	11	39	0.222
	Zimbabwe	1980-1994	15	40	0.421
Yurtoglu (2004)	Turkey	1985-1998	14	172	0.380

Source: Glen et al. (2001), for all except Glen et al (2001) and Yurtoglu (2004)

[a] All references are from Glen et al (2001), except Glen et al (2001) and Yurtoglue (2004).

[b] Based on nominal profit on capital, before tax.