THE PORT OF ROTTERDAM IN CRISIS YEARS

Measuring and analyzing the impact of the late 2000s financial crisis on the performance of Europe's largest port

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Rotterdam, March 2012

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Master Program: Economics & Business
Master Specialization: Urban, Port and Transport Economics

Preface

This master thesis represents the final project of the master program Economics and Business with the specialization Urban, Port and Transport Economics at the Erasmus School of Economics of the Erasmus University Rotterdam. It also marks the end of a year of studying together with interesting people and gaining knowledge from inspiring lecturers. During the past seven months I have been working on this thesis with great pleasure. Although the speed of the writing process slowed down sometimes due to my other master study, I have been able to stay motivated and finish this project. Overall, the effort was more than worth it and I am proud of what I finally realized.

The writing of this thesis would have been impossible without the help of my supervisor Michiel Nijdam, to whom I would like to show my appreciation here: thank you very much for all your advice and support. Your comments have been very beneficial for both the structure and the content of this thesis. Besides, I enjoyed working together with you in the Havenmonitor study, which was used as the basis for this thesis.

Dorus Bakker

Rotterdam, March 2012

Abstract

During the second half of 2008, worldwide stock exchanges plunged, the investment bank Lehman Brothers declared bankruptcy and commodity prices collapsed. These are all signs of how the late 2000s financial crisis hit the world economy. With this hit of the world economy, global trade in goods was obviously also affected. Despite the fact that there was a seemingly unstoppable growth in global trade for many years, the late 2000s financial crisis slowed down this growth and turned it into a decline. Simply stated, a lack of consumers' trust in the economy lead to the postponement of expenditures, resulting in a lack of businesses' trust in the economy and the layoff of employees: a negative vicious circle.

The Port of Rotterdam, Europe's largest port in throughput of containers, cargo tonnage and transshipment, was (not surprisingly) also impacted by the crisis. From the third quarter of 2008 until the second quarter of 2009 the port reported a downfall in throughput for four quarters in a row. A clear sign of the fact that things did not went well for the port. The question is: how bad was it? Or in a more scientific form: *what has been the impact of the late 2000s financial crisis on the performance of the Port of Rotterdam?*

This thesis tries to show the reader the impact of the crisis in the Port of Rotterdam by following a step-by-step procedure. The main idea behind this is the fact that the explanation of how the crisis impacts the port is rather complex. Within Rotterdam's port area many different types of companies and organizations are operating and almost all of them responded in a different manner to the crisis. In order to cope with this, it is first clearly determined what we want to measure in order to be able to answer the question stated above: port performance indicators are created. Based on these measures, expectations for the port are outlined and finally, an analysis of the port's performance will take place.

In the analysis, the impact of the crisis on the added value generated by companies within the port, the number of employees working at companies within the port and the number of business establishments within the port is explained extensively. It shows the effect of the crisis and compares the effects on different industries by using input output models. In doing so it is clarified why certain sectors performed fairly well despite the fact that the crisis was present (energy companies), whilst others, such as the petroleum- and chemical industry faced heavy downfalls in added value. Where some companies had to lay off a large share of their staff due to a fall in added value, others were able to retain their employees. Furthermore, the indirect effects of the crisis in the Port of Rotterdam are discussed. These are the economic effects that are caused in other parts of the country due to the presence of the Port of Rotterdam.

Key words: port performance, economic impact, financial crisis, Port of Rotterdam

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1 Introduction

1.1 Context

With worldwide stock exchanges plunging and the liquidation of business bank Lehman Brothers as one of the most striking events, the late 2000s financial crisis hit the world economy hard. In the middle of October 2007, the Dow Jones Industrial Average index (a reflection of customer's and business's confidence in the economy, based on the stock values of 30 large, publicly owned US companies) closed at a record braking level of more than 14,000 points. Only 17 months later, in March 2009, the index closed at less than half the points: a little more than 6,500. This implies that in the period in between a severe economic crisis hit the world. Many companies went bankrupt and world trade diminished.

1.2 The Port of Rotterdam in Crisis Years

As the worldwide economic downturn carried on, this obviously also had its influence on throughput figures in ports. The Port of Rotterdam (PoR) faced decreasing throughput figures from the final quarter of 2008. This implies a delayed reaction on the stock markets that already started to decline from the autumn of 2007 onwards. The PoR was still seeing growth in the first two quarters of 2008 and actually announced record beating throughput figures of 420 million tons of cargo by the end of 2008 (Port of Rotterdam authority, 2008a). However, Hans Smits, the CEO of the PoR, already knew that 2009 would be a very heavy year for the PoR: "Certainly, throughput will initially fall very substantially in 2009. On average, however, we will be able to achieve 100 million tons per quarter and a five to eight percent drop. We would be happy if we can achieve 400 million tones."

When looking at the actual throughput figures, as presented in the Annual Report of 2009 (Port of Rotterdam authority, 2009a) things where even worse than Smits thought at the beginning of the year. Actual throughput was 386 million tons, with in particular the dry bulk share of throughput showing huge losses of thirty percent. The first, and especially the second quarter of the year where the quarters where the losses where high, as can be seen in figure 1. From the second quarter on, the economy started to recover from the crisis and thus, throughput started to rise again. Overall, 2009 showed an 8,1 percent loss in throughput compared to 2008 (PoR Authority, 2009a).

This graph illustrates the effects of the crisis on the PoR:

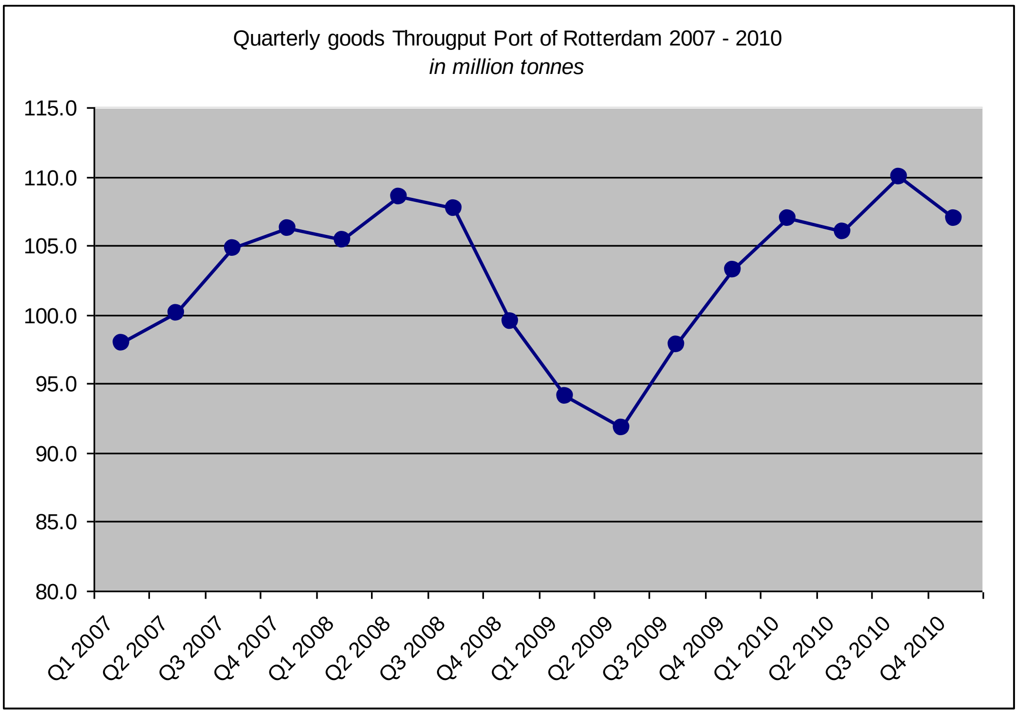

Figure 1 Quarterly goods Throughput Port of Rotterdam 2007-2010

When comparing the throughput figures of the Port of Rotterdam with throughput figures of its closest competitors, Rotterdam performed fairly well during and after the crisis (see figure 2). Especially the port of Hamburg faced a tremendous decrease in throughput that was hardly recovered in 2010.

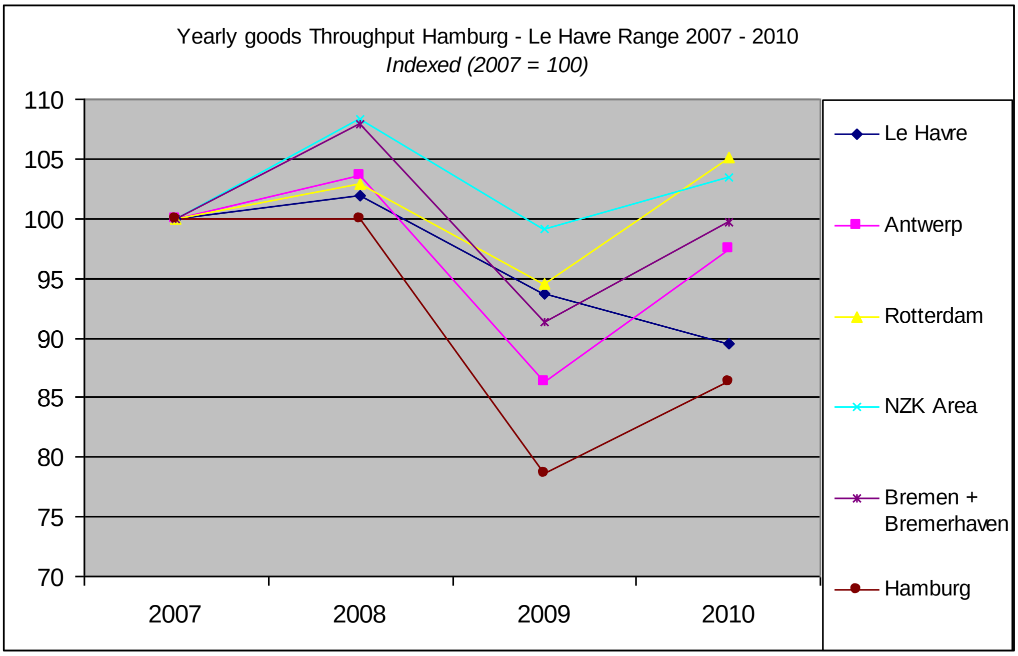

Figure 2: Yearly goods throughput Hamburg – Le Havre Range 2007-2010

Based on these figures one can rapidly judge that the crisis has had a severe impact on the European ports and thus, on the European economy at large. The latter, due to the notion that the performance of a port can be seen as a reflection of the economy's performance. It has a direct relationship with both customer spending and industry performance, based on the goods that pass through a port: this will rise in times of economic progress and will drop in times of economic downturns. However, with these figures on port's throughput, some questions arise on their meaning. They clearly show that something happened in the end of 2008 and the largest share of 2009, however, the figures do not show the economic effects on a broader level, both within the port(s) and within the economy at large. Based on these figures it is impossible to state what the crisis meant for the Port of Rotterdam.

This thesis tries to cope with this by assessing what we should measure, if we are willing to know what the crisis actually meant for the Port of Rotterdam. It is clear that the amount of throughput is an important indicator of a port's performance, but there will most probably be many more consequences for the port from the crisis. In order to assess this, it implies that first of all, there will be a theoretically grounded explanation on the relation between global trade and the state of the global economy. The explanation should tackle the question: *what can we generally expect for ports from a crisis?* Following from this, is a theoretically grounded chapter that will assess the question: *what should we measure if we are willing to show the impact of a crisis for ports?* Based on the measures that are defined there, the thesis will focus more specifically on the late 2000s financial crisis and its influence on global trade to and from the EU and to and from The Netherlands. The main goal here is to answer the question: *what can the Port of Rotterdam expect from the late 2000s financial crisis?* This question should thus assess the crisis in a more empirical way, going beyond an analysis of throughput figures. It should merely show the effects of the drop in throughput on other port related subjects and the consequences that follow from this for the Dutch economy. At this point, the study by Nijdam, Van der Lugt and myself (2011) will be used to actually obtain the measures that are to be clarified by this thesis. After an extensive analysis of these measures, I hope that I am able to show how the crisis not only impacted the Port of Rotterdam, but also how the downturn in the port had its impact on a larger scale throughout the Dutch economy.

1.3 The Port of Rotterdam

The Port of Rotterdam (PoR) is Europe's largest port and in its port area one of the world's largest oil and chemical clusters is situated. From 1962 until 2004 it was the world's largest port (by cargo tonnage) and it currently (2009 figures) ranks third on this list, after Shanghai and Singapore (AAPA Ports, 2011). However, the current figures probably would set Rotterdam back a few places, since the ports of Tianjin, Ningbo and Guangzhou in China were already very close to Rotterdam's cargo tonnage in 2009 and it can be assumed they have grown faster than Rotterdam did in the last two years (they showed average growth rates of over 10 percent between 2004 and 2009). When comparing the PoR with its closest competitors - ports in the Hamburg-Le Havre Range - it is clear however, that Rotterdam is still in a very dominant position (see figure 3). It is argued by many (especially by the PoR themselves) that the ever increasing Chinese ports are not a problem for the PoR, despite the fact that they keep on going down on the list of world's largest ports. This is mainly because of the fact that Rotterdam is not a competitor of these ports, but merely cooperating with them. It is in general very beneficial for the PoR when Chinese ports grow: it simply means that more cargo is being exported from China and thus, more cargo will be imported in Europe.

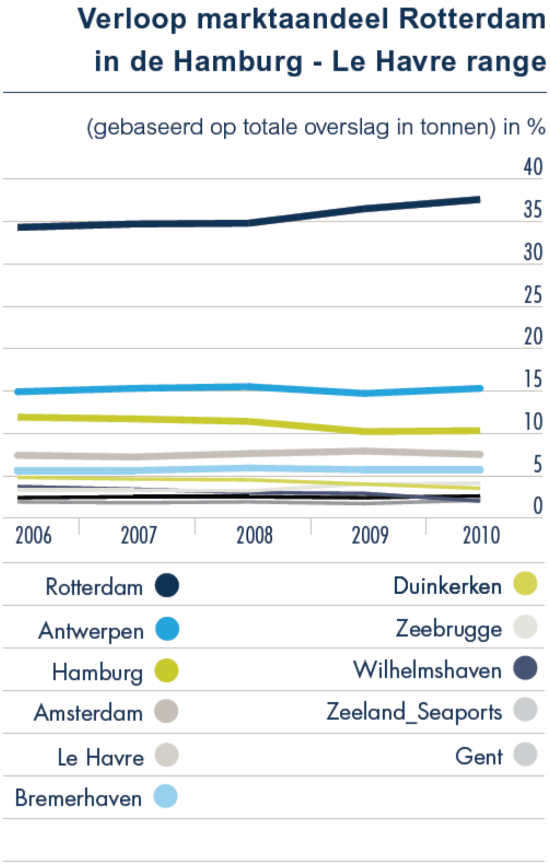

Figure 3: Rotterdam's share in throughput in the Hamburg – Le Havre Range 2006-2010

The PoR stretches over an area of 105 square kilometers, from Rotterdam's city center over a distance of 40 kilometers west. Thereby it crosses several municipal borders (see figure 4) and it ends at the current second expansion project of the port: Maasvlakte 2. This expansion is the second part of the port that exists of reclaimed land. It is currently constructed next to Maasvlakte 1, which was reclaimed by the sea in the 1960s. The main reason for these expansions is the fact that the port keeps growing and there is not enough space available on existing territory. Furthermore, the two Maasvlaktes are accessible for ships with very high drafts and are easily reached directly from open waters.

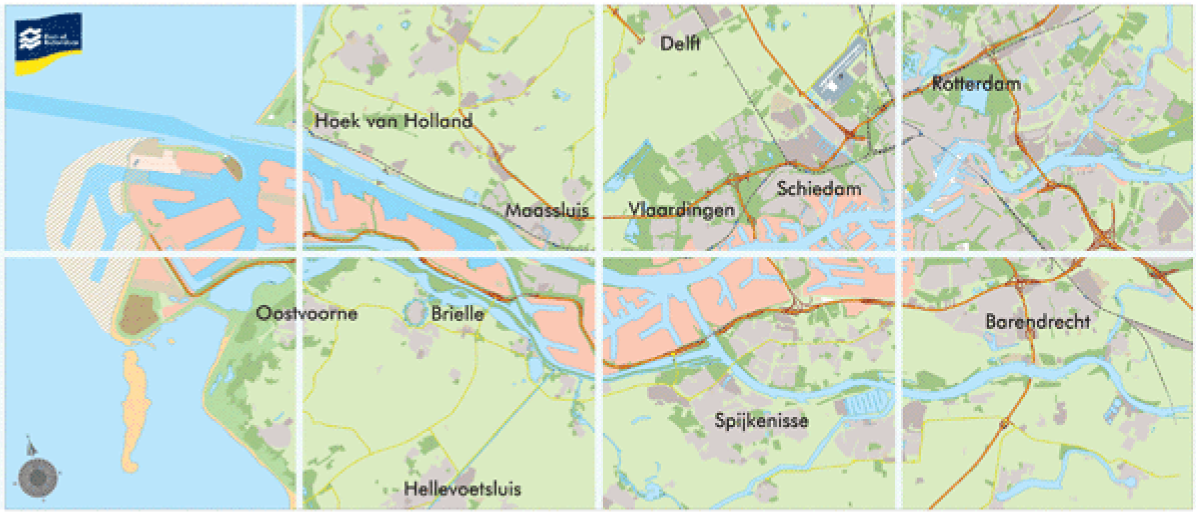

Figure 4: Map of the Port of Rotterdam's area

The PoR is operated, developed and managed by the Port of Rotterdam Authority, a government corporation that is jointly owned by the municipality of Rotterdam and the Dutch state (Port of Rotterdam Authority, 2011). The port authority in Rotterdam acts as a *landlord* port: it "comprises the development, management and control of the port area, including nautical access and port infrastructure, taking into account safety and environmental issues" (Van der Lugt and De Langen, 2007).

In this research, when mentioning the PoR, this will imply the whole port area that is under supervision of the Rotterdam Port Authority, including the ports of Rotterdam, Schiedam, Vlaardingen, Maassluis and the remaining small ports in the area (Albrandswaard, Barendrecht, Capelle aan den IJssel, Krimpen aan den IJssel, Ridderkerk, Rozenburg and Spijkenisse).

2 Trade and transport in a globalizing world

Numerous articles have been written on the (inter)dependency of trade and the state of the global economy. The performance of ports is subsequently dependent on these two factors and has also been assessed by multiple authors. The most important and relevant findings will be reported in this chapter. Furthermore, the relation between globalization and the growth of trade flows, and thus, the growth of ports in general will be assessed. In the second part of this chapter, the impact of the late 2000s financial crisis on will be investigated by using literature and statistics. The final part deals with the impact of the crisis on ports specifically and on the different types of cargo handled in ports. Overall, this chapter will show the (inter)dependency of trade on global economic cycles, prove this by showing the impacts of such an economic cycle on ports' performance, and go more into detail on the specific types of cargo that are handled in ports.

2.1 Transport and the Global Economy

Quinet and Vickerman (2004) come up with a framework that shows the relation between transport and economic growth. They argue that, obviously, there is a clear link between economic activity and transport, simply because economic activity requires transport: "the volume and nature of transport are explained by the level and structure of economic activity" (pp. 13). Starting with the industrial revolution, the authors see parallels between the growth of freight transport and the growth of total output from the beginning of the nineteenth till the late twentieth century. However, the relationship between the two factors is reduced during the end of this period, due to the fact that users of transport started to change their policy. In periods of crisis or fierce competition, companies start to adjust their stock levels, change suppliers or customers, leading to "a decoupling of the link between the volume of transport and the volume of production" (pp.15).On the other hand they also state that there is a reversed causation in the sense that transport improvements induce economic development.

Rodrigue (2006, pp. 1450) explains the derived demand pattern in freight transport in his article on geographical issues in freight distribution. According to Rodrigue, among many others, demand for transport is derived demand, simply stated: "transport itself is not necessary unless it is required". Demand for (in this case) freight transport is derived from the supply of a unit at a point of origin and the demand for that unit at a point of destination. The measure that is mostly linked with the amount of supply and/or demand of a unit are variations in GDP, "as the more active an economy is, the more freight will be in circulation because of manufacturing and consumer demands." In his article, Rodrigue shows a rather interesting figure, where different growth factors related to transport, trade and demographics are included and compared:

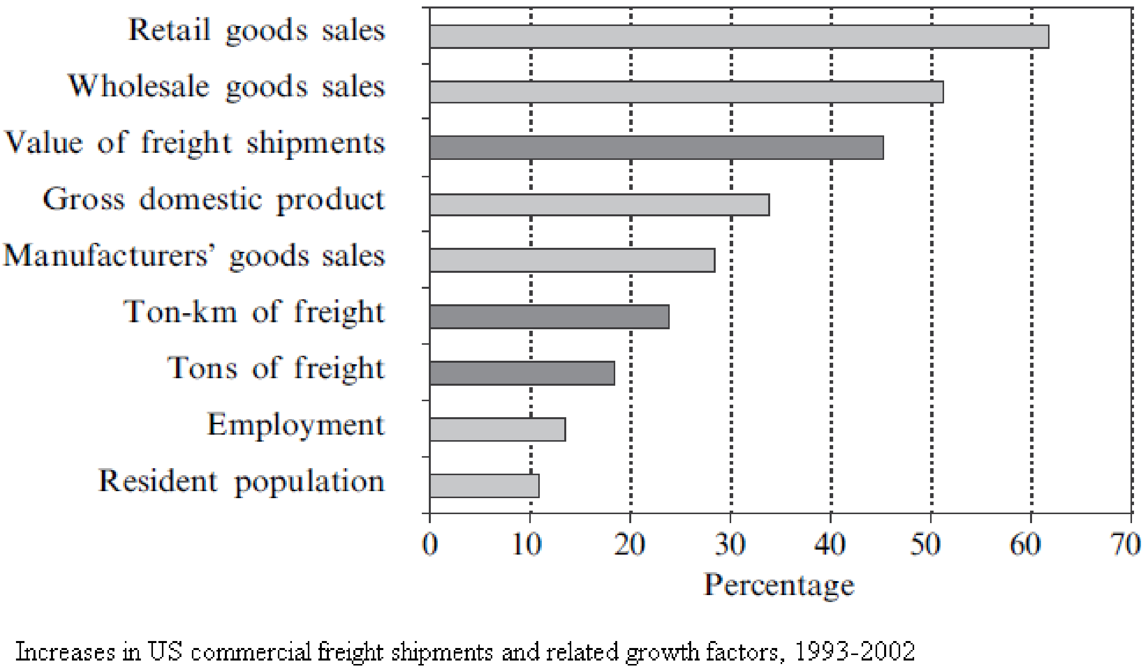

Figure 5: U.S. commercial freight shipments and related growth factors, 1993 - 2002

The figure shows the increase in multiple factors related to transport compared with three factors related to transport on its own. From the figure it is obvious that the throughput, as measured in transported tons of freight (one of the figures used to measure port's performance), does not show the same growth percentage as GDP did. According to Rodrigue, this is mainly due to the fact that demand for freight transport is very complex and difficult to predict, since it is dependent on such a large number of variables. The factors mentioned by Rodrigue (2002, pp. 1451) are:

- Economy in terms of resources, goods and services. The general derived demand impact, linked with GDP.
- Spatial structure determines the transport mode and thus influences transport demand.
- Globalization as an effect on ton-km of freight: the more globalized, the more freight traffic.
- International agreements and cooperation increases the trade and transportation between countries.
- Just-in-time practices and warehousing decreases inventories and thus require more shipments and other means of transport.
- Strategic alliances between shippers and carriers result in lower distribution cost and as such might increase trade.
- Packaging and recycling make freight density lower and reverse distribution necessary.
- Regulation and deregulation on a global scale induce increased competition and lower costs of transport.

- Fuel costs, taxes and subsidies are still a large share of costs for transport; therefore they can lead to a certain transport mode becoming preferred over other modes: changes the demand structure.
- Infrastructure and congestion influence efficiency, reliability and operating costs and thus influence transport demand.
- Safety and environmental policies decide whether or not a certain transport mode might be used, influence speed and/or weight limits.
- Technology makes cost reductions and efficiency increases for transport possible due to automation, containerization, handling systems and even automated terminals.

Helling and Poister (2000), in their research on U.S. ports, name some of the factors that influence the growth of ports and/or the usage of sea transport in trade, based on four trends in maritime transport. These trends are: "(a) containerization, intermodal shipment of freight, and increasing scale; (b) rail and over-the-road freight costs, which have diminished as a share of the total cost of production in many industries; (c) advances in information technology and freight logistics; and (d) the integration of international markets."(pp. 301). Although the researchers only assessed the impact of these trends in the US, it can be assumed that these trends also yield for European ports, since they show many similarities with US ports. Ports in both areas have an import/export ratio of around 60/40 percent and their main trading partners are Asia, South America and each other (Eurostat, 2011 and AAPA, 2010). According to the authors, the trends will lead to an increased competitiveness between ports. Low cost for overland transportation imply that former captive hinterlands get more and more attractive to be served by multiple ports: contestable hinterlands emerge (De Langen, 2007) as can be seen in figure 6 that is derived from Veldman and Bückmann (2003).

Figure 6: Contestable Hinterland for four European ports

Furthermore, Helling and Poister (2010, pp. 307) state that there is considerable uncertainty concerning worldwide maritime trade: "The smooth increase in trade value masks dramatic 8-to-10 year cycles of boom and recession in maritime shipping rates and volumes". These boom and recession cycles are mainly a problem for worldwide maritime businesses. Demand for shipping and port capacity is changing much quicker than the supply of both matters can be adjusted (ships take a long time to build and have long lives and for port capacity this is even more the case). One example of the rapid change in worldwide maritime transport demand can be seen when comparing two economic outlooks by Paul Bingham of IHS Global Insight (2007, 2009) in Appendix A. In November 2007, world's largest economics organization's (IHS Global Insight) global commerce and transportation manager predicted the containerized trade to grow in the coming years by about six percent annually (see Appendix A). Less than one and a half year later he came back from this prediction and showed a totally different forecast (see Appendix A).

2.2 Global Trade during the Crisis

Besides these general transport and trade related issues, there are more detailed issues involved when taking into account the different cargo types that are handled in ports. All these different cargo types have different supply chains that thus show large differences in their response to an economic downturn. Besides the fact that different cargo types show different responses to the crisis, there is also a large difference on a geographical scale. Developed countries (E.U., U.S. and Japan) suffered much more from the crisis than developing countries such as China and India. Multiple authors and institutions assessed these differences.

Levchenko, Lewis and Tesar (2010) investigated the impact of the crisis on the U.S. economy. They provide a table (pp.33) that lists the relative changes in imports and exports of different product types between the second quarter of 2008 and the second quarter of 2009. From this table it is clear that almost all sectors were hit by the crisis, but the differences are striking: automotive exports dropped by 47 percent, automotive imports dropped by 49 percent and petroleum imports dropped by 54 percent. On the other hand, food and beverage import and export dropped only by 9 and 19 percent respectively, just as consumer goods that dropped by 15 and 12 percent respectively. These figures show that especially the industrial sectors of the economy were hit hard. Furthermore, consumers keep on buying products they need in their daily lives, but their larger expenses (cars) are put on a hold. In a working paper by the World Bank (Freund, C., 2009), the change in trade for specific product groups is mentioned. Again, some industries seem to have avoided the crisis' influence: food and beverages and some durable goods such as washing machines, driers and refrigerators show less decline. Trade in automobiles shows a downfall that was quickly recovered, whereas trade in iron, steel and other commodities showed more long-term decreases.

In the World Banks' report "Global Value Chains in a Postcrisis World", the 2008-2009 crisis is investigated and explained based on so called global value chains. These global value chains are "the full range of activities that are required to bring a good or service from conception through the different phases of production—provision of raw materials; the input of various components, subassemblies, and producer services; the assembly of finished goods—to delivery to final consumers, as well as disposal after use." (Cattaneo, Gereffi and Stairz et. al. 2010, pp. 4). The authors give some examples of how companies in these global value chains suffered from the worldwide crisis: the postponement of new car purchases by U.S. consumers lead to huge problems for the Liberian rubber sector that supplied rubber for car tires. The same yields for the drop in U.S. imports for computers and cell phones that indirectly leads to a drop in U.S. exports of semiconductors and components: Chinese factories producing these computers and cell phones use semiconductors and components produced in the U.S.

One of the graphs that typically shows the impact of the crisis on international trade can be found in an article by Francois and Woerz (2010, pp. 88), published in Baldwin's (2010) book on 'the great trade collapse':

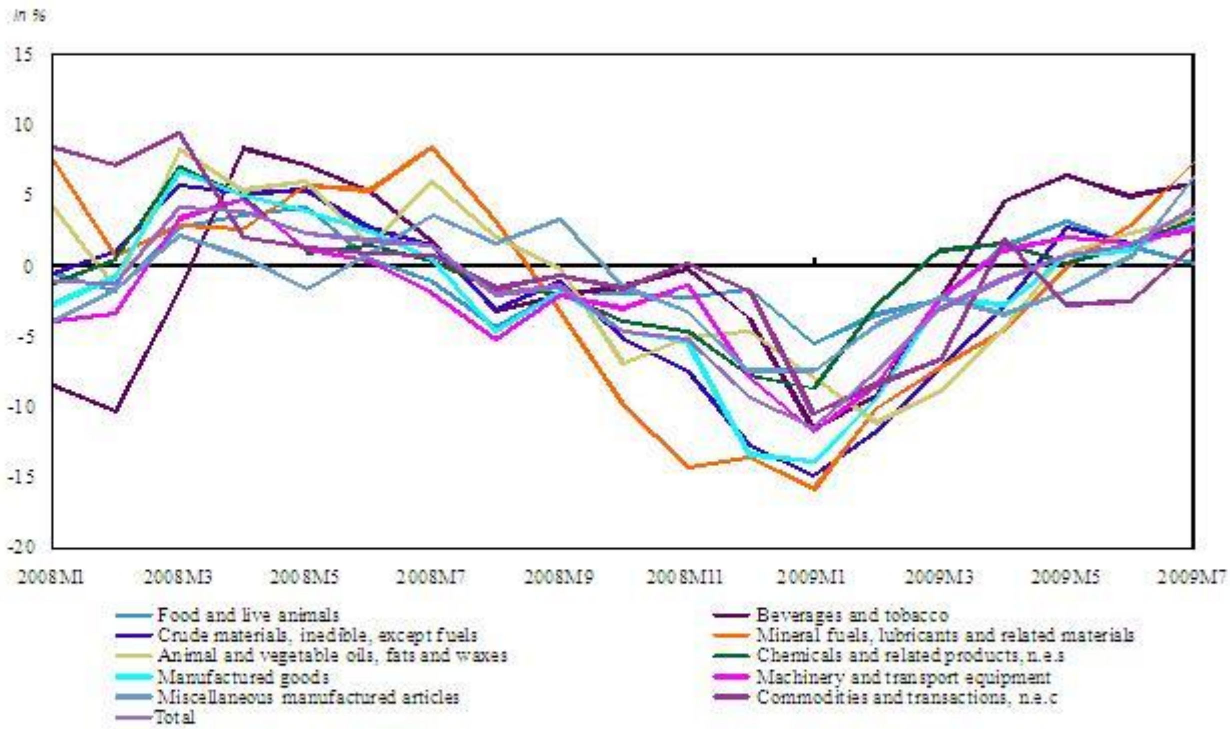

Figure 7: OECD import growth (month on month, 3-month moving averages)

As was already clear from the previously mentioned literature, some industries were hit harder by the crisis than others. This graph however, shows clearly how hard these industries where hit and how long it took them to recapture some of their trade flows after the crisis. It shows the import growth (in percentages) of multiple types of goods in the 34 countries that are part of the Organisation for Economic Cooperation and Development. Trade in mineral fuels for example started to stop growing relatively late, in July 2008. At that moment, many other industries were already down at 0 percent or even less. However, many of these other industries did not experience very large losses: between 0 and 5 percent in the final months of 2008. The mineral fuel trade collapsed in four months from a growth rate of more than 5 percent to a rate of minus 15 percent. And although the collapse in mineral fuel trade went very rapidly, its recovery to a level above 0 percent took longer than it did for most of the other product categories. The trade in food and live animals was much less affected by the crisis. In the beginning of 2009 it suffered most, with an import growth of 'only' minus 5 percent.

2.3 Seaborne Trade during the Crisis

On a more detailed scale, solely focusing on seaborne trade, developments are assessed in the annually UNCTAD (United Nations Conference on Trade and Development) Review of Maritime Transport (2010). In the 2010 edition, the global seaborne trade for 2009 is investigated and reviewed in detail. The first chapter (pp. 6-19) deals with the general developments in seaborne trade and contains a paragraph that describes these trade developments sorted by cargo type and region. The most important parts of this paragraph will be mentioned here in order to gain more insight in what the crisis meant for seaborne shipments worldwide.

Crude oil, petroleum products and gas

The total worldwide shipments of tanker trade volumes fell by 3,0 percent in 2009 to 2,65 billion tons. Of these shipments, the largest amount (1,72 billion tons) contained crude oil that fell by around 3,4 percent in 2009. The reason for this fall is the fact that the demand for crude oil in developed countries dropped tremendously, whilst the oil stocks in these countries was relatively high. This thus required less shipments of crude oil to these countries. The reason that the volumes fell with 'only' 3,4 percent is the fact that China, India and countries in Latin America showed growing oil demands. The same was true for petroleum products (including diesel and gasoline), where volumes fell with 2,4 percent. Shipments of Liquefied Natural Gas (LNG) grew by 7,2 percent, with a notable 28 per cent increase in the United States, due to the cold weather and lower prices.

Dry cargo shipments: major and minor dry bulks and other dry cargo

In 2009, the shipments of dry cargoes (including containerized cargo) recorded their first drop (by 5,2 percent) in shipped tons since 1983. The total volume of dry cargo shipments accounted for 5,2 billion tons, which still is the largest share (66 percent) of worldwide shipments.

Dry cargo: major bulks

The seaborne trade in the five major bulks (iron ore, coal, grain, bauxite/alumina and phosphate rock) did not show a large proof of the crisis when looking at a global scale: it increased by 1,6 percent to 2,1 billion tons. However, when going more in depth and focus on specific geographic regions, it is clear that the impact of the crisis was visible in this sector as well.

The worldwide shipments of iron ore (together with coal, the main ingredient for steel production) increased by 8,6 percent to 907 million tons. This increase can be fully attributed to the "Chinese growth engine": the iron ore imports in China increased by 40,1 percent (!) in 2009. When looking at the other large importers of iron ore, it is obvious why the growth in worldwide trade was 'only' 8,6 percent: Japan imported 24,8 percent less, Western Europe imported 38,2 percent less and the Republic of Korea (South Korea) imported 14,6 percent less.

The worldwide shipments of coal stayed almost the same as in 2008 (799 million tons), with 805 million tons. A distinction is made between thermal coals (for power generation) and coking coals (for steel production). The trade in thermal coals increased by around 2,1 percent to 590 million tons, whereas the trade in coking coals dropped by 2,7 percent to 215 million tons. The reason for this can be found in the fact that there was cold weather in Northern Europe (UNCTAD, 2010, pp. 7) and as such, more thermal coals were needed there. On the other hand, trade in coking coals (for steel production) dropped, whilst the trade in iron ore (for steel production) increased. The reason for this is in the fact that China, the country where iron ore imports skyrocketed, has enormous coal reserves itself (the third largest in the world after the U.S. and Russia, BP, 2010, pp. 32) and obviously does not have to import large amounts of coking coals.

The worldwide shipments of grain have fallen by 2,2 percent to 316 million tons. The reasons for this according to UNCTAD are the fact that demand for meat has dropped due to the crisis, which obviously means less grain is needed for cattle feed. Furthermore, demand for industrial maize and wheat, used in making starch and ethanol also dropped due to the crisis. The reason why the demand is only 2,2 percent can again be assigned to the Asian economies that kept growing during the crisis.

The worldwide shipments of bauxite and alumina plunged by 23,2 percent to 66 million tons. The reason for this is the fact that the main importers are Europe, North America and Japan: the parts of the world where the crisis' input was largest on the industrial production.

The worldwide shipments of phosphate rock (the most important raw material for fertilizer) also faced a sharp decrease by 38,7 percent to 19 million tons. The reason for this is mostly the fact that the United States, the major importer of phosphate: according to UNCTAD the demand for fertilizer dropped, but another striking reason is the fact that bank credits on sales of farm inputs (which fertilizer is) was much tighter.

Dry cargo: minor bulks

The worldwide seaborne trade in minor bulks (manufactures, agribulks, metals and minerals) was also hit by the crisis: a 12,6 percent drop to 851 million tons. The sectors that were hit hardest were the manufactures (13,8 percent) and metals and minerals(19 percent): goods that are directly related to construction industry and the housing sector. As can be expected (people tend to keep eating and drinking, also during crises), the agribulks responded much less to the crisis and only fell by 2,9 percent.

Other dry cargo: containerized cargoes

The worldwide seaborne trade in containerized cargo in 2009 was one of "the most challenging and dramatic years in the history of container shipping" (UNCTAD, 2010, pp. 17). With average growth rates of 10 percent per year for two decades, the trade in containerized cargo dropped by 9,0 percent in 2009. The total volume of twenty-foot equivalent units (TEUs) being 124 million, carrying 1,19 billion tons of cargo. The reason for this dramatic downturn can be found in the fact that the typical cargo that is transported in a container (consumer and manufactured goods) dropped tremendously in the two parts of the world that account for the largest share of importing containers worldwide: North America and Western Europe. The impact of the drop in demand is clearly shown by this table from the UNCTAD report (2010, pp. 19):

Table 1.5. Estimated cargo flows on major East–West container trade routes, 2008–2009
(millions of TEUs and annual percentage change)

	Trans-Pacific	Far East–North America	North America–Far East	**Europe–Asia–Europe**	Asia–Europe	Europe–Asia	**USA–Europe–USA**	USA–Europe	Europe–USA
2008	20.3	13.4	6.9	18.7	13.5	5.2	6.7	3.3	3.3
2009	18.4	11.5	6.9	17.0	11.5	5.5	5.3	2.5	2.8
Percentage change	**-9.3%**	-14.2%	0.1%	**-9.5%**	-14.8%	4.3%	**-20.1%**	-25.1%	-15.1%

Source: European Liner Affairs Association at http://www.elaa.net (accessed in September 2010); and *Containerization International*, August 2010.

Figure 8 Estimated cargo flows on major East-West container trade routes, 2008-2009

The two most important routes from this table are the Far East-North American route and the Asia-Europe route, with both having around 13,5 million TEU flows in 2008 and both a drop of more than 14 percent to 11,5 million TEUs. The UNCTAD report mentions that the world's leading container carrier, Maersk Lines reported annual losses of 2,1 billion dollars in 2009, compared to 583 million dollar profits in 2008. These figures all give a clear image of the impact of the crisis on seaborne containerized trade.

3 Port Performance Indicators: what to measure?

Until now, the main focus of this thesis has been on the pure throughput function of a port: "how many tons of cargo have been handled in year Y?" or "how many TEUs have been handled by port X?" as some examples of the questions that were assessed. Although this throughput function might be the basic reason of a port's existence, nowadays ports generally are much more than a place where cargo is moved from ship to shore or the other way around. Despite the fact that there are quite some drawbacks in using the throughput function as an indicator, when searching for "world's busiest ports" or "world's largest ports", most lists that show up contain the ports with the largest throughput volume in either cargo tonnage or containers in TEU. This chapter will deal with the question of "what to measure?" when one is willing to look at a port's performance or size. First of all the term *port performance indicators* will be explained in more detail, by using both an example from practice and academic literature. Finally, port performance indicators will be linked to cluster economics in order to come up with a list of port performance indicators for this thesis.

3.1 Introduction to Port Performance Indicators

De Langen, Nijdam and Van der Horst (2007) investigated the use of different types of port performance indicators (PPIs) and concluded that the use of throughput volumes as a performance indicator does not guarantee to show the right picture of how a port is actually performing. Simply adding up cargo volumes is not a solid base for port comparison, or as the authors state it: "one ton of crude oil is very different from one ton of fruit juice" (pp. 24). And as was mentioned before: throughput volumes do not give a clear image of the economic impact of a port. Finally, the growth in throughput volumes of a port might be much more dependent on global trade flows than on the port's performance itself.

One example of the 'wrong' picture that throughput volumes might give can be clearly seen in the case of the large commodity exporting ports in Australia, Africa and South America. The port of Port Hedland in Australia is the world's 15th largest port in terms of cargo tonnage, but the economic impact of the port for the region will be far less than the port of Antwerp that is the 19th largest port in terms of cargo tonnage. The Port Hedland's statistics clearly show this (Port Headland Port Authority, 2012): of the 22 million tons of total throughput (both imports and exports) in December 2011, 21,36 million tons were exported iron ore shipments. The port solely functions as a place where iron ore is loaded from train/truck to ships and then exported abroad. This is contrary to what happens in the port of Antwerp, with very large petrochemical complexes and a large financial sector operational due to the presence of the cluster. As such, the port of Antwerp is responsible for more than 65.000 jobs within the port directly and another 118.000 jobs elsewhere in Flanders (Port of Antwerp Port Authortiy, 2012).

3.2 Literature on PPIs

Earlier research by Talley (1994) and Tongzon (1995) tried to overcome this problem of 'measuring the wrong indicators' by investigating what determines a port's efficiency (Tongzon) and what determines a port's economic optimum throughput (Talley). They both carried out this research for container handling terminals. Tongzon constructs a model that evaluates the performance of 23 container terminals in terms of numbers of TEUs per year and efficiency. The number of TEUs per year is estimated in a model with factors like *location, frequency of ship calls, port charges, economic activity* and *terminal* efficiency. The *terminal efficiency* is estimated by a function that includes the *mix of containers (20ft vs. 40ft), delays in the port, crane productivity* and *vessel size.* After carrying out a regression analysis, he finds some factors that influence the performance of a port that are beyond the port authority's control: the level of economic activity, geographical location and the frequency of ship calls. However, there are more factors that influence the port's performance, such as the terminal efficiency and the port charges. Especially the terminal efficiency is a factor that has a large influence on a port's performance. In my opinion, the factors that Tongzon mentions as being 'beyond the control of the port authority' can be in control of the port authority in the long term: a port authority can improve its port facilities and/or services and thereby stimulate the level of economic activity and the frequency of ship calls. Furthermore, locational factors can even be influenced as the Port of Rotterdam has shown in constructing the land reclamation projects Maasvlakte and Maasvlakte 2 and the Port of Antwerp with the creation of a new port area, the Deurganckdok: these projects (will) have quite an impact on the accessibility of these ports.

Talley's (1994, pp. 340) paper is focused on "presenting a methodology for selecting performance indicators for evaluating a port's performance with respect to its economic optimum throughput". This is done by both using his own research based on public transport performance evaluation and an Australian research on port performance indicators. Talley also finds multiple factors that influence a port's performance. These are: *ship berthing rate, ship unberthing rate, ship loading-unloading service rate, inland-carrier entrance service rate, inland-carrier departure service rate, inland-carrier unloading service rate, inland-carrier loading service rate*. The Australian PPIs are: *the number of ships and cargo handled, the cargo handling rate, containers handled per crane, units per man-shift, average delay to ships awaiting berths, average delay to ships whilst alongside berths, facility utilization, tonnage handled* and *truck turn time and queuing.*

It can be concluded that both scholars have tried to come up with PPIs that make it possible to measure a port's performance in terms of efficiency, more than a port's performance in terms of size. This seems to be a reasonable assumption when thinking about what a port should be for its customers: places where they are able to (un)load their ships in a fast and reliable way. However, it can be stressed that currently, this loading and unloading of cargoes has become one of many factors that a port should offer its customers as De Langen's research in the previous paragraph showed. As such, Talley's and Tongzon's research has some shortcomings that are further examined by Marlow and Paixao Casaca (2003) and De Langen, Nijdam and Van der Horst (2007).

Marlow and Paixao Casaca (2003) also assessed the problem of what an optimal PPI would be. In a very extensive research on the supply chain performance of seaports, they assess the leanness' of ports. The authors see leanness as the ability of ports to adapt to changes in worldwide supply chain trends (Marlow and Paixao Casaca, 2003, pp. 190). This implies that not only the port's efficiency is taken as a PPI, but also the effectiveness of its multimodal process, the effectiveness of the transport operators in the port and the effectiveness of the infrastructure in the port. For all these four parts of the port's leanness, the authors come up with an extensive list of measures that can be used to evaluate a port's performance (see Appendix C). Some of the most important measures, per category, are:

- *Multi modal process' effectiveness*:
    - Timeliness in picking up shipment and in delivering it
    - Reliability of transit time/transport availability
    - Flexibility of operations
    - Accuracy of information regarding status of shipment
    - Employee interaction with customers
- *Port's effectiveness* (a ship's discharge at a port):
    - Ship's waiting time to be berthed
    - Berth availability
- *Transport operators' effectiveness* (ship operations) :
    - Ship's capacity utilization
    - Ship costs by unit of cargo carried (TEUs if containers, tons if break-bulk or bulk cargo)
    - Degree of process adaptability in meeting customer requirements
- *Infrastructure's effectiveness* (road infrastructure):
    - Delays caused by road works
    - Delays caused by congestion
    - Inter-connectivity of road networks at a national and international level

The focus of Marlow and Paixo Casaca's article is mainly on the efficiency and effectiveness of a port's main process of loading and unloading cargo and transporting this to the hinterland. However, they do not list any PPIs that measure the port's performance in terms of the firms that are located in the port for other reasons. The value of large manufacturing sites that are present in many ports and that are of great importance for many port areas is not taken into account.

De Langen, Nijdam and Van der Horst (2007) also developed multiple alternative PPIs that are more applicable for current seaports. They do make a distinction between the different activities that take place in a port, not only looking at the performance of a port's core business. The authors classify these 'new' PPIs based on the different port products that a seaport offers, namely:

- The *cargo transfer* product: the loading and unloading of ships. Main users are shipping lines.
- The *logistics* product: the storage of cargoes and value adding activities such as re-packing, labeling or quality inspection. Main users are logistic service providers and importing and exporting companies.
- The *port manufacturing* product: the provision of space for manufacturing facilities. Main users are manufacturing companies.

Since the three port products are very different in their main users, all three require a different way of measuring their performance.

Besides this distinction based on port products (and thus on port users), the authors make a distinction in PPIs from the eye of the port (authorities) itself. These indicators are based on the different bodies where port authorities have to, or want to report to. The three port performance indicators for ports are:

- *Output indicators*: indicators that show the relevant output of ports
- *Upgrading indicators*: indicators that provide insight in the long term development of ports
- *License to operate indicators*: indicators that show the social and environmental performance of a port

De Langen, Nijdam and Van der Horst combine the three port products and the three performance indicators into three tables that show the PPIs that are currently (2007) used by port authorities (see Appendix D). The main indicators used in port authorities' annual reports are still for a large share different than the ones that Marlow and Paixao Casaca recommend. The PPIs that Marlow and Paixao Casaca use for measuring a port's leanness or agility are not used by the port authorities assessed by De Langen, Nijdam and Van der Horst.

However, in the final part of their article, De Langen, Nijdam and Van der Horst indicate some new PPIs that are based on performance indicators that are already used in other environments, such as airports, (industrial) clusters, business parks and economic regions. These 'new PPIs' are listed in Appendix E. The new PPIs that the authors suggest to be used for the cargo transfer product are focused on the port's efficiency, as Marlow and Paixao Casaca also did: *ship turnaround time* (as an output indicator) and *throughput per square meter* (as an upgrading indicator) as some examples. For the logistics product, some of the new PPIs that are suggested are: *percentage of goods to which value is added in the port region* (as an output indicator) and *value added per square meter* (as an upgrading indicator). For the manufacturing product, some of the new PPIs are: *investment level in manufacturing sites* (as an output indicator) and *the productivity in port industries* (as an upgrading indicator). Finally, some new PPIs for the port as a whole are: *number of new business establishments*, *the number of patents*, *education level of employees* (as upgrading indicators) and *housing prices in the vicinity of the port* (as license to operate indicators).

Both these new PPIs as mentioned by De Langen, Nijdam and Van der Horst and the PPIs mentioned by Marlow and Paixao Casaca have in common that many of them measure a port's performance based on its operational efficiency or the effectiveness of its surroundings. New PPIs like turnaround times or congestion delays are certainly adding something to the current list of PPIs. However, in this thesis the main goal is to look at the impact of the economic crisis on a port. As such, the operational efficiency and effectiveness of a port are not suitable measures in this case: the crisis' impact is largely independent of them as it did not influence the operational efficiency or effectiveness of a port.

3.3 Ports as Economic Clusters

Willing to measure the influence of a crisis on a seaport, it is very important to determine what a seaport actually is. The previous paragraph already showed some examples of classifications of the different port products. These classifications showed that it is obvious that this goes beyond the main transport function. Driving through Rotterdam's port area, one can easily distinguish much more activities taking place there: large chemical complexes, oil refineries, power plants and offshore industry are some examples of businesses that are located within the port. When measuring how a port performs (which is one of the goals of this thesis), it might be necessary and logical to take into account that a port is much more than a node in a transport network where cargo is moved from ship to shore. The question is: how to measure the impact of these companies that are located in the port, but whose primary activity is not in shipping cargo?

These businesses are illustrative examples of companies that settle in a port region for reasons of clustering as it is investigated by De Langen (2004). In his doctoral dissertation, he investigates the performance of three seaport clusters (in Rotterdam, Durban and the Lower Mississippi Port Cluster). He defines clusters as being "a population of geographically concentrated and mutually related business units, associations and public(-private) organizations centered around a distinctive economic specialization." (De Langen, 2004, pp. 10). The distinctive economic specializations that all companies within the port cluster have in common are related to the arrival of goods and ships. De Langen distinguishes five broad categories of port cluster activities that are related to this common specialization, namely: *cargo handling* activities, *transport* activities, *logistics* activities, *manufacturing* activities, and *trading* activities.

For the Rotterdam port cluster, De Langen derived the number of firms for every category of activities from the Dutch Chamber of Commerce. This finally leads to a total number of 3559 companies within the Rotterdam port cluster, of which *transport* and *logistics* are the largest groups, with 36 and 45 percent of the firms respectively. *Trade*, *cargo handling* and *manufacturing* have far smaller shares: 9, 6 and 4 percent respectively.

De Langen investigated why firms are willing to settle in a cluster and found out that mainly the presence of a specific labor force, specific customers and suppliers and specific knowledge within the cluster are reasons to settle there. This was done by investigating the importance of different factors that influence a seaport cluster's performance. He finds four variables that together form the cluster's structure and that thus, affect the cluster's performance: *agglomeration effects*, *internal competition*, *cluster barriers* and *heterogeneity*.

- *Agglomeration effects* are improving a cluster's performance, since these are the main effects that give a reason for a cluster population to exist. These agglomeration effects are the effects that were earlier mentioned: companies within clusters make use of a shared labor market, which results in a large pool of skilled workers. Secondly, companies within clusters make use of shared customers and suppliers, where upstream firms find their customers within the cluster and downstream firms find their suppliers in the cluster. Thirdly, the appearance of knowledge spillovers within clusters leads to the cheaper and earlier availability of knowledge and information in clusters compared to companies outside clusters. The final agglomeration effect is a more negative one, namely so called dispersion forces. Land scarcity and congestion are the two dispersion forces that De Langen mentions. Scarcity of land exists due to the fact that all companies want to settle in the same place, this drives up prices and as such decrease the attractiveness of the cluster again. Together with the scarcity of land, congestion appears in clusters, due to the fact that all companies want to settle in the same place and thus, congestion will occur, decreasing the attractiveness of the cluster.

- *Internal competition* is improving a cluster's performance for three reasons. First it fosters a decrease in switching cost due to the fact that internal competition allows firms in a cluster to switch between suppliers against lower transaction costs. Second, internal competition leads to companies specializing within the cluster due to the fact that specialization leads to less competition that finally results in higher profitability. The third reason why internal competition improves a cluster's performance is the fact that it creates a "vibrant environment" (De Langen, 2004, pp. 44). This implies that workers and managers within clustered companies are feeling fierce competition in all aspects of their job and thus "competition is in the air".

- *Cluster barriers* are also influencing a cluster's performance. Two categories of barriers for clusters that De Langen mentions as being negative for a cluster's performance are entry barriers and start-up barriers. The reason for this is the fact that they are keeping firms away from entering a cluster. Entry barriers could then be the way in which companies can get 'local tacit knowledge' about public organizations and the labor market. Start-up barriers are barriers such as the availability of venture capital.
  Exit barriers are supposed to have a positive influence on cluster performance. When these are high, companies are somewhat forced to stay in a cluster. This could be due to the fact that their labor pool is only available in the current cluster, due to investments in buildings and plants or due to the presence of specific companies in the cluster that are not present in other clusters. All these factors lead to a reduced uncertainty within the cluster and thus, improve the performance.

- *Heterogeneity* is improving a cluster's performance because it enhances the possibilities for companies to benefit from cooperation. De Langen argues that when there all multiple different types of companies active within a cluster it is more likely that they will cooperate when compared to a cluster with very similar companies. Furthermore, heterogeneity leads to a cluster that is stronger in terms of its resistance to external shocks: some firms are hit harder by a specific economical/social/technological change than others. This implies that a cluster consisting of the same firms will be more vulnerable to a specific change than a heterogeneous cluster that is able to 'spread risks'. Finally, heterogeneity leads to more innovation, since it would lead to a more diverse information- and knowledge base that fosters innovation.

When looking at seaports from this cluster perspective, besides investigating what forces improve and what forces deteriorate a cluster's performance, it is important to have the ability to measure how these clusters perform. Measuring a seaport's performance is mostly done either in terms of 20 foot equivalent units (TEUs) or in tons of cargo volume that is shipped per time unit (Marlow and Paixao Casaca, 2003, pp. 192). However, when using these kinds of indicators to measure a seaport cluster's performance, it is obvious that one will not see the true value of the cluster. Many of the companies that are located in the PoR are not solely "stacking containers" or "unloading ships". The earlier mentioned chemical complexes, oil refineries, energy plants and offshore companies are all actually constructing a product or creating a service in the port area. This implies that what they are actually doing is adding value to a specific product or service. For this reason, De Langen uses the value added (consisting of labor expenses, depreciation and profit (before tax)) in the seaport clusters as the measurement unit for determining seaport cluster performance.

Applying this performance indicator to seaport clusters directly leads to interesting results for the PoR. De Langen mentions that, despite the fact that only 4 percent of the firms in the Rotterdam seaport cluster are manufacturing firms, these firms generated more than 24 percent of the value added in the cluster in 2003. The contrary is true for the transport and logistics firms, which account for a far larger share of the number of companies, but that have much less impact on the value added in the cluster. When solely measuring throughput in terms of TEUs or tons shipped, the impact of what is produced or created as a service in the port is not taken into account. If this occurs, an important part of the value that a port (cluster) has for a region or country is not taken into account.

3.4 PPIs for this Research

In the case of this research, willing to assess the impact of a crisis on a specific port, the question is: "what to measure?". This chapter on PPIs and port clusters gives some insight in what indicators can be used to measure a port's performance. However, as mentioned earlier, quite a large share of the PPIs mentioned in the articles that were investigated are difficult to relate to a crisis. The turnaround time of ships in a port will probably show very little impact of the crisis. Besides that, following De Langen (2004), a port's performance is much more than the activities taking place at a quay where containers or bulk cargo is loaded and unloaded. For this reason, this research will use the PPI as it was indicated by De Langen, namely the added value that is generated in Rotterdam's port cluster. Furthermore, the number of employees that are working in companies within the PoR will be analyzed. This can give a clear view of how a specific industry is hit by the crisis: were people fired in order to reduce costs, or were employees retained because of a large pool of skilled labor that would be difficult to recruit again after the crisis? Finally, the number of companies that are settled in the PoR will be used as an indicator of how the port responded to the crisis: were there many bankruptcies or did most companies survive?

Besides these rather intuitive PPIs, there will be some additional indicators that are derived from the ones mentioned. This means that the ports efficiency in terms of added value per ton (throughput) and added value per hectare will be analyzed. These PPIs will be fairly easy to subtract from the data that is necessary to create the other PPIs, since they will mostly only require the merge of two datasets.

Furthermore, in order to give a clear view of the industrial sectors that were impacted most by the crisis, a comparison will be made between the different industries that are present in the PoR.

4 Implications for ports from the crisis

This chapter deals with the practical implications of the crisis for ports (and more specifically, for the PoR). It contains a study on Dutch newspaper articles that handled this topic during the crisis (between the end of 2008 and the end of 2009). Furthermore, it extensively handles the impact of the crisis by using European statistics from Eurostat on trade, industrial production and on transport. The overall goal of this chapter is to show the practical implications of the crisis in order to come up with expectations for the PoR: what happened during the crisis?

4.1 Implications for the PoR from the crisis: Newspapers

Multiple sources give practical examples of the crisis' influence on the PoR. In Dutch newspapers, the crisis and its influence on the PoR have been mentioned extensively during the crisis in 2009 (see Appendix B for newspaper's headlines). The most striking thing when going through the articles is the fact that the crisis' impact was becoming stronger and stronger during the year. The articles published by the end of december 2008 state the coming 'difficult year', with expected throughput drops of "5 percent, or maybe even 8 percent" (Wanders, J., 2008). In april 2009, a 10,8 percent decrease in throughput was mentioned in *De Volkskrant* (Wanders, J., 2009) and in july 2009 *NRC* (NRC Handelsblad, 2009a) announced a 13,4 percent decrease. Finally, by the end of 2009, after the improved third and fourth quarter of the year, the total decrease in throughput was 8,5 percent according to *NRC* (NRC Handelsblad, 2009b). This decrease was also mentioned during the end of the year presentation by PoR's CEO Hans Smits (Port of Rotterdam authority, 2009c): total troughput decreased by 8,5 percent compared to 2008. Imports of cargo were hit most with a decrease of 13 percent, whereas the export of cargo grew over the year with 5 percent. Bulk was 29 percent down on the previous year; general cargo fell by 9 percent. The press release also mentions the different cargo sectors in the port and their in- or decrease: "There was less incoming and outgoing trade in agribulk (-22 percent), ores and scrap (-47 percent), coal (-12 percent), other dry bulk (-13 percent), crude oil (-6 percent), other liquid bulk (-16 percent), roll on/roll off (-11 percent), other general cargo (-16 percent) and containers (-6 percent). Only the handling of mineral oil products showed a positive trend (+23 percent), actually achieving the biggest absolute increase (13 million tons) ever."

When looking at these figures, it is striking to see how the trade in the multiple types of cargo responds on the crisis. Especially the trade in agribulk and ores and scrap were hit very hard, whereas trade in mineral oil products seems to have not responded at all (or in a contrary way) to the crisis.

4.2 Implications for the PoR from the crisis: Eurostat data

When considering the figures given in the previous paragraph it is striking to see the collapse in trade in the PoR. In order to give a clear view of the impact of the crisis on trade, transport and industrial production, figures similar to the one of Rodrigue (2002) that is shown in paragraph 2.1 of this thesis will be constructed. These figures will contain data for both the Netherlands and the European Union as a whole between 2000 and 2010. When creating such figures, it can be clearly assessed what industries, transport modes and trade flows were hit by the crisis and in which sense they were hit. Besides the Dutch figures, the EU figures are also assessed here because of the importance of the hinterland for the PoR. A large share of the cargo arriving in the PoR is immediately loaded onto inland barges, trains or trucks and shipped to other countries within Europe.

Using Eurostat (2012) data, it is possible to create similar graphs like Rodrigue did. Three categories of graphs will be created, namely on transport, trade and industrial production. This will be done in two graphs for every topic and geographic area, namely for the period between 2000 and 2008 (the period prior to the crisis) and for the period between 2008 and 2009 (the period when the crisis hit the economy). By doing so, it is possible to compare the Dutch economic performance during the crisis to that of the European Union as a whole. For the different topics (transport, trade and industrial production), different categories of industries were selected, due to the availability of data at Eurostat. There is quite a large difference in the level of detail of Eurostat data on these three topics, for example, the number of categories of industries for trade that are available at Eurostat are much less specific than they are for industrial production. Another problem in Eurostat data were the transport statistics (trade by transport mode) for the Netherlands. These are not used in this case since they lack accuracy: in about ten percent of the cases the transport mode is ‘unknown’ according to Eurostat data. This implies that it is impossible to supply accurate data on this. As such, the graphs for transport development will only be created for the European Union.

In all three cases, the indicators for the economic performance will be compared to some basic growth factors, just as Rodrigue (2002) does. These basic growth factors are: Population, GDP per capita, Employment and Retail Sales. For some categories additional growth factors were used when data was available at Eurostat.

4.2.1 Industrial Production

At first it might seem to be less important or less logical to look at the European and Dutch industrial production when willing to look at the influence of a crisis on a port’s performance. However, as was shown in the third chapter, seaports are much more than nodes in a transport network and also function as industrial cluster where manufacturing activities are taking place. In De Langen's (2004, pp. 97) research the most important industrial firms in the PoR are mentioned per category. Of the manufacturing firms, the largest share is in chemical manufacturing (60 out of the 143 firms). This implies that especially the chemical industry is important within the PoR's cluster. On the other hand, there are many industries that are important for the cluster, but not in a sense that they are operating in the cluster. This is especially the case for the German steel industry, which is dependent on the PoR for both its iron ore and its coking coals. On the other side, this implies that the PoR is dependent of the German steel industry: if German plants produce less steel, there will be less throughput in the port. As such, both the intra-cluster industries and the extra-cluster industries are important in this case. The following figures show both the long term increases in industrial production for the Netherlands (NL) and the European Union (EU 27). The growth factors are based on Eurostat (2012) data on industrial production indices. These indices are "a business cycle indicator which measures monthly changes in the price-adjusted output of industry" (Eurostat, 2012a) and as such are a good indicator of the condition of European manufacturing industries. The figures were converted into growth percentages in order to be able to compare the different industries and growth factors on one level. Production of food products was added in these figures in order to give a view of how an industry that is relatively insensitive to economic developments would perform in a crisis year.

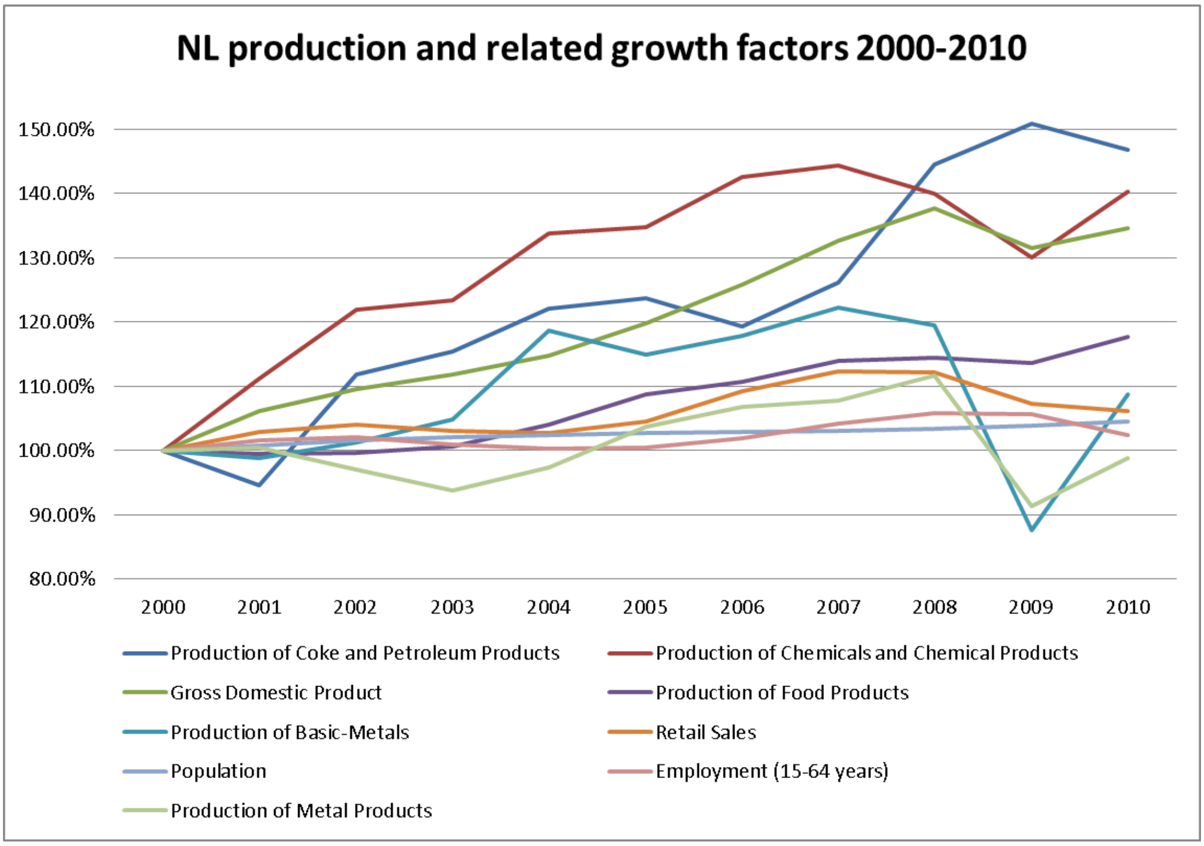

Figure 9: Increases in Dutch industrial production and related growth factors 2000-2010

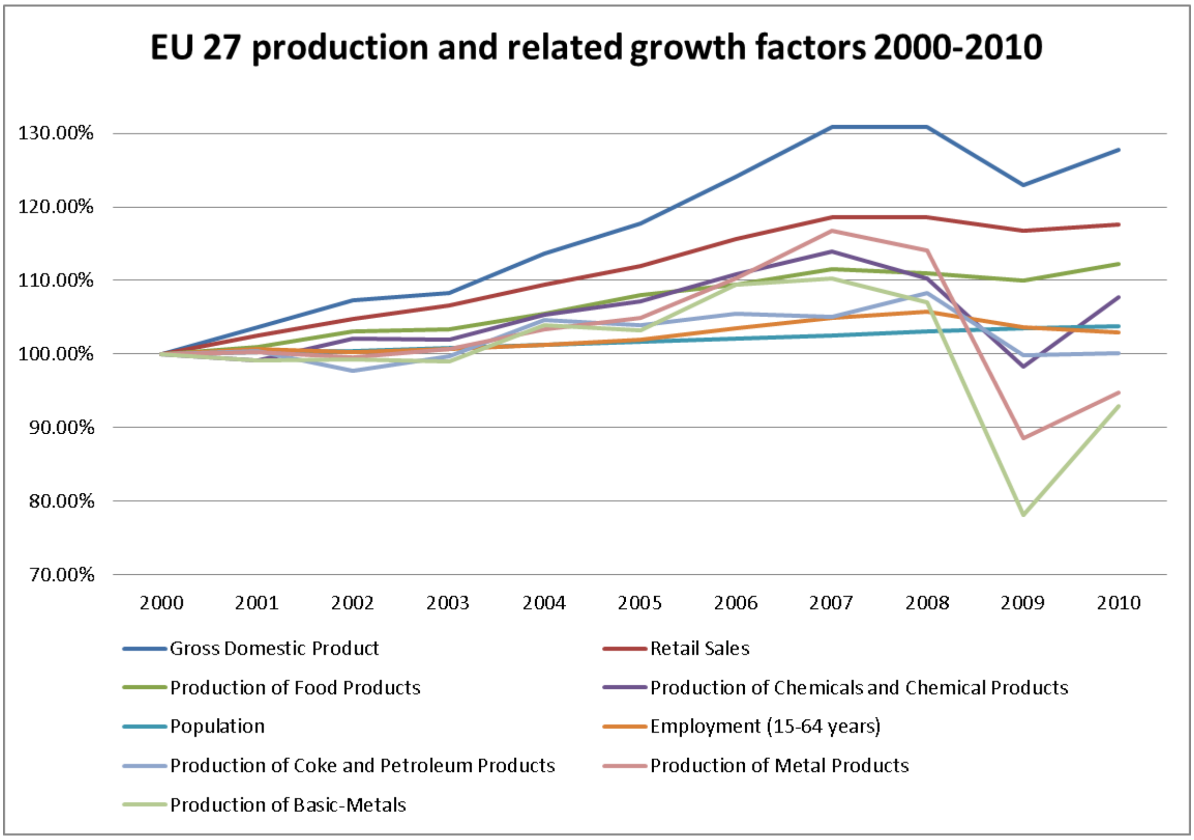

Figure 10: Increases in European Union industrial production and related growth factors 2000-2010

Both the Dutch as the European situation clearly shows the impact of the crisis in 2009. Where there was growth in all industries between 2000 and 2008 (altough not as much as GDP per capita grew), the crisis year showed a contradictory picture. The industries that were hit hardest in the Netherlands in 2009 were the production of metals and metal products, with decreases between 20 and almost 30 percent. This is mainly due to reduced production at Tata Steel Europe in IJmuiden, the only large metal producer in the Netherlands. The European production of steel showed similar downturns, between 24,22 and almost 28 percent. The production of chemicals faced a less drastic downturn, with around 10 percent in the Netherlands and a little more in Europe. The production of coke and petroleum decreased by 8,14 percent in Europe, whilst proudction in the Netherlands even increased with 5,02 percent. When looking at the related growth factors for the Netherlands, the drop in GDP per capita and retail sales are quite high when compared to the drop in employment. This can be explained by the fact that many Dutch companies operate in knowledge industries, where skilled labor is very important. Firing these employees in a crisis means that in periods of economic growth they have to be hired again, with high recruiting costs as a consequence. The graph also clearly shows the relative insensitivity of the food industry on economic fluctuations: whether there is an economic crisis or not, people will always need food. On a European level, the drop in food products shows the same pattern, however, the figures also show that the crisis hit Europe harder than the Netherlands: GDP per capita fell by 6 percent and employment dropped by 1.3 percent.

4.2.2 Trade

Besides the cluster role, the function of the port as a place where cargo is moved from ship to land is also taken into account. In this perspective, trade figures are important to assess the influence of the crisis on a port's performance. As the most important trade routes for European ports are the major east-west flows, the focus will be on so called extra-EU-trade: transactions with countries outside the European Union. The trade figures will again be compared to other growth factors. The data, derived from Eurostat, consists of extra-EU trade figures (imports and exports) for both the Netherlands and the European Union, classified by product category. The value of the trade flows is given in euro's and is therefore converted into growth percentages in order to be able to compare the different industries and growth factors on one level. At first an analysis of import trade figures will be discussed, followed by an analysis of export trade figures.

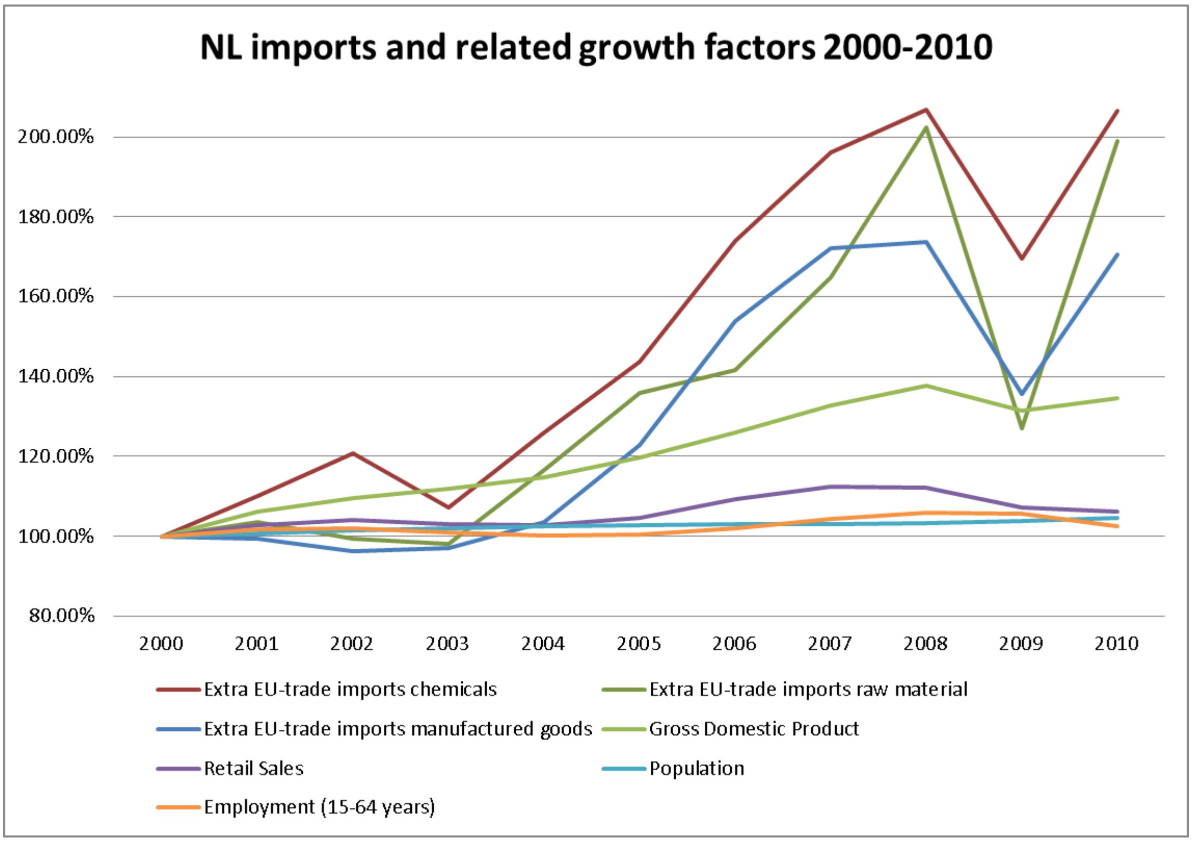

Figure 11: Increases in Dutch imports and related growth factors 2000-2010

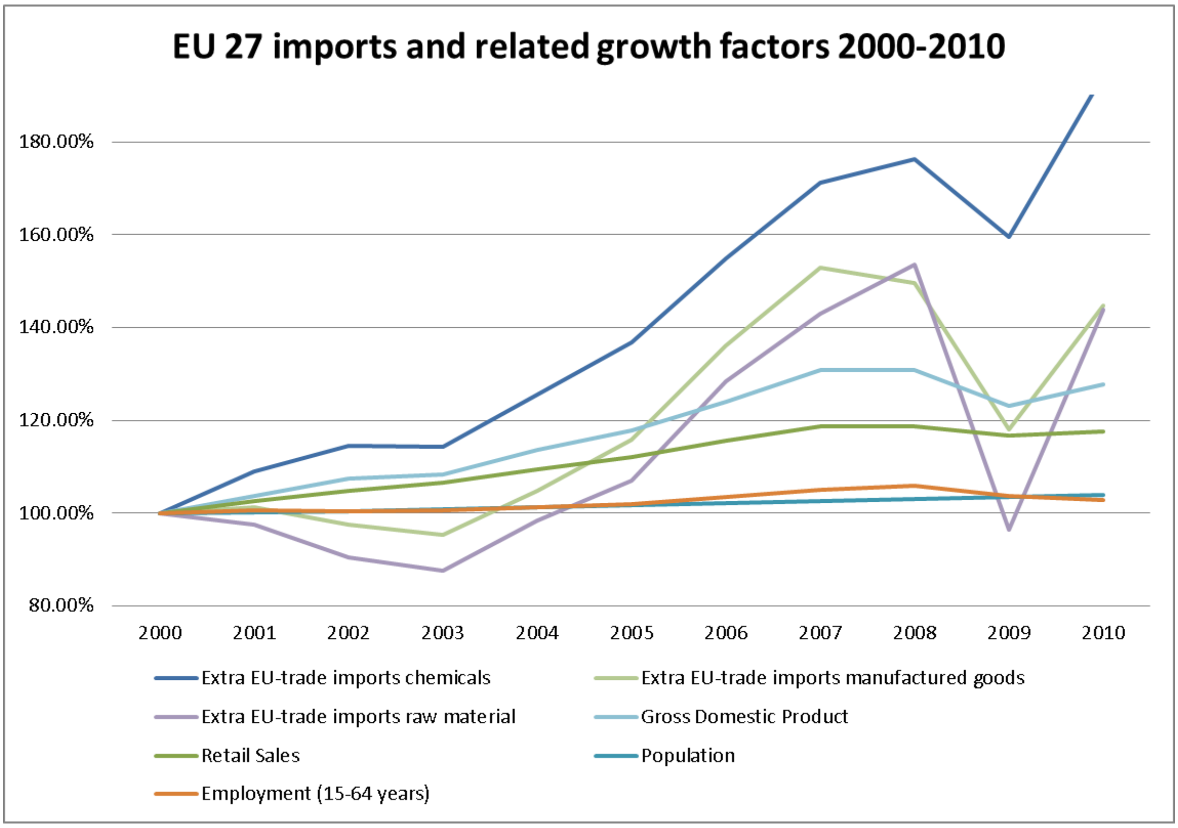

Figure 12: Increases in European Union imports and related growth factors 2000-2010

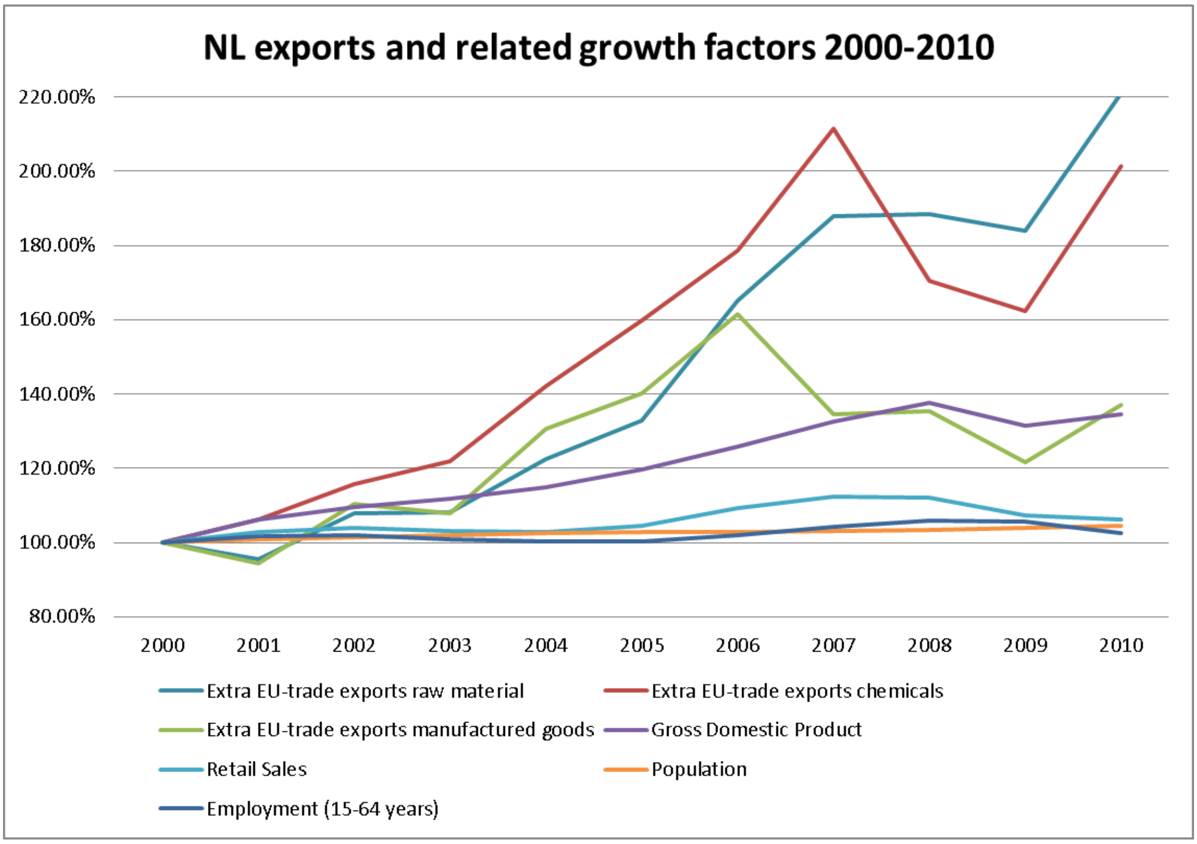

Figure 13: Increases in Dutch exports and related growth factors 2000-2010

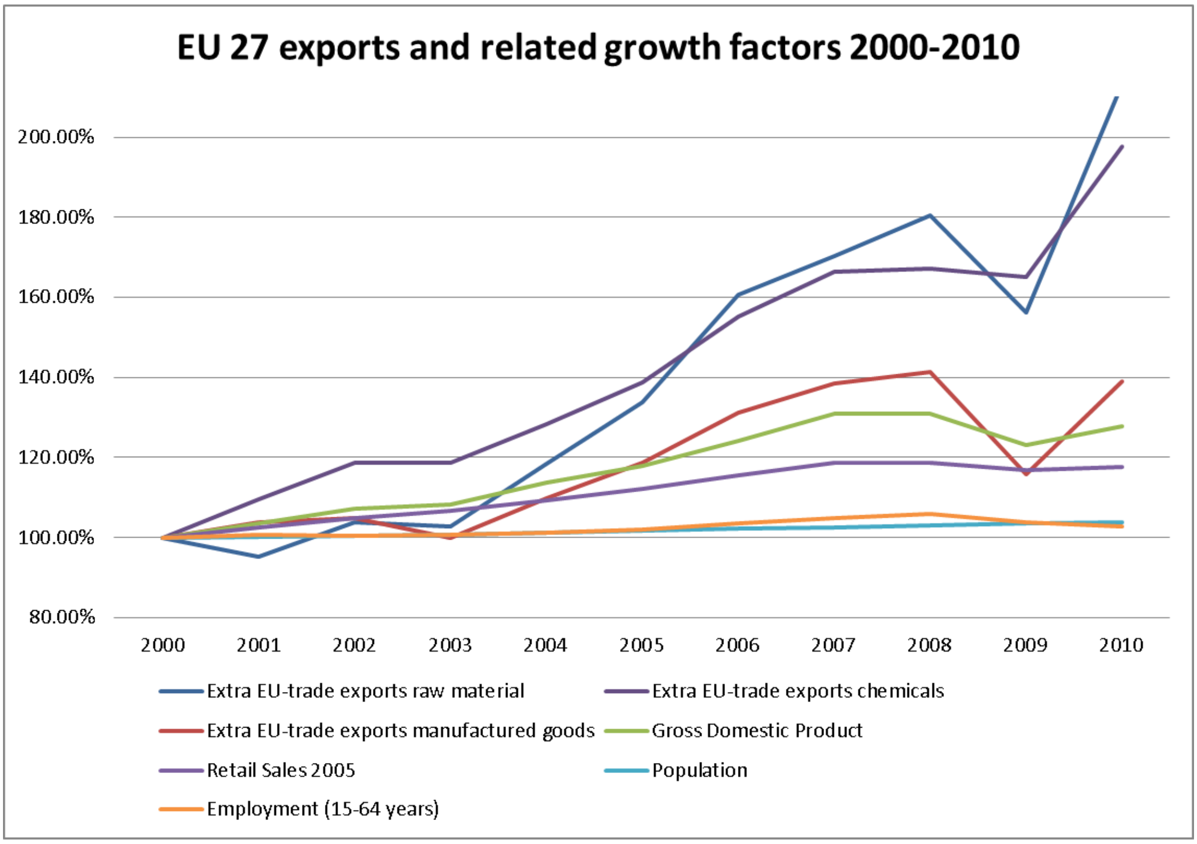

Figure 14: Increases in European Union exports and related growth factors 2000-2010

All trade graphs shown above are excluding the figures for the import and export of mineral fuels. This is due to the fact that this product category showed such an enormous rise (and in 2009 drop) in its trade flow that it would be impossible to see a clear development in trade for the other trade categories. The Y axis should be up to four times larger in order to display the development of trade in mineral fuels and as such, these figures are displayed in Appendix F.

In general it can be argued that the import trade flows faced a larger influence of the crisis than the export trade flows did. A reason for this could be the fact that countries like India, Brazil and China did not show any sign of a crisis. Their economies kept growing and that might be a reason that the EU and Dutch export trade was influenced to a lesser extent by the crisis. The table in Appendix H gives a good 'overall' view of this phenomenon in a table that compares the import and export growth for extra-EU trade between 2008 and 2009. When looking at the crisis' impact on the extra-EU trade flows, it is thus striking to see (after a rise for eight years) an enormous decline of the trade in mineral fuels, both in imports and exports and for both the EU as a whole as for the Dutch market alone. The trade graphs shown above clearly indicate the crisis and its consequences for the economy for trade in other port-related products. Trade in chemicals, one of the fastest growing trade segments before the crisis, was also the segment that showed the highest losses during the crisis, especially the EU and Dutch imports in chemicals were hit. Exports of chemicals showed much less response to the crisis. The trade in manufactured goods diminished most for EU import and export (-21 and -18 percent) and

Dutch imports (-22 percent). For Dutch exports, the trade in manufactured goods already dropped since 2006 and this continued (by 10 percent) in 2009. The trade in raw materials clearly reflects the earlier noted difference in exports and imports: imports fell by 37 percent in both the EU and The Netherlands, whilst exports 'only' fell by 13,41 and 2,41 percent respectively.

When comparing these trade figures with GDP data, it is striking to see the difference: GDP per capita for the EU and The Netherlands dropped by 6,00 percent and 4,42 percent between 2008 and 2009. This is only a fraction of the drops in trade that some product categories experienced. When comparing it with data that Eurostat provides on total trade flows the differences are striking as well: total EU imports (all products) dropped by 22,97 percent, total EU exports dropped by 16,24 percent and for The Netherlands these figures are 21,01 and 11,64 percent. When assuming that these trade figures should reflect the GDP per capita figures in some manner (i.e. GDP equals the market value of all final goods and services produced within a country in a given period), there is quite some difference between them. This could be explained by the fact that GDP per capita is measured by both goods and services, whilst the trade figures are solely based on the measure of trade in goods. Another reason could be the fact that the GDP is measured here as GDP per capita. Multiplying the 'capita' by the GDP per capita results in the total GDP. When calculating the actual GDP fall between 2008 and 2009 for both the EU and The Netherlands results in a 7,58 percent and 5,56 percent drop respectively.

Overall, it can be argued that the extra-EU trade was hit severely by the crisis and that this will have had its influences on the PoR, as a trade node between Europe and the rest of the world.

4.2.3 Transport

Now we know the impact of the crisis on trade in the European Union and the Netherlands, the question is: which transport sector was able to cope with this drop in trade and which sector was not? It might be possible that some transport sectors have had the ability to respond very well to the crisis and thereby reduce the influence of it, whilst others have faced very large consequences. In order to assess this question, Eurostat data was used again. As mentioned earlier, it was not possible to execute this analysis for the Netherlands, since they lack accuracy: in about ten percent of the cases the transport mode is 'unknown' according to Eurostat data. This implies that it is impossible to supply accurate data on this. As such, the graphs for transport development will only be created for the European Union.

Eurostat provides very much data on transport: both for imports and exports it is possible to lookup how much freight (tons) and the value of that freight (euro's) is transported by transport mode. As such, it is also possible to calculate the value per ton to indicate whether a certain transport mode is used for valuable goods or not and how this changed during the crisis. Graphs will be constructed containing data on growth of different transport modes, both for imports and exports and for both tons and euros of freight for the timeframe between 2000 and 2010. Finally two graphs that are solely focused on the performance of transport by ship are created that show the impact of the crisis for port's main transport activity. In the figures (see Appendix F), Inl. WW stands for transport by inland waterways (barge). Looking at these figures, the crisis' impact is still very obvious. All transport modes have been hit by it. However, there are striking differences between all indicators. Especially rail transport was hit very hard; both in export as import and both in tons as in euro's the decline was at least 26 percent. Another striking implication of the crisis can be observed when looking at the pipeline figures, where the amount of transport in tons went down with almost 10 percent for imports and 0.67 percent for exports, whilst the transport in euros went down with 34 percent and 24 percent respectively. This implies that the value of the goods (in this case oil or gas) has decreased by around 25 percent within one year.

When focusing on the shipping market alone, the following figure applies:

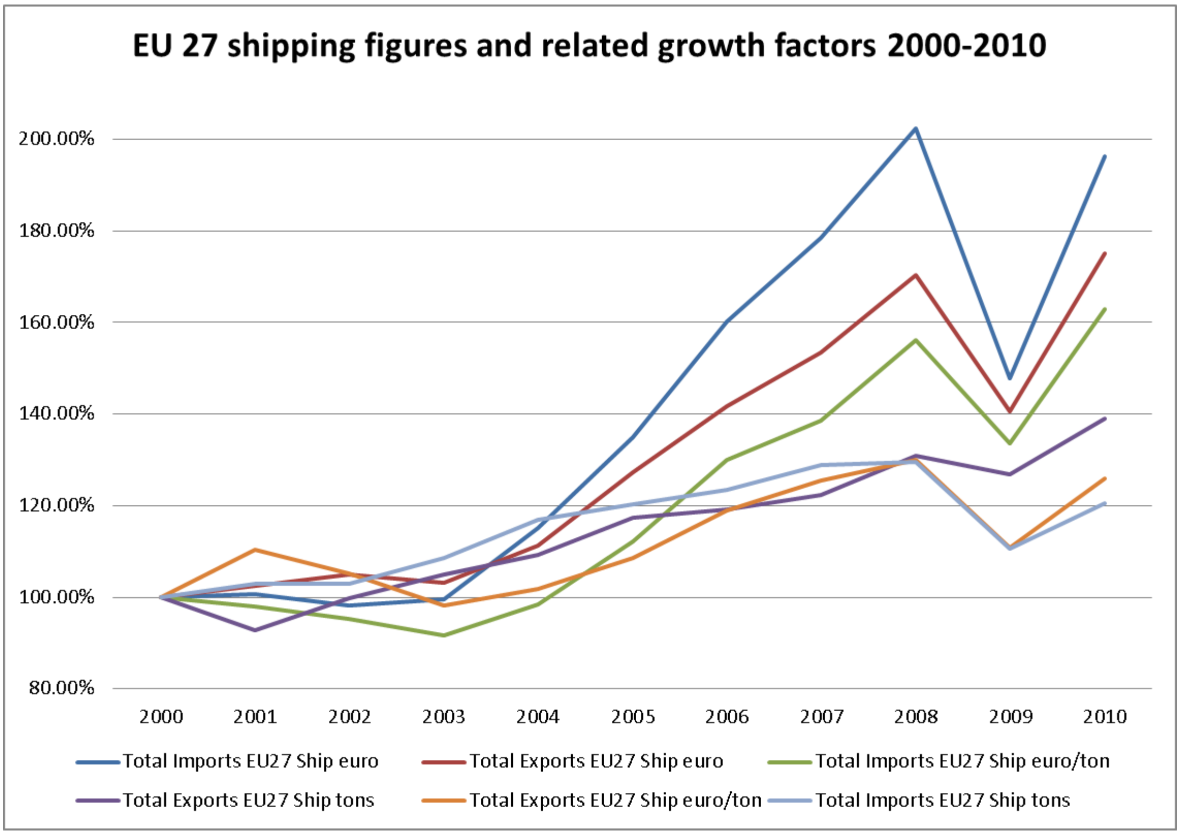

Figure 15: Increases in European Union transport by ship 2000-2010

These figures show the impact of the crisis on the shipping of cargo from outside the European Union to the European Union and vice versa. From these figures it is clear that the European imports were influenced more by the crisis than the exports: both the total imports in euro's and in tons decreased with a higher percentage than that of exports. It is also striking to see the decrease in the relative value in euro's per ton of the goods that were both imported and exported: these dropped by more than 14 percent.

4.3 *Expectations for the PoR*

The previous paragraphs showed the implications of the crisis for the PoR from newspapers and the implications for both the Dutch and the European economy from Eurostat data. With these two 'practical' sources combined with the PPIs that were assessed in the previous chapter, it is possible to come up with some expectations for the crisis' influence on the PoR. Looking from the production perspective, the decline in European steel production will have its influence on the throughput in the port, as was shown in the Dutch newspapers. However, the influence of this on the added value in the port will most probably be rather small: there are hardly any value adding activities in the steel industry within the PoR. Despite the fact that a large share of the iron ore and cokes that are used in the German steel industry pass through the PoR, these activities in general do not generate large sums of money through added value. The production of chemicals in the Netherlands (minus 7.44 percent) will have a larger influence on the port I suppose, because of the presence of the large (petro-)chemical cluster in the PoR. This can also be seen by the drop in imports and exports of both mineral fuels and chemicals for the Netherlands. These activities both generate added value and jobs, which are two of the PPIs that are assessed here. Another industry that might suffer more from the crisis than one would think when looking at the production graphs in the previous paragraph is the petroleum (oil) industry. Despite the fact that production rose by more than five percent in 2009, the price for crude oil showed a tremendous drop from $147 per barrel in July 2008 to $32 per barrel in December of that year. In 2009, the oil price stayed rather low with a maximum of $80 per barrel (see Appendix I). This implies that profits of companies in petroleum (products) will most probably be much lower in 2009 than in 2008, leading to a decrease in the value added in these industries.

The number of persons employed in the PoR will also have been impacted by the crisis. However, it is difficult to stress which sectors will see larger impacts than others. As was mentioned earlier, it might be the case that industries with a highly-skilled labor force will retain their employees because they are a valuable asset to the company. On the other hand, in industries where employees are easy to fire (and hire again), the crisis' influence will be much more clear. This will most probably be the case for companies in trucking and shipping.

Finally, the number of business establishments in the PoR will also show an impact of the crisis, since it is obvious that a crisis will lead to some companies getting bankrupt and cease operations.

The impact of the crisis on the PPIs that focus on the efficiency of the port is a question mark for now. It seems logical to state that the crisis should have no influence on a port's efficiency: if a port is efficient before a crisis, why would it not be efficient during the crisis? This will probably be the case for the added value per ton of cargo: both the numerator and denominator of this fraction will decrease during a crisis. Only the added value per hectare will probably show the crisis implications, since the size of the PoR's geographical area will not have changed (significantly) during the crisis, whilst the added value did change significantly.

5 The Crisis in the Dutch Seaports: quantifying the impact

In order to investigate the real impact of the crisis on the PoR, we (Dr. M. Nijdam, Drs. L. van der Lugt and myself) conducted a research on the performance of the Dutch seaports. This chapter will explain the basic background of this research and the methodology that was used.

5.1 Introduction

The study that we carried out is a yearly Dutch research report, studying the economic development and performance of the Dutch Seaports. This development and performance is described in terms of employment, added value, private investments and the number of business establishments in the ports. We measured these performance indicators for all Dutch seaports for 2009. The study is made on behalf of the Dutch Ministry of Infrastructure and Environment and the Dutch Havenraad (i.e. *Port Council*), a consulting- and cooperation body where all Dutch seaport authorities, port companies and some relevant governmental organizations are members of (Havenraad, 2011). As such it is one of the typical examples of the Dutch political system, where consensus and consultation are considered essential, just as cooperation between multiple parties (businesses, government and society as a whole). The council tries to strengthen the competitive position of Dutch port-, industrial-, transport- and distribution cluster. The creation of knowledge and a vision for these sectors as a whole are the main goal for the council, which should be reached through the cooperation between the parties.

The Havenmonitor (*i.e. Port Monitor*), as the study is called, has been carried out by the Regionale Economie, Haven- en Vervoers Economie (i.e. *Regional, Port and Transport Economics)* department of the Erasmus School of Economics since 2008. The 2009 edition that will be assessed for this thesis was made by Dr. M. Nijdam, Drs. L. van der Lugt and myself. However, a large share of the methodology used was already developed by previous researchers: Rebelgroup/MBTS/Buck for the 2006 and 2007 edition and Dr. M. Nijdam, Drs. L. van der Lugt and B. van der Biessen for the 2008 edition.

5.2 Methodology

This paragraph will deal with the methodology used for our research. It starts with the delimitation of the research: what is taken into account and what is not. Afterwards a description of the calculations that were used will be given.

5.2.1 Delimitation

Our study investigates the employment and added value in Dutch seaports. This obviously means that there has to be some form of delimitation on what is taken into account as a seaport and what is not.

The main method used is thus based on a delimitation of multiple topics, namely: functional, sectorial and geographical. With this delimitation, the research field for the study is created. The delimitation is as follows:

- Functional:

 The government's port policy is based on two main functions of ports. On the one hand, ports are seen as nodes in transport chains. This view focusses on transport modalities, throughput, storage and distribution. The other view is based on ports as locations for industry (clusters) and as such, this focusses more on the business and service parts of ports.

- Sectorial:

The sectorial delimitation distinguishes three types of activities that take place in ports, namely, quay bound activities, seaport bound activities and seaport related activities. The first category contains activities that need quays in order to operate, such as storage and handling of cargo. The second category contains activities that require a proximity to a seaport, but not necessarily a quay. These are for example the oil refineries that are present in many ports. The latter category contains activities of which the cargo flows have a direct relation with the seaport. These activities can take place in proximity of seaports, but the presence of a seaport might not be essential for their functioning. An example would be distribution activities.

- Geographical:

The final delimitation is based on the geographical distinction that can be made in the different areas that were assessed in this study. The geographical delimitation uses multiple concepts in order to make a distinction between multiple areas, which is necessary to decide which areas should be taken into account and which areas should not be taken into account in the research. These concepts are:

- *Seaport*: a seaside port, or a port that is connected to deep waters that can handle seaworthy ships and that has a marine terminal.
- *Seaport site*: a site in a seaport that is situated next to deep waters, situated for seaworthy ships. Also sites in close proximity of seaports that have a clear connection with the port and that are managed by the port community are taken into account as seaport sites here.
- *Seaport municipality*: a municipality with a seaport within its municipal borders.
- *Seaport location*: locations that have close connections with a seaport, but that are not actually located within the borders of the seaport municipality.
- *Seaport areas*: a combination of multiple seaport municipalities (and their ports and sites) and seaport locations. These zones form multiple consecutive areas that are all geographically delimited by the North Sea

These geographical limitations finally result in the following four seaport areas:

- The *Noordelijke Zeehavens* or Northern Seaports

- The *Noordzeekanaalgebied* or North Sea channel area
- The *Rijn- en Maasmond* or Rhine- and Meuse estuary area
- The *Scheldebekken* or Scheldt basin area

This map shows the different areas:

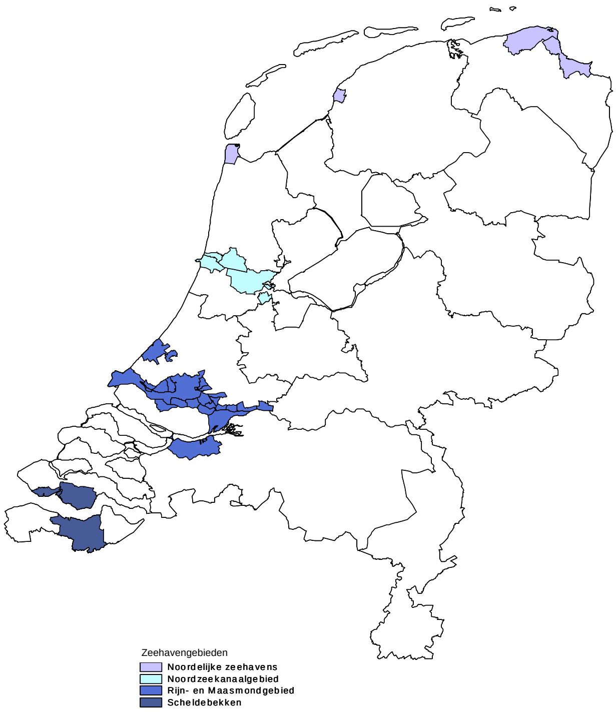

Figure 16: The Dutch seaport areas

The following table shows the multiple seaports and municipalities that are located within a specific seaport area. The fifth seaport area *Rotterdam Rijnmond*, or Rotterdam – Rhine estuary is part of the Rhine- and Meuse estuary, but is taken as a separate area in our research. This is mostly because of the fact that the Port of Rotterdam, being the largest port in The Netherlands, is situated in this area. In order to fully assess the importance of this largest port, it was separated from the other ports in this research.

Northern Seaports		**North Sea channel area**		**Rhine- and Meuse estuary area**		**Of which Rotterdam – Rhine estuary**		**Scheldt basin**	
Seaport	**Municipality**	**Seaport**	**Municipality**	**Seaport**	**Municipality**	**Seaport**	**Municipality**	**Seaport**	**Municipality**
Delfzijl	Delfzijl	Amsterdam	Amsterdam	Dordrecht	Dordrecht	Rotterdam	Rotterdam	Vlissingen	Vlissingen
Eemshaven	Eemsmond	Beverwijk	Beverwijk	Moerdijk	Moerdijk	Schiedam	Schiedam	Borsele	Borsele
Harlingen	Harlingen	Velsen/ IJmuiden	Velsen/ IJmuiden	Scheveningen	Den Haag	Vlaardingen	Vlaardingen	Terneuzen	Terneuzen
Den Helder	Den Helder	Zaanstad	Zaanstad	Drechtsteden	Alblasserdam*	Maassluis	Maassluis		
				(excl. Dordrecht)	Gorinchem* Hardinxveld-Giessendam* Hendrik-Ido-Ambacht* Nieuw-Lekkerland* Papendrecht* Sliedrecht* Zwijndrecht*	Overig Rijnmond	Albrandswaard (Rhoon)* Barendrecht* Capelle aan den IJssel* Krimpen aan den IJssel* Ridderkerk* Rozenburg* Spijkenisse*		

Table 1: Dutch seaports and seaport municipalities

After this delimitation, the areas that will be assessed are clear: all seaport areas mentioned in the table.

5.2.2 Calculating employment and added value

The two fundamental components that are investigated in our study are the employment figures and the added value in ports. How to measure these?

The first step is to make a distinction based on the following scheme:

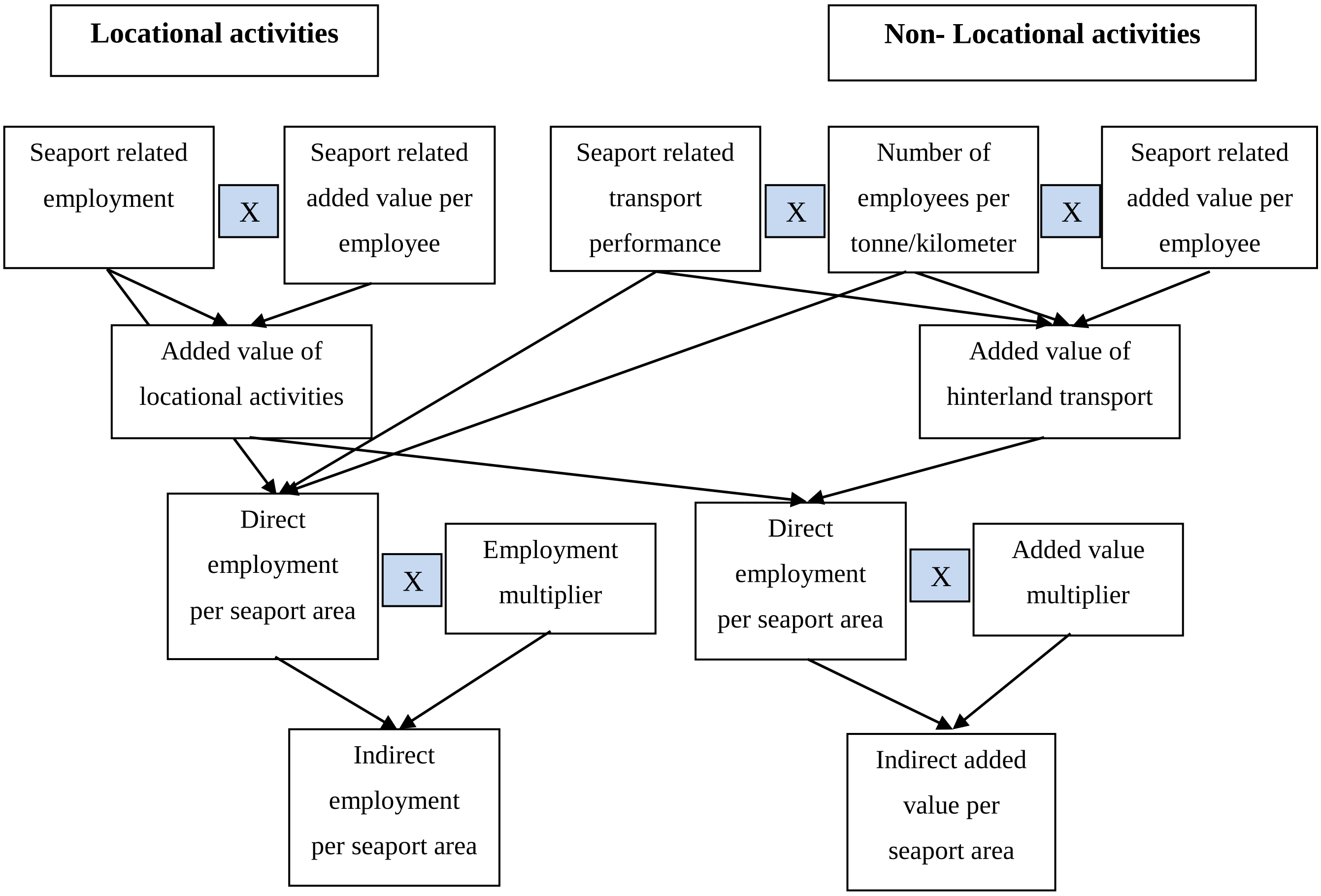

Figure 17: Calculation scheme for added value and employment in Dutch seaports

The bases for the scheme are locational and non-locational activities: These two components are used for the reason that some companies that are doing business in a port area might not be actually located there. Some transportation companies (might) have their office outside the port, whilst their actual operations are taking place from the port to the hinterland. For this reason, the added value to the economy by these companies is taken into account here: the companies are able to operate and make money due to the fact that the port is present. They use the function of the port as a node in a transport network in order to operate, whilst companies that have plants within the port are merely using the port for its locational activities.

Furthermore, there is a distinction between direct and indirect effects: direct effects are the economic effects of companies that are situated within the port areas. Indirect effects are the economic effects of companies within the port areas that buy products or services outside the port areas for use within their own company (a terminal operator buying a crane and thus, creating employment and added value for a crane manufacturer).

The scheme finally results in a part with direct employment and added value per seaport area and indirect employment and added value per seaport area. The indirect part is calculated by using a multiplier that differs per seaport area: these are calculated based on input-output models. A multiplier effect of 1.5 for example implies that besides the 1.0 direct effect of employment, there is another 0.5 effect of it in other parts of the economy.

Locational Activities

The direct employment figures are derived from the Dutch National Information system on Employment (locations): LISA or (for some ports) directly from the port authorities. The LISA figures are checked by the different port authorities, in order to make sure that solely seaport related companies are taken into account here. The port authorities also had the ability to add companies that for some reason were not part of the LISA data.

If we take a look at the data beyond the added value figures, it is important to mention that every single figure actually consists of multiple calculations. As can be derived from the scheme, the figures are calculated by multiplying the added value per person by the number of persons in order to arrive at the total added value for locational activities. For non-locational activities, a multiplication by the seaport related share of the transport performance is then needed to come up with the added value. The number of persons employed in a certain sector is readily available through the Dutch Central Bureau of Statistics: CBS. However, the other part that affects the added value for a certain industry is thus depicted by the added value per person. This can be calculated by using the input-output models (again, available through the CBS). In these input-output models, the added value per sector can be calculated by adding up the wages, the social security contributions (funds paid by employers for the insurance of their employees in case of pregnancy, incapacitation or unemployment) and the operating surplus (i.e. the cumulative difference between a company's revenue and expenditure, before taking into account taxes, rents, interests, depreciation and amortization for all companies in that sector).

This is the basis for the added value per employee calculations. In order to calculate the added value per employee for a specific sector in a specific seaport area, this figure is multiplied by a regional correction multiplier. This is a multiplier that corrects for differences in labor-productivity per sector and region, based on the size and capital intensity of the companies in a specific region. For example: a chemical refinery in the PoR will, on average, have a larger size and capital intensity than a similar company in the port of Delfzijl and as such, will have a higher added value per employee. These region corrections are based on regional economic data by the CBS.

The indirect employment per seaport area is calculated by using the direct employment figures and multiply these with an 'indirect employment multiplier'. This indirect employment multiplier is derived from CBS input-output models.

Non-Locational Activities

As mentioned earlier, some companies that are operationally dependent on seaports, but that are not necessarily settled in seaport areas are also taken into account in our study. The LISA data on companies is based on their zip code, and thus it is not appropriate to measure the added value and employment figures of companies that are not settled in the seaport areas (that have another zip code than the areas where these companies are settled). For these reasons, the following categories of companies are taken into account for the seaport-related share of their transport to/from a specific seaport area:

- freight transport by rail
- freight transport by truck
- transport through pipelines
- freight transport by inland waterway

For these four categories of transport companies, the transport performance is calculated and multiplied by the number of employees per tonne/kilometer and the added value per employee in order to be able to calculate the added value of hinterland transport per seaport area. This is done by research institute NEA. They calculate the performance indicators for the transport companies based on the weight of goods that are transshipped in the Dutch seaports. After determining the modal split of hinterland transport for every seaport, the transport performance of the Dutch share of the transport companies that are responsible for the hinterland transport is calculated. This implies that only the Dutch transport performance is used in our study, which is obvious, since the goal of the study is to show the impact of the Dutch seaports on the Dutch economy.

Overall, it is now possible to derive all earlier mentioned performance indicators that are to be used in this study by now. The added value, number of employees and number of companies within the port can be directly derived from the study. The efficiency indicators such as the added value per ton and added value per hectare can be derived by coupling the added value to statistics that were supplied by the PoR itself on throughput and on the size of the port area (Port of Rotterdam authority, 2008b, 2009d)

6 Results

This chapter will deal with the results that follow from our research. It will discuss these results, analyze them and compare them with the expectations that were mentioned in chapter 4. It starts with an overview of the most important findings, followed by a detailed investigation of all the PPIs that are assessed. This will thus include an analysis of the way in which the added value, the employment figures, the business establishments and the efficiency in the port were affected by the crisis. Afterwards, a more in-depth analysis will be applied on the impact that the crisis in the port had on other parts of the economy: the indirect effects.

6.1 Main Results

The most important findings of our study show a clear result of the economic crisis that hit the world economy in that year when compared to 2008. When looking at the Dutch situation, the direct added value in the seaports dropped by 22.7 percent to 20.5 billion euro's. When comparing this with the added value in the Dutch economy as a whole (i.e. the Gross Domestic Product) that dropped by 4.1 percent, it is clear that the crisis had a major impact on the Dutch seaports. As can be expected, the number of employees in the seaports also dropped. However, the decline in employment was far less than the decline in added value: it decreased by 4.3 percent on average. As such, the average added value per person (productivity) in the Dutch seaports decreased quite substantially in 2009. All these figures will be investigated (with a focus on the PoR) subsequently.

When focusing more on the PoR, the main object of study in this research, some of the most striking results from the influence of the crisis can be derived from our research. The number of persons working in the PoR, the number of business establishments in the PoR and their added value to the Dutch economy are reported in it. An overview of these three factors can be found in figure 18.

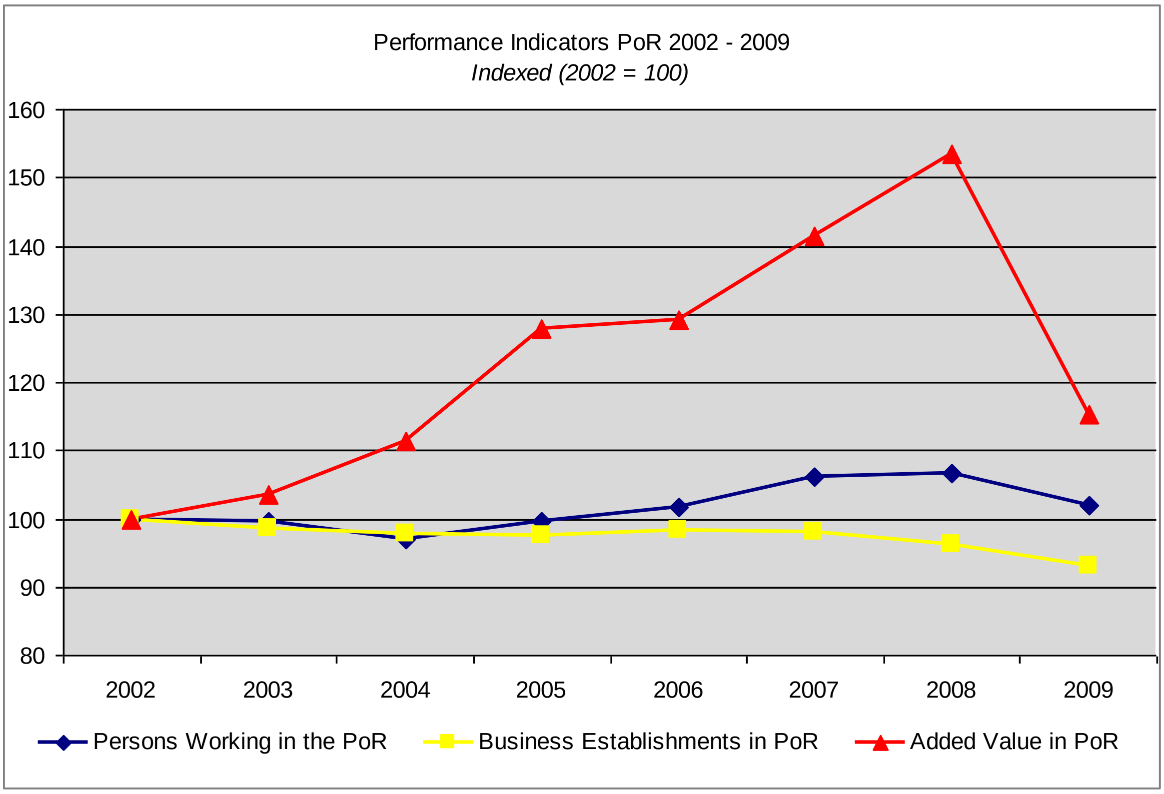

Figure 18: Performance Indicators PoR 2002 - 2009

This graph clearly shows the point where the PoR was hit most by the crisis. Where the number of employed persons dropped slightly from almost 92000 to a little less than 88000 (-4,3 percent) and the number of business establishments showed even less decrease from 1392 to 1344 (-3,4 percent), the added value of the companies in the port declined tremendously from 15,18 billion euros to 11,42 billion euros (-24,8 percent). These figures thus mean that companies in the port have overall 'survived' the first year of the crisis and did not lay off a large share of their staff. However, they were hit hard by the crisis in the sense that their added value for the Dutch economy declined. The total of the price where their product(s) or service(s) were sold at minus the costs of generating these product(s) or service(s) was much lower than it was in the years before.

The following paragraphs will give a more detailed view on the different PPIs and what they meant for the different types of companies within the PoR. In order to assess these PPIs in a logical manner, it starts with the employment in the PoR: this is a factor that is seen as 'given' in our research. It is derictly derived from the port authority's figures. When this factor is analyzed, it is possible to continue with an analysis of the added value of companies within the port. This requires a clear view of what happened with the employment figures, since the added value in our research is calculated by a multiplication of the number of employees and the added value per employee. Afterwards, the number of business establishments in the port is analyzed based on the added value figures: did this change as one could have expected from the change in added value, or not?

6.2 Employment in the PoR

As the table in the previous paragraph of this chapter showed, the added value in the PoR was the PPI that showed the largest fall during the crisis. With this large fall, the question rises what the impact was on the employment in the port: it seems logical to state that companies will put off their labor force when their ability to 'make money' decreases. In order to analyze this expectation in a more detailed manner, this paragraph will use a table from our study on the number of persons employed in the Rotterdam-Rijnmond area: the whole area under supervision of the PoR port authority (see Appendix J).

The first thing that is striking to see when observing the employment table is the fairly limited decrease in employment in between 2008 and 2009. The largest decline in employment happened in the 'node' industries, with a total drop of 4,9 percent, almost 3000 employees were laid off. Especially in road transport there was a significant fall of 7,6 percent (a little more than 2000 employees). Employees in rail transport also suffered more than average, with a 5,8 percent decrease and 80 employees laid off. This clearly indicates the size differences between road and rail transport, the first one being more than 20 times larger in employment figures. The other two categories in the transport section, maritime transport and inland waterway transport both had around 3,5 percent less workers and had to lay off 137 and 227 employees respectively. Companies in the transport related services (forwarders and shipbrokers for example) and handling/storage industries were mostly able to retain their employees during the first crisis year. In these industries the number of employees dropped by 1,6 and 2,7 percent, or around 150 and 250 employees respectively. Overall, employment figures for companies in the node section were back on 2006 levels.

The locational section showed lesser decreases in its employment figures: the section's number of persons employed dropped by 3 percent overall. The service industry (rental companies and public companies like customs, police and fire brigade) faced the largest fall in number of employees: 11,8 percent or 650 workers. Within the wholesale section that only went down by 1 percent, or 70 workers the differences are more striking than one would conclude based on the 1 percent. If we split the section by type of wholesaler, there are some categories that dismissed large number of employees (wholesalers in gas, oil and solid fuels: - 200 employees) whereas other categories hired new employees (wholesalers in cereals: +50 employees). The food industry, an industry that one would expect to be rather crisis-insensitive, faced a rather high downfall of 6,2 percent or 170 employees. Again, when splitting this category up by type of food-industry, there are large differences. Some companies fired large numbers of employees (margarines and edible fats: -12,5 percent or 180 employees, animal feed: -15 percent or 40 employees) where others hired new employees (manufacturing and refining of vegetable and animal oils: + 22 percent or 50 employees). Both the chemical industry as the metal and metal products industry shows a decrease of around 2,6 percent, with 120 and 90 employees less than in 2008. ‘Other’ industries (such as timber and paper industry, manufacture of building materials and equipment and dredging/hydraulic engineering) faced a drop of 1,8 percent, or 35 employees in 2009. This is mainly caused by the large decrease in the recycling and engines- and turbine industry, where 150 employees were laid off. The increase of 130 employees in the manufacturing of hoisting, lifting and handling equipment compensated this partly. There were three subsectors that actually hired more employees during the crisis: electricity generation (4,8 percent, 100 employees), petroleum industry (1,6 percent, 60 employees) and the transport equipment industry (1,2 percent, 20 employees). Overall, the number of employed persons in the PoR dropped 3 percent in 2009 to 56.708 persons, around the same level it was in 2006.

The question is: what will be the impact of these changes in employment figures on the added value for specific industries or subsections within the PoR? Does a decrease in employees automatically mean a decrease in added value (and the other way around?)? These questions will be assessed in the following paragraph.

6.3 Added Value in the PoR

The table in the first paragraph clearly showed that the added value in the PoR was the PPI with the largest fall (-24,8 percent) during the crisis. In order to analyze this fall in a more detailed manner, this paragraph will use a table from our study on the added value in the Rotterdam-Rijnmond area, comparable to the one used in the previous paragraph (see Appendix K). This table contains the direct added value created in companies that are settled within the PoR area (the industries that are part of the ‘locational’ sector) or that are operationally dependent on the PoR (the industries that are part of the ‘node’ sector). Both sectors are split up in subsectors that contain the different types of companies that we distinguished in our research. First of all, the main observations from the table will be discussed after which an analysis will follow that deals with the background from the figures in the table: where are they based upon and what do they mean?

6.3.1 Added Value: observations from our research

If we look at the last two years of the table for the different industries, one can observe that there is a large difference between their performances: this is further clarified by the final column that shows the differences as a percentage. The heaviest decline in the added value can be observed in the industrial subsector: it went down 38,7 percent. The main reason for this can be found in the petroleum (-61,2 percent) and chemical (-35,5 percent) industry. These two industries were responsible for more than 65 percent of the added value in the locational section of the PoR in 2008 and as such, their performance has a major impact on the overall performance of the locational section. This also implies that the relatively slight decrease (between -10,4 and -2,4 percent) in performance of the other subsectors of the locational section is hardly influencing the overall section's performance. The locational industries' added value dropped on average by 34 percent, with electricity generation as the only subsector performing positive with an 8,6 percent growth. Overall, the locational sector was back at a performance level similar to 2004.

The other section, where the port is seen as a 'node' by the primary industries of this section, showed much less decreases in its performance. It overall went down by 14,8 percent, with the maritime transport part as the subsector with the largest decline (-39,8 percent). This large decline is also the main reason for the 14,8 overall decrease: all other sectors performed less bad, with decreases between 14,8 and 3,7 percent. Overall it implies that the 'node' section was back at a performance level similar to 2006.

6.3.2 Added Value: analysis of the figures

If we look at the added value from the perspective of the previous sub-paragraph, it clearly shows us the effect of the crisis on certain industrial sectors. However, it does not show the way in which these figures are composed. We know from the previous paragraph that most sectors were hit, but it is not clear from the plain figures how the parameters affecting the added value were affected by the crisis. As was described in the methodological paragraph, the added value figures consist of a multiplication of the added value per person in a sector by the number of persons working in that sector. This implies: the change in added value in a specific port sector is caused by a change in the number of employees and a change in these employees' productivity (as added value per person). The first part - the number of persons working in a sector – was assessed in the previous paragraph. This paragraph will focus on the other three components of the added value: the sum of the wages, the social security contributions and the operating surplus. If we look at the different sectors and their changes in added value during the crisis, it is interesting to see where these sectors were hit.

When recalling the table from Appendix K on the added value and looking at the striking drops in some of the sectors, the way in which the added value per person is constructed can elucidate the effects of the crisis extensively. First of all, we have to take into account the fact that the added value per person in a seaport is calculated by using the region corrections that rectify the lower or higher performance in specific industries in specific seaports. These corrections have stayed the same for all the years our research was performed. The figure that thus impacts the change in added value in a seaport most, is the added value per person for a specific industry for a specific year. This is calculated in our research by dividing the sum of the wages, social security contributions and operating surplus in an industry by the total number of employees (as given by the CBS) in that industry. For every industrial sector in our research an overview of the changes in these factors will be given and analyzed here. It is important to mention that the influence of the wages and the operating surplus are the most influential factors in the input-output models. The social contributions provide for only 12 percent of the added value on average, whilst the wages and the operating surplus both account for more than 40 percent of the added value.

6.3.2.1 Transport

In the transport sector, Maritime Transport, Inland Waterway Transport, Road Transport, Rail Transport and Pipeline are the subsectors. In the input-output models used for calculating the added values, the categories used are 'maritime transport', 'inland waterway transport', 'cargo transport' (for both Road Transport and Rail Transport) and 'pipeline transport'. This implies that for both road and rail transport, the basic added value figure will be the same, however, by using region corrections and the change in the number of employees, a different final figure for the added value appears in the table in Appendix K.

For *maritime transport*, the added value figure dropped by 39,8 percent or almost 300 million euros. More specifically, the passenger shipping part went down by -42,8 percent (from 431,5 to 246,8 million euros) and the cargo shipping part by -35,7 percent (from 311 to 200 million euros). It is important to mention that the passenger shipping part also contains the large ferry lines such as Stena line and P&O ferries and therefore it is relatively large when compared to the cargo shipping part. Consulting the input-output model (i.e. the added value without any corrections for number of employees or regional performance), a 38,4 percent decrease can be observed when comparing the 2008 and 2009 figures. This is mostly caused by a staggering fall of 58,45 percent in the operation surplus that was realized in the sector. Something that can be clearly derived from the Baltic Dry Index (Appendix O), an index that on a daily basis assesses the price for moving raw materials by sea (Baltic Exchange, 2012). From the table in the appendix, it is clear that shipping prices showed a huge drop from the second half of 2008 on. This has clearly had its influence on the price that the maritime transport business could set for its services in 2009. This huge drop in the operation surplus could not be offset by the wages and social securities: these two surprisingly did not drop, but even increased slightly by 4,7 and 1,4 percent respectively. All in all, we can conclude that for maritime transport, the income from operations has decreased fiercely in 2009. Since the decrease in number of employees was only minor, this implies that their added value per person dropped significantly. We can calculate this by using the following formula:

$$\boldsymbol{Added\ Value} = added\ value\ per\ employee \times number\ of\ employees\ \times regional\ correction$$

We know that the added value changed by 39,8 percent (i.e. = 60,2 percent), the regional correction remains the same and the number of employees has dropped by 3,4 percent (i.e. = 96,6 percent). This implies that the added value per employee changed by:

$$0.602 \div 0.966 = 0.623$$

The added value per employee for 2009 was 62,3 percent of what it was in 2008, which implies that it dropped by 37,7 percent. Overall this means that both a drop in the number of employees as a drop in their productivity lead to the decrease in the added value for this industry. The latter one had a far larger share in the drop of total added value and obviously, the highest fall in productivity can be assigned to the operating surplus.

For *inland waterway transport*, the added value figure dropped by 'only' 5,8 percent. The passenger shipping part went up by 2,34 percent (from 9,46 to 9,68 million euros), whereas the freight shipping part went down by 6,01 percent (from 376,8 to 354,2 million euros). The latter subcategory's performance obviously influences the inland waterway section for a large share. Consulting the input-output model again, a 3,3 percent decrease can be observed when comparing the 2008 and 2009 figures. The fall is largely caused by the operation surplus, that dropped by 9,31 percent. Also the social securities dropped, although with a somewhat lower rate (2,86 percent). The wages increased quite considerably (by 5,88 percent), but could not offset an overall decrease for the inland waterway transport.

If we recall the formula from the previous page and fit it for the inland waterway transport, we know that the added value dropped by 5,8 percent (i.e. = 94,2 percent), the regional corrections is still the same and the number of employees dropped by 3,7 percent (i.e. = 96,3 percent). This implies that the added value per employee changed by:

$$0.942 \div 0.963 = 0.978$$

The added value per employee for 2009 was 97,8 percent of what it was in 2008, which implies that it dropped by 2,2 percent. Overall this means that both a drop in the number of employees as a drop in their productivity lead to the decrease in the added value for this industry. In this case, the fall in the number of employees was larger than the fall in their productivity. Again, the highest fall in productivity can be assigned to the operating surplus.

For both *road and rail transport*, the same basic input-output model was used, namely 'cargo transport'. This implies that their basic added value was the same. However, a difference in their final added values occurs due to the fact that their number of employees has changed from 2008 to 2009 in a different manner. For road transport, the added value dropped by 12,6 percent (from 1708 to 1492 million euros) and for rail transport, the added value dropped by 11,0 percent (from 76 to 68 million euros). In their input-output model, the overall drop in added value was 9,82 percent, with wages dropping 3,11 percent, social contributions rising 0,11 percent and the operation surplus dropping 25,52 percent.

If we fit the previously used formula for *road transport*, we know that the added value dropped by 12,6 percent (i.e. = 87,4 percent), the regional corrections is still the same and the number of employees dropped by 7,6 percent (i.e. = 92,4 percent). This implies that the added value per employee changed by:

$$0.874 \div 0.924 = 0.946$$

The added value per employee for 2009 was 94,6 percent of what it was in 2008, which implies that it dropped by 5,4 percent. Overall this means that both a drop in the number of employees as a drop in their productivity lead to the decrease in the added value for road transport. In this case, the fall in the number of employees was larger than the fall in their productivity. Again, the highest fall in productivity can be assigned to the operating surplus.

If we fit the previously used formula for *rail transport*, we know that the added value dropped by 11,0 percent (i.e. = 89,0 percent), the regional corrections is still the same and the number of employees dropped by 5,8 percent (i.e. = 94,2 percent). This implies that the added value per employee changed by:

$$0.89 \div 0.942 = 0.946$$

As can be expected from the calculation for road transport, the change in added value per employee for rail transport is the same in our research, due to the fact that their input-output category is the same.

For the *pipeline* industry, with only very limited number of employees (53 in 2008 and 51 in 2009), the added value per person is enormous when compared to the other industries in the transport subsector. The added value dropped by 3,7 percent (from 123 to 118 million euros). In their input-output model, the overall drop in added value was 3,67 percent, with the largest drop in wages (12,5 percent), a lesser drop in the contribution surplus (3,4 percent) and the social contributions staying equal. These figures show the minimum influence of the wages for this sector: they account for only 7 million euros of the total 236 million euros in added value. The social contributions thus are minor as well (only 2 million euros) and by far the largest share comes from the operation surplus (227 million euros).

If we fit the previously used formula for *pipeline*, we know that the added value dropped by 3,7 percent (i.e. = 96,3 percent), the regional corrections is still the same and the number of employees dropped by 4,6 percent (i.e. = 95,4 percent). This implies that the added value per employee changed by:

$$0.963 \div 0.954 = 1.009$$

The added value per employee for 2009 was 100,9 percent of what it was in 2008, which implies that it increased by almost 1 percent. This means that for the pipeline industry, the drop in the number of employees and a drop in the added value did not influenced the added value per person: the fall in the numbers of employees was larger than the fall in the added value and as such, the added value per person even increased during the crisis.

6.3.2.2 Transport Related Services

For *transport related services*, the added value dropped by 9,0 percent (from 1.661 to 1.511 million euros). However, we cannot use this category as a whole here, due to the fact that two input-output categories are used for the calculation of the added value of transport related services. These categories are: services for land transport and services for water transport. The calculations are as follows: of the 1.661 million euros in 2008, 648,8 million euros can be assigned to the 'water' part of the transport services and 1012,6 million euros can be assigned to the 'land' part of the transport services. These dropped to 584,7 and 926,6 million euros respectively in 2009. The added value for the water part thus dropped by 9,87 percent and for the land part by 8,49 percent. The input-output models show added value decreases of 14,0 percent for the water part and 7,96 percent for the land part. The water part's input output model faced a large decrease in operating surplus by 18,2 percent, whereas the wages and social contributions rose by 1,4 and 3,5 percent. The land part's input output model shows almost the same picture, with operating surplus decreasing by 17,9 percent and wages and social contributions rising by 0,3 and 4,4 percent. However, it is striking to see that for the water part, the wages only accounts for a little more than 20 percent of the added value and the operating surplus accounts for 75 percent of it. For the land part, the wages have a much higher share of the added value, namely 47,6 percent. The operating surplus accounts for 42,3 percent.

From the employee figures, we know that the water part accounts for 2310 (2008) and 2369 (2009) employees (a 2,55 percent increase) and the land part for 9119 (2008) and 8872 (2009) employees (a 2,7 percent decrease). Now all figures are known, we can again fit the formula for the added value per employee change to this industry. For the water part this is:

$$0.901 \div 1.026 = 0.878$$

This implies that the added value per person for the water part of transport related services dropped by 12,2 percent in 2009. Even though more employees were hired, the added value for the industry did not rise, leading to a much lower added value per employee.

For the land part of the transport related services the following figures apply:

$$0.915 \div 0.973 = 0.940$$

This implies that the added value per person for 2009 dropped by 5,96 percent. The layoff of workers could not prevent a drop in their productivity.

6.3.2.3 Handling/Storage

For handling and storage, the same functions apply as were applicable for transport related services. That is, the categories of input-output models that are applicable for this industry are again the water and land transport related services. As such, the same way of calculating the added value per employee will be used.

The distribution between the water and land part of transport related services for the handling and storage industry is as follows: of the 2.627 million euros in 2008, 2.436 million is for the water part and 191 million is for the land part. Of the 2.240 million euros in 2009, 2.055 million is for the water part and 185 million is for the land part. These figures imply a 15,64 percent decrease for the water part and a 3,14 percent decrease for the land part.

The input-output model figures are the same as they were for the transport related services and thus can be found there. The employment figures show an overall drop of 2,7 percent for handling and storage. The water related part accounts for a drop from 7858 to 7547 employees (-3,96 percent) whereas the land related part shows small growth from 1747 to 1802 employees (3,15 percent). Applying the formula for the added value per employee for the water part results in the following figures:

$$0.843 \div 0.960 = 0.878$$

This implies that the added value per person for the water part of transport related services dropped by 12,2 percent in 2009: the same figure as in the previous sub-paragraph for the water part of transport related services. This is no coincidence due to the fact that the same basic tables were used in calculating the number.

For the land part of the handling and storage the following figures apply:

$$0.969 \div 1.032 = 0.94$$

This implies that the added value per person for 2009 dropped by 5,96 percent. Due to the growth in the number of employees, the added value per person relatively decreased even more than the added value did overall.

6.3.2.4 Industry

For the industrial sector, a division is made in seven subsectors. All these subsectors gather their data from different input-output models, just as it was the case for the transport related services and handling/storage. However, in many of the industry sectors, the number of input-output models that is used for the calculation of the added value is rather high (up to seven categories of input-output models). This implies that for the purpose of clarity, these will not all be assessed as extensively as was done in the previous sub-paragraphs. The two most important sectors in terms of added value for the PoR, the petroleum and chemical industry will be analyzed carefully though. These together accounted for a third of the added value in the PoR in 2008, a figure that dropped to less than a quarter in 2009: a tremendous change with large consequences for the port. For this reason, these two sectors will be discussed first.

In the *petroleum industry* the added value decreased by 61,2 percent (from 2.904 to 1.128 million euros). This industry consists of the two input-output categories 'petroleum refining' (that went down from 2.798 to 1.067 million euros, a 61,9 percent decrease) and 'petroleum extraction' (that went down from 106 to 60 million euros, a 43,4 percent decrease). It is thus obvious that the petroleum refineries in the PoR account for a very large share of the added value. If we look at the input-output models for these two categories the following numbers apply: for the refineries, the total added value decreased by 63,4 percent. This figure was mostly influenced by the operating surplus, which dropped by 75 percent and that thus accounted for the largest share (85 percent) of the operating surplus in 2008. This enormous drop does not come unexpected when one again looks at the graph in Appendix I on the crude oil prices in 2009: these were very low and thus, profits for the large went down. The wages and social contributions increased very slightly, by 0,94 and 2,59 percent but this does not have a significant influence on the final figures: they are much too small in comparison to the operating surplus. For the petroleum extraction, the downfall in operating surplus was less heavy than for the refineries: -30 percent (from 20,5 to 14,3 billion euros) for the Netherlands as a whole. The wages and social contributions increased by 5,76 and 5,98 percent, but these are again very small when compared to the operating surplus.
If we look at the change in the number in employees in this industry, from the previous paragraph we can conclude that this shows a somewhat contradictory figure: it increased by 1,6 percent. More specifically, the refineries hired 57 persons (from 3336 to 3393 employees: a 1,71 percent increase) and the extraction sector fired 3 persons (from 20 to 17 employees: a 15 percent decrease).
Now all data is known again, we can fit the formula for the added value per person and show how this changed from 2008 to 2009. For the refineries, the formula is as follows:

$$0.381 \div 1.017 = 0.375$$

This implies that the added value per person in the oil refineries in the PoR dropped by a staggering 62,5 percent in 2009.
For the extraction industry, the formula is as follows:

$$0.698 \div 0.85 = 0.821$$

This implies that the added value per person in the oil extraction industry in the PoR dropped by 17,9 percent in 2009.

In the *chemical industry* the added value decreased by 35,5 percent (from 2.220 to 1.432 million euros). For this industry, there are more input-output categories, namely: *basic chemicals, inorganic chemicals, petrochemicals, fertilizers, chemical end products* and *rubber & synthetics*. In order to keep a good overview of the added value changes in these industries, the following table is constructed:

Industry subsector	Added value 2008	Added value 2009	Change
Basic chemicals	€ 195,108,087	€ 125,854,319	-35.50%
Inorganic chemicals	€ 422,894,631	€ 244,821,624	-42.11%
Petrochemicals	€ 1,013,204,548	€ 819,625,652	-19.11%
Fertilizers	€ 581,508,692	€ 232,908,193	-59.95%
Chemical end products	€ 5,886,335	€ 7,158,585	21.61%
Rubber & synthetics	€ 1,165,552	€ 1,351,164	15.92%

Table 2: Chemical subsector's added value (2008-2009)

From the table, it is clear that petrochemicals, fertilizers and inorganic chemicals were the most important subsectors for the added value in the PoR's chemical cluster. However, all three industries faced rather high drops in added value, with fertilizers hit hardest by the crisis. The reasons for these changes (on a national level) can be found in the following table, which shows the changes between the different added value parameters in 2008 and 2009. It clearly shows that for most industries the decrease in operating surplus was the main reason for the drop in added value.

Industry subsector	Wages 2008	Wages 2009	Social Contributions 2008	Social Contributions 2009	Operating Surplus 2008	Operating Surplus 2009
Basic chemicals	831	815	247	247	1504	660
Inorganic chemicals	157	146	48	45	199	67
Petrochemicals	641	586	189	178	3232	2592
Fertilizers	101	98	29	27	727	200
Chemical end products	1662	1589	492	481	734	1207
Rubber & synthetics	1259	1200	322	294	399	637

Table 3: Chemical subsector's wages, social contributions and operating surpluses (2008-2009)

If we now look at the relative difference between 2008 and 2009 and the relative importance of the different factors for the total added value, the following table applies. It shows again that the largest changes for the added value in the chemical industry can be assigned to the large fall in operating surplus that the companies in the industry faced in 2009. However, it is striking to see that chemical end products and rubber & synthetics industries realized (much) higher operating surpluses despite the crisis.

Industry subsector	Wage difference 2008-2009	Social Contributions difference 2008-2009	Operating Surplus difference 2008-2009	Wages as a share of total added value 2009	Social Contributions as a share of total added value 2009	Operating Surplus as a share of total added value 2009
Basic chemicals	-1.93%	0.00%	-56.12%	47.33%	14.34%	38.33%
Inorganic chemicals	-7.01%	-6.25%	-66.33%	56.59%	17.44%	25.97%
Petrochemicals	-8.58%	-5.82%	-19.80%	17.46%	5.30%	77.23%
Fertilizers	-2.97%	-6.90%	-72.49%	30.15%	8.31%	61.54%
Chemical end products	-4.39%	-2.24%	64.44%	48.49%	14.68%	36.83%
Rubber & synthetics	-4.69%	-8.70%	59.65%	56.31%	13.80%	29.89%

Table 4: Chemical subsector's wages, social contributions and operating surpluses: differences and relative share (2008-2009)

From the employment statistics, the following table can be derived:

Industry subsector	Employees 2008	Employees 2009	Change
Basic chemicals	638	637	-0.16%
Inorganic chemicals	1659	1552	-6.42%
Petrochemicals	1399	1414	1.07%
Fertilizers	748	723	-3.34%
Chemical end products	39	38	-1.30%
Rubber & synthetics	14	14	0.00%

Table 5: Chemical subsector's employees (2008-2009)

Now all data is known again, we can fit the formula for the added value per person and show how this changed from 2008 to 2009. Since we cope with the large amount of industries, another table was created, with the changes in added value and employees as the input and the final change in added value per employee as the output:

Industry subsector	Change in added value	Change in employees	Change in added value/employee
Basic chemicals	0.645	0.998	0.644
Inorganic chemicals	0.579	0.936	0.542
Petrochemicals	0.809	1.011	0.818
Fertilizers	0.401	0.967	0.387
Chemical end products	1.216	0.987	1.200
Rubber & synthetics	1.159	1.000	1.159

Table 6: Chemical subsector's change in added value, employees and added value/employee (2008-2009)

The figures from the table tell us that for most of the chemical industries, the added value per employee dropped by quite a high number (from 61,3 percent for fertilizers to 18,2 percent for petrochemicals). The two exceptions are the chemical end products and the rubber & synthetics, that both increased their added value per employee by 20,0 and 15,9 percent respectively.

The final industrial sector that will be discussed extensively is the *electricity generation*. The reason for this is the fact that this sector was the only industrial sector that grew during the crisis. The added value increased by 8,6 percent (from 628 to 628 million euros). The industry consists of one group of input-output categories, namely: 'energy companies'. This category shows a rather high increase in added value from the input output models: 9,9 percent. The wages were the figure that had the highest growth percentage, namely, 13,67 percent. The other two components of the input-output added value also grew, the social contributions by 6,92 percent and the operating surplus by 9,46 percent. The latter component was the one that mostly influenced the added value, it accounted for 83,2 percent of the sector's added value in 2009, the wages accounted for 13,1 percent and the social contributions for 3,7 percent.

Looking at the change in the number of employees for energy companies in the previous paragraph gives us the following figures: it increased by 4,8 percent to 2.051 employees in the PoR. With all figures known, we can fit the formula for the added value per person again:

$$1.086 \div 1.048 = 1.036$$

This implies that the added value per person in the electricity generation industry increased by 3,6 percent in 2009. This is a figure that is hard to explain when one takes into account how the energy prices dropped in 2009 (see Appendix P). One would expect that electricity generating companies would have suffered from the lower energy prices: their profits should be lower. However, it seems that they have been able to benefit from the crisis, which implies that they either have been able to ask a higher margin on their product from their customers or that they paid a lower price for their raw materials needed in producing energy (coals or natural gas mostly).

For the other four categories within the industry section, the information regarding the added value and its background can be found in the Appendix. This is not analyzed extensively due to the fact that these industries are of minor influence for the PoR's performance.

6.3.2.5 Wholesale

The *wholesale* industry faced an 8,7 percent downfall in added value (from 659 to 602 million euros) in 2009 in the PoR. Its input-output categories consist of both the general 'wholesale' category and the 'car wholesale' category. For the general wholesale, the added value dropped by 8,82 percent. The operating surplus lost most of its value, with an 18,14 percent decrease. The wages and the social contributions also decreased, but to a much lesser extent: 0,09 and 2,69 percent respectively. These figures also show that there is a more even distribution between the wages and the operating surplus when comparing them with other industries: in 2009, the wages accounted for even a higher share of the added value than the operating surplus. For car wholesale, the added value dropped by 18,15 percent and again, the operating surplus accounted for the largest part of this share. It dropped by 58,53 percent, whereas the wages and the social contributions only dropped by 0,84 and 2,38 percent respectively. This sector is one of rare examples where the operating surplus is accounting for a relatively small share of the added value (15 percent in 2009). The wages accounted for almost 70 percent of the added value.

The number of employees in the wholesale sector dropped by 0,98 percent from 7213 to 7142 employees in the PoR. With this, we can calculate the change in the added value per employee:

$$0.913 \div 0.990 = 0.922$$

Overall, this implies that the added value per employee in the wholesale industry in the PoR dropped by almost 7,8 percent. The main reason for this is the large downfall in added value in the industry that was caused by a much lower operating surplus.

6.3.2.6 (non-) Business Services

The final industry category for the added value analysis is that of the *(non-) Business Services*. This is a rather mixed up category with multiple input-output classes in it. These are: *rental of goods*, *other business services*, *environmental services*, *general administration*, *defense*, *other general administration & social insurance*, *general administration & municipality* and *other services*.

Again, in order to keep a good overview of the added value changes in these industries, the information will be put in tables.

Industry subsector	Added value 2008	Added value 2009	Change
Rental of goods	€ 126,366,274	€ 104,133,429	-17.59%
Other business services	€ 37,843,516	€ 28,727,210	-24.09%
Environmental services	€ 121,868,348	€ 116,793,269	-4.16%
General administration	€ 210,131,571	€ 179,519,294	-14.57%
Defense	€ 5,406,344	€ 2,667,351	-50.66%
Other G.A. & social insurance	€ 45,158,627	€ 47,220,248	4.57%
G.A. & municipality	€ 47,363,144	€ 53,248,585	12.43%

Table 7: (non-) Business services subsector's added value (2008-2009)

From the table, it is clear that rental of goods (like ships, cars, trucks and other machines), environmental services (recycling of waste) and general administration (the seaport related part of the administration) were the most important subsectors for the added value in the PoR's services companies. All three were hit by the crisis, with lowered added values between 17,6 and 4,2 percent. The defense department in the PoR was hit hardest by the crisis and saw half of its added value diminish. On the other hand, the 'other general administration' under which the police is operational, almost restored this downfall in the defense department due to its growth of 4,6 percent. The 'general administrations and municipality', under which the fire department is operational, even faced an increase of 12,43 percent in added value.

The reasons for these changes (on a national level) can be found in the following table, which shows the changes between the different added value parameters in 2008 and 2009. It is striking to see how large the social contributions part is, for most of this category. That is probably mainly due to the fact that a large number of the organizations in this subsector are government organizations.

Industry subsector	**Wages 2008**	**Wages 2009**	**Social Contributions 2008**	**Social Contributions 2009**	**Operating Surplus 2008**	**Operating Surplus 2009**
Rental of goods	740	762	199	193	3838	3470
Other business services	3270	3430	806	844	1973	1893
Environmental services	664	702	191	202	1034	1116
General administration	5965	6146	2468	2539	2829	2896
Defense	2175	2256	1567	1527	643	629
Other G.A. & social insurance	4760	5083	1559	1703	1282	1368
G.A. & municipality	5074	5345	1901	2047	5886	6107

Table 8: (non-) Business services subsector's wages, social contributions and operating surpluses (2008-2009)

If we now look at the relative difference between 2008 and 2009 and the relative importance of the different factors for the total added value, the following table applies. It clearly shows the larger influence of the social contributions and the wages on the organizations in this sector (with an exception for the rental of goods and the environmental services).

Industry subsector	**Wage difference 2008-2009**	**Social Contributions difference 2008-2009**	**Operating Surplus difference 2008-2009**	**Wages as a share of total added value 2009**	**Social Contributions as a share of total added value 2009**	**Operating Surplus as a share of total added value 2009**
Rental of goods	2.97%	-3.02%	-9.59%	17.22%	4.36%	78.42%
Other business services	4.89%	4.71%	-4.05%	55.62%	13.69%	30.70%
Environmental services	5.72%	5.76%	7.93%	34.75%	10.00%	55.25%
General administration	3.03%	2.88%	2.37%	53.07%	21.92%	25.01%
Defense	3.72%	-2.55%	-2.18%	51.13%	34.61%	14.26%
Other G.A. & social insurance	6.79%	9.24%	6.71%	62.34%	20.89%	16.78%
G.A. & municipality	5.34%	7.68%	3.75%	39.60%	15.16%	45.24%

Table 9: (non-) Business services subsector's wages, social contributions and operating surpluses: differences and relative share (2008-2009)

From the employment statistics, the following table can be derived:

Industry subsector	Employees 2008	Employees 2009	Change
Rental of goods	1143	1050	-8.16%
Other business services	831	633	-23.91%
Environmental services	1839	1737	-5.52%
General administration	1866	1576	-15.52%
Defense	68	34	-50.37%
Other G.A. & social insurance	757	744	-1.78%
G.A. & municipality	530	570	7.65%

Table 10: (non-) Business services subsector's employees (2008-2009)

Now all data is known again, we can fit the formula for the added value per person and show how this changed from 2008 to 2009. Since we cope with a large amount of industries, another table was created, with the changes in added value and employees as the input and the final change in added value per employee as the output:

Industry subsector	Change in added value	Change in employees	Change in added value/employee
Rental of goods	0.824	0.918	0.757
Other business services	0.759	0.761	0.578
Environmental services	0.958	0.945	0.905
General administration	0.854	0.845	0.722
Defense	0.493	0.496	0.245
Other G.A. & social insurance	1.046	0.982	1.027
G.A. & municipality	1.124	1.077	1.210

Table 11: (non-) Business services subsector's change in added value, employees and added value/employee (2008-2009)

The figures from the table tell us that two of the governmental organizations performed fairly well and even saw an increase in their added value per employee. However, it is striking to see that in all the other cases, not only the added value dropped significantly, but also the number of employees dropped. This implies that a large share of the employees in the services industry was laid off. Furthermore, most of the organizations saw quite a decrease in added value per employee, ranging from 'only' 9,5 percent for environmental services to 75,5 percent for the defense department.

The goal of this paragraph was to show how the added value in the different sectors that are operational in the PoR changed during the crisis. It showed how the added value was constructed by the three parts (wages, social contributions and the operating surpluses) and how this related to the added value per employee. The following paragraph will analyze the effect of the (mostly) lowered added value in the port on the number of businesses establishments.

6.4 Business Establishments in the PoR

As the first two chapters showed, the added value in the PoR was the PPI that showed the largest fall during the crisis. With this large fall, the question rises what the impact was on the business establishments in the port: it seems logical to state that (some) companies will have to go bankrupt or cease operations if their ability to 'make money' decreases. In order to analyze this expectation in a more detailed manner, this paragraph will use a table from our study on the number of persons employed in the Rotterdam-Rijnmond area (see Appendix L). For this study, the term business establishment is used in the same manner as the data provider, LISA, uses it: "A location of a company, institution or sole practitioner (i.e. any factory, workshop, office, shop or other business premises, or any complex thereof) in which or from which an economic activity or self-employed profession is being exercised by at least one person."

A striking thing in the table is probably the fact that there is no data available on the number of business establishments for the transport companies (except for maritime and inland waterway transport). This is caused by the fact that in our study, the performance of companies that offer hinterland transport services is determined separately as was explained in paragraph 5.2 on methodology. As such, the largest share of transport related companies within the port is not taken into account in the tables.

Due to the fact that there are quite some categories with a very limited number of companies in them, a minor change (i.e. a decrease of 1 company) might already have a large impact on the percentage decrease. For this reason, one should preferably look at the actual decrease in the number of companies to see the impact of the crisis.

When looking at the change in the number of business establishments, the companies within the 'node' section faced the largest impact of the crisis: there was a 3,9 percent decrease. This is mainly due to the fact that the number of service providers (-9,6 percent) and 'other' companies (-15,5 percent) went down. In the wholesale subsector, the actual decrease in the number of business establishments was as large as it was for service providers (-12 establishments), but this was relatively less due to the fact that the number of wholesale establishments is much larger.

In the node section, the subsector on transport related services had the largest absolute decrease with 13 fewer business establishments (-3 percent). The largest percentage decrease took place in the maritime transport subsector, where there were 6,5 percent fewer business establishments. Overall, this section faced a 3 percent decrease in the number of business establishments. For the whole category of business establishments, the 3,5 percent drop means that the downward trend of the pre-crisis years has continued in a somewhat increasing manner.

If we look at the downfall in number of business establishments, it is quite obvious that there seems to be a similarity between it and the downfall in the number of persons employed. When comparing the two tables, many of the industries show rather similar downfalls in persons employed and business establishments.

6.5 Efficiency Measures for the PoR

The efficiency measures for the PoR were not directly used in the research as investigated by us. However, they are fairly easy to be derived using data from the PoR and the data as used for the previous paragraphs.

The two efficiency PPIs that are to be measured for this thesis are the added value per hectare and the added value per ton of throughput. For the first one, there is very limited data available which makes it impossible to analyze this PPI for multiple categories of companies. The PoR port authority supplies a yearly factsheet, '*De haven in cijfers*' (i.e. The port in figures) in which the total size of the port area is mentioned. The total size of the port area is given in both the size of all industrial sites and business premises, the size of the infrastructure (both water and land) and the total size of the port area. For this PPI, it is obvious that only the size of the industrial sites and business premises will be used: these are the actual locations where companies are settled. However, there is no distinction made on the size of the land area that the different industries use: there are only cumulative numbers available for the whole port area. As such, it is only possible to measure this PPI for the port as a whole. In calculating the added value per hectare of land, the two 'De haven in cijfers' reports for 2008 and 2009 (PoR Authority, 2008b and 2009d) were used. In these it is stated that the total hectares of industrial land and business premises for 2008 and 2009 were respectively 5.257 and 5.167. Combining these with the added values (see Appendix J) of 15.181 and 11.422 million euro's results in added value per hectare figures of €2,888 million per hectare for 2008 and €2,211 for 2009: a 23,4 percent decrease.

The second efficiency PPI, the added value per ton of throughput is calculated in the same manner as was done for the added value per hectare. The data on tons of throughput is again available in the 'De haven in cijfers' reports. The total throughput of cargo for 2008 and 2009 was respectively 421.098.000 and 386.957.000 metric tons. The added values of 15.181 and 11.422 million euros are the same as used earlier. Combining the two figures leads to an added value per metric ton of throughput of €36,05 for 2008 and €29,52 for 2009: a 18,1 percent decrease.

6.6 Indirect Effects of the Crisis

Besides the direct effects of the crisis for the PoR that were discussed up till this point, we also investigated the indirect effects: the effects of the crisis in the port that had its influence in other parts of the economy as well. In order to find these results, we have to recall paragraph 5.2 on the methodology of our research. The indirect effects are calculated by using input-output models as they are provided by the Dutch Central Bureau of Statistics (CBS). With these input output models, so called added value- and employment multipliers are created. These are the earlier mentioned multipliers that show the percentage of both the added value and employment figures that emerge outside the ports due to their existence. For every input-output category (the same as were used for the calculation of the direct effects) the added value and employment multipliers are different, based on a sector's economic performance in a specific year.

In our research, these indirect effects were both measured for the port as a whole and per industry sector. Thereby they give a clear overview of what the total indirect added value and employment of the PoR is and what industry sectors are important for these indirect effects. As opposed to the direct added value, the calculation of the indirect added value is not dependent on the number of employees. Both the indirect added value and the indirect number of employees are derived from the direct effects by using multipliers. For this reason, it is not necessary to first analyze the changes in number of employees and afterwards the changes in the added value. Therefore, this paragraph starts with an analysis of the indirect added value since it is regarded to give a better overview of the influence of the crisis than the employment figures.

6.6.1 Indirect Effects: Added Value

When looking at the table (see Appendix M), it is clear that the indirect effects that occur from the presence of the PoR, are enormous: more than 55 percent of the added value that is created within the PoR is additionally generated throughout The Netherlands due to the PoR's existence in 2009. However, in 2008 this figure was much lower: almost 49 percent. The total indirect added value dropped from 7.428 million euros to 6.382 million euros: a decrease of 14,1 percent, whereas the direct added value (as was shown in paragraph 6.3) dropped by 24,8 percent. This implies that the performance of businesses within the PoR has been relatively worse compared to that of related businesses in the rest of the country. This paragraph tries to show the reasons for this by analyzing the underlying economic parameters that were used to calculate this in our research.

6.6.1.1 Transport

In the transport sector, the overall drop in indirect added value was 13,6 percent (from 1.162 to 1.005 million euros) in 2009. Thereby it accounted for 15,75 percent of the total indirect added value. This is much lower than the size of the transport sector in the PoR itself, where it accounts for 21,79 percent of the added value: this clearly shows the relative importance of the transport industry for the PoR when comparing it to the rest of the country. This is obvious since transport still plays an important role in ports. When comparing the specific industries' performances in the sector (*maritime transport*, *inland waterway transport*, *road transport*, *rail transport* and *pipeline*) with that of their performances in the direct added value (in Appendix K) some striking differences appear. The maritime transport's part of the indirect added value (18 percent) is much smaller than it is in the direct added value (30,8 percent). This is mainly due to the fact that the road transport and inland waterway transport companies are relatively much bigger outside the PoR (which is obvious taking into account where these companies are operational: the hinterland). If we look at the downfalls in indirect added value percentages for the specific industries the largest downfall can be seen in the inland waterway transport (-22,9 percent). This is caused by the fact that both the direct added value decreased and the indirect added value's multiplier decreased in 2009. This large downfall is striking when compared to the downfall in rail (-9,5 percent) and road transport (-11,1 percent). These sectors fulfill the same role (hinterland transport), but have been hit by the crisis to a lesser extent. This is mostly due to the fact that the added value multiplier for cargo transport slightly increased, whilst the direct added values decreased.

6.6.1.2 Transport Related Services

In transport related services, the drop in indirect added value was 7,8 percent in 2009 (from 583 to 538 million euros). It accounted for 8,43 percent of the total indirect added value. This is rather low when compared to the amount where it accounts for in the direct added value (13,23 percent). It implies that just as the transport industries, the transport related services are relatively bigger in the PoR than in the rest of the economy. This is making sense: the transport related services are the core business for the node function of ports and thus, will generate the largest amounts of money within the ports. If we look at the reasons for the decrease in indirect added value, the two parts of transport related services (water and land) have to be taken into account again. The direct added value of the two components was already discussed in paragraph (-9,87 percent for land and -8,49 percent for water). However, the added value multiplier for the water part of transport related services slightly increased from 1,177 to 1,186. The multiplier for the land part stayed even at 1,463 and thus, the drop in indirect added value for transport related services was less than the drop in direct added value.

6.6.1.3 Handling/Storage

In handling and storage, the drop in indirect added value was 9,9 percent in 2009 (from 520 to 468 million euros). It accounted for 7,33 percent of the total indirect added value. In this industry, this figure is again, much lower when compared to the relative share that it has for the direct added value. Handling and storage namely accounts for almost 20 percent of the added value within the PoR.

Again, it shows that the transport sector is still very important in the port. Furthermore it is obvious that this sector does not generate large amounts of added value in other parts of the economy due to the fact that its activities are merely taking place at places where cargo is moved and ports are very large examples of these sort of places. For this sector, the same multipliers were used as for the transport related services, and as such, the indirect added value for handling/storage performed relatively better than its direct added value.

Overall, the node function of the port relatively does not generate a large amount of added value in other parts of the economy. Its total contribution to the indirect added value is 31,5 percent, whereas it contributes to more than 54,6 percent of the direct added value in the PoR. The added value multipliers in this section are on average much lower than they are in the locational section and thus lead to a lowered average indirect added value. This can be explained by the fact that many of the activities taking place in the node function are relatively independent of other industry sectors.

6.6.1.4 Industry

In the industrial subsection the indirect added values are relatively much larger than they are in the node function of the port. In 2009 it accounted for 68,5 percent of the indirect added value of the PoR with a value of 4.371 million euros (a 15,3 percent decrease compared to the 5.163 million euros in 2008). The decrease in indirect added value for the overall industry section is much lower than it was for the direct added value within the PoR. This implies that the added value multipliers for companies within this section increased during the crisis.

Just as was the case in the direct added value, the chemical and petroleum cluster are causing the largest amount of indirect added value for the economy. It is striking to see that the indirect added values of the chemical and petroleum industry did not drop as much due to the crisis as the direct added value did. The drop in the petroleum industry was only 16,3 percent (compared to 61,2 percent in direct added value) and the drop in the chemical industry was 18,8 percent (compared to 35,5 percent in direct added value). This implied that the indirect added value multipliers have increased. This is the case for most multipliers in the chemical industry: all increased, except for the rubber & synthetics. For the petroleum industry, the refinery part’s multiplier increased from 1,65 to 2,44, which obviously had a large impact on the indirect added value.

In electricity generation, the indirect added value accounts for 10,4 percent of the total industry section’s indirect added value. This is a decrease when compared to 2008, when it still accounted for 12,3 percent of the indirect added value in industry. As such, there thus was a decrease in the indirect added value for electricity generation. This is unexpected when one takes into account the 8,6 percent increase that the section made in direct added value. The cause of this decrease is the drop of the added value multiplier of the energy companies from 1,91 to 1,66 in 2009.

6.6.1.5 Wholesale

In the wholesale subsection, the indirect added value accounts for a smaller part of the total added value than in the direct added value. With an indirect added value of 225 million euros, 3,53 percent of the total indirect added value can be assigned to the wholesale sector. In the direct added value, this share is 5,27 percent. The indirect added value changed from 238 to 225 million euros (a 5,3 percent decrease). When comparing this to the 8,7 percent decrease that wholesale faced within the port, it means that the added value multiplier increased from 1,336 to 1,35.

6.6.1.6 (non-) Business Services

In the (non-) business services, the indirect added value is about the same size as it is in the direct added value: 4,1 percent compared to 4,7 percent in 2009. In 2008 these figures were 3,6 percent and 3,9 percent. In absolute numbers, the indirect added value of the business services was 269 million euros in 2008 and 260 million euros in 2009. If we look at the reasons for the drop in this category, we have to recall the tables from paragraph 6.3.2.6. These can be used to analyze the change in the added value multipliers. When calculating the changes in indirect added values, it is striking to see the difference between the sectors. This is mostly caused by the large differences that were already present in the direct added value. The added value multipliers did not change by very large numbers (between -5,6 and +6,1 percent).

Industry subsector	Change in added value	Change in added value multiplier	Change in indirect added value
Rental of goods	0.824	1.061	-12.57%
Other business services	0.759	0.991	-24.78%
Environmental services	0.958	0.984	-5.73%
General administration	0.854	0.991	-15.37%
Defense	0.493	1.049	-48.28%
Other G.A. & social insurance	1.046	1.047	9.52%
G.A. & municipality	1.124	1.014	13.97%

Table 12: (non-) Business services subsector's change in added value, added value multiplier and change in indirect added value (2008-2009)

Overall, the change in indirect added value figures showed us that these are for many sectors influenced for a large share by the direct added value figures (i.e. the added value multipliers stayed around the same level between 2008 and 2009). However, in some cases the added value multipliers increased by such large numbers (for petroleum and chemicals for example) that the indirect added values were much less influenced by the crisis. In other cases, such as the energy producing industry, the figures changed the other way around and thus, the indirect added values were much more influenced by the crisis. On average, the added value multipliers have increased. This can be derived from the fact that the overall change in indirect added value for the PoR was 14,1 percent (from 7.428 to 6.382 million euros), whilst the overall change in direct added value was 24,8 percent (from 15.181 to 11.422 million euros). The largest fall occurred in the locational function of the port, where the indirect added value dropped by 15,3 percent whereas the node function experienced a decrease of 11,2 percent.

6.6.2 Indirect Effects: Employment

When analyzing the impact of the crisis on the indirect employment that results from the presence of the PoR, the table in Appendix N is used. The most right column of the table clearly indicates which sectors' indirect employment figures were influenced most by the crisis. Especially the node function, with transport, transport related services and handling and storage was hit hard in terms of the numbers of employees that were laid off. In inland waterway transport, more than 22 percent (or 456 employees) of all employees that worked in the sector due to the PoR lost their jobs. And although the percentages for maritime transport and road transport were lower (-15,9 and -8,6 percent), the absolute decreases in these sectors were enormous as well: -652 and -610 employees. In transport related services and handling and storage, the percentages were also modest (-9,2 and -11,5 percent), the absolute values here are also large: -608 and -642 employees. This implies that overall, the node function lost almost 3000 employees (11,6 percent) due to the crisis. It can thus be concluded that employees in the transport (related) sectors generally have little job security: during a crisis they are quickly dismissed. When comparing the drops in indirect employment with the drops in indirect added value for the node section of the PoR, the two seem to be very much related. A downfall in added value leads to a comparable downfall in employment. This implies that manpower is still very important in this sector: less work thus simply means less trucks/barges/ships/trains/cranes/forklifts have to be operated and thus layoffs are unavoidable.

If we compare the node section with the locational section, the differences are quite striking. Despite the fact that the added value in the locational section decreased more than it did for the node section, the layoffs in the latter section were much higher. Despite a 15,3 percent drop in indirect added value, the locational section only faced a 4,4 percent drop in its indirect employment. Especially the industrial part of the locational section showed very little direct consequences from the crisis, with a 3,9 percent decrease in the number of employees. In the wholesale and service parts the decreases were slightly higher (6,2 and 6,3 percent), but still not comparable to what happened in the node section. The reason for this will probably be that most companies in the locational section tried to retain their employees for the times when the economy would recover: appropriate staff will be difficult to find for many of them. Another reason could be that large share of the companies in the locational section is very large and thus, labor unions will be active there. This implies that the employees are protected better during a crisis.

7 Conclusion and recommendations for further research

This chapter will give an overview of the outcomes of the previous chapter, compares these with each other and with the expectations that were given in the fourth chapter. This finally results in an overview of what the PoR experienced as a whole during the crisis. The chapter ends with some limitations of this thesis that could be countered in further research.

7.1 The Port of Rotterdam during the crisis: main findings

The main findings from this thesis, as shown in chapter six are derived from the research by Dr. M. Nijdam, Drs. L. van der Lugt and me. These figures are in a sense self-explanatory: they show the results from the crisis for the Port of Rotterdam on multiple performance indicators. However, when combining these figures and studying what happened to the performance on the different PPIs brings in some striking results. This is especially the case when comparing the added value figures with the employment figures: for transport related businesses the figures make clear that these are rather labor-intensive industries. When the added value in these industries drops (inland waterway -5,8 percent, road transport -12,6 percent and rail transport -11 percent), the number of persons employed also drops (inland waterway -3,7 percent, road transport -7,6 percent and rail transport -5,8 percent). This implies that in a poor economic situation, employees in these industries will be laid off very quickly. This is easily explained by the fact that most of the employees in these industries will be relatively low-skilled and thus, are assumed to be readily available when needed again.

The impact of the crisis on the maritime transport sector is showing an even larger effect than it had on the other transport sectors: the added value dropped by almost 40 percent. However, employees were relatively spared, with a decrease of only 3,4 percent. This would imply that the employees in this sector might be very hard to fire due to legislation or union power. Another reason could be that there is a larger share of highly skilled labor that is assumed to be difficult to recruit when the economy recovers.

When comparing the added value figures with the employment figures for industries that face a larger share of highly educated people (petroleum and chemical industry for example) a contrary picture shows up. Although both of these industries faced enormous drops in their added value (-61,2 percent for petroleum and -35,5 percent for chemical), this was in no way reflected by a change in the number of persons employed in these sectors: for chemicals it dropped by 2,6 percent and for petroleum it even increased by 1,6 percent. This implies that these industries are relatively insensitive towards the economic situation when looking at the lay-off of their employees. This can be explained by the fact that it will be very difficult for these companies to find the right people: engineers and technicians will be very hard and costly to recruit and as such these are retained during an economic downturn.

The number of business establishments in the port has also dropped during the crisis. Despite the fact that there already was a downward trend in the number of business establishments from 2006 on, this got worse during the crisis. In general however, one cannot draw clear conclusions from these figures: only for maritime transport, wholesale and (non-) business services, there was a significant drop (more than 5 business establishments less). It implies thus that most companies within the PoR were able to survive the first year of the crisis.

The impact of the crisis on the indirect added value and indirect employment that is generated due to the presence of the PoR was also analyzed. The indirect added value figures showed that especially companies in the locational function of the port faced the consequences of the crisis in their added values. Although it did not drop as heavily as was the case for the direct added value, the downfall in added value was quite substantially for the petroleum and chemical industry. The node function's indirect added value also dropped for a large share of the businesses, with especially the inland waterway transport being hit. When comparing the added value figures with the employment figures, it is striking to see that the employment in the node function decreased much more than the employment in the locational function: contrary to what the added value figures would predict. This implies that the employees in the node function will (on average) either be less protected by unions or will be easier to hire again when the economy is growing again.

Comparing the influence of the crisis from a cluster perspective, with the port as a place in a transport network and a place where production takes place, the influence of the crisis on the added value is much larger on the latter port function. The added value in the locational section of the port dropped 34 percent between 2008 and 2009, whilst the added value in the 'node' section dropped 14,8 percent. This implies that the industrial cluster is being affected much more by the economic fluctuations in the late 2000s than the transport function.

If we look back on the expectations for the PoR that were derived from the newspaper journals and Eurostat data in the fourth chapter, most of them are in line with what actually happened. However, based on the Eurostat production data, one could never have expected the enormous drop in added value for both the chemical and the petroleum industry. In the Eurostat production data for the Netherlands, the production for coke and petroleum products even increased by 5 percent in 2009, whilst the production of chemical decreased with 'only' 7 percent. The Eurostat trade data, based on the value of exported and imported goods, did show a large drop for both imports and exports of both mineral fuels (-31,76 percent and -20 percent) and chemicals (-17,93 percent and -4,69 percent).

However, these figures are much smaller than the decrease in added value that the PoR experienced for these two industries.

The overall conclusion for the Port of Rotterdam from the crisis is the fact that the port has gone through an extremely difficult time: with throughputs going down, the traditional node function of the port was strained, resulting in the laying off of staff and a reduction in added value. On the other side, the locational function of the port, with a large industrial cluster, was not spared from the effects of the crisis either. The main issues for the businesses in this sector were the enormous drops in added value. Laying off staff was no option for many of the companies due to the presence of a large share of high skilled labor.

7.2 Suggestions for further research

This thesis assessed the influence of the late 2000s financial crisis on the Port of Rotterdam. Besides the obvious performance indicators such as port throughput, additional indicators were used to measure the port's performance. Thereby, the different functions of the port have been used to show the impact of the crisis, both within the port as throughout the economy.

With this method as a basis, it is possible to conduct further research on ports. It would certainly be interesting to apply the same method for the same timeframe on the ports where Rotterdam is competing with (the earlier mentioned Hamburg – Le-Havre range). By doing so, the relative performance of these different ports on the port performance indicators could be measured. From the viewpoint of competition between these ports this could be very interesting. Another suggestion for further research would be to look at the Port of Rotterdam's ability to recover from a crisis and thus to conduct this study for 2010 as well. I am very curious on what happened to the petroleum and chemical clusters in the port, which were hit hardest by the crisis: will they be able to recover from it.

There could also be a more policy based sequel to this thesis, when one would be more interested in the question on how the Port of Rotterdam should cope with a crisis or how it can prepare itself for a future crisis. It might be possible to advice port authorities and their investors about their role in an attempt to minimize the influence of a crisis. On the other hand, such a research could also look at the social consequences of a crisis in the port: it is striking to see the decrease in the number of employees. This is obviously a point where many policymakers would be interested in.

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Appendices

Appendix A: Economic Outlooks – IHS Global Insight

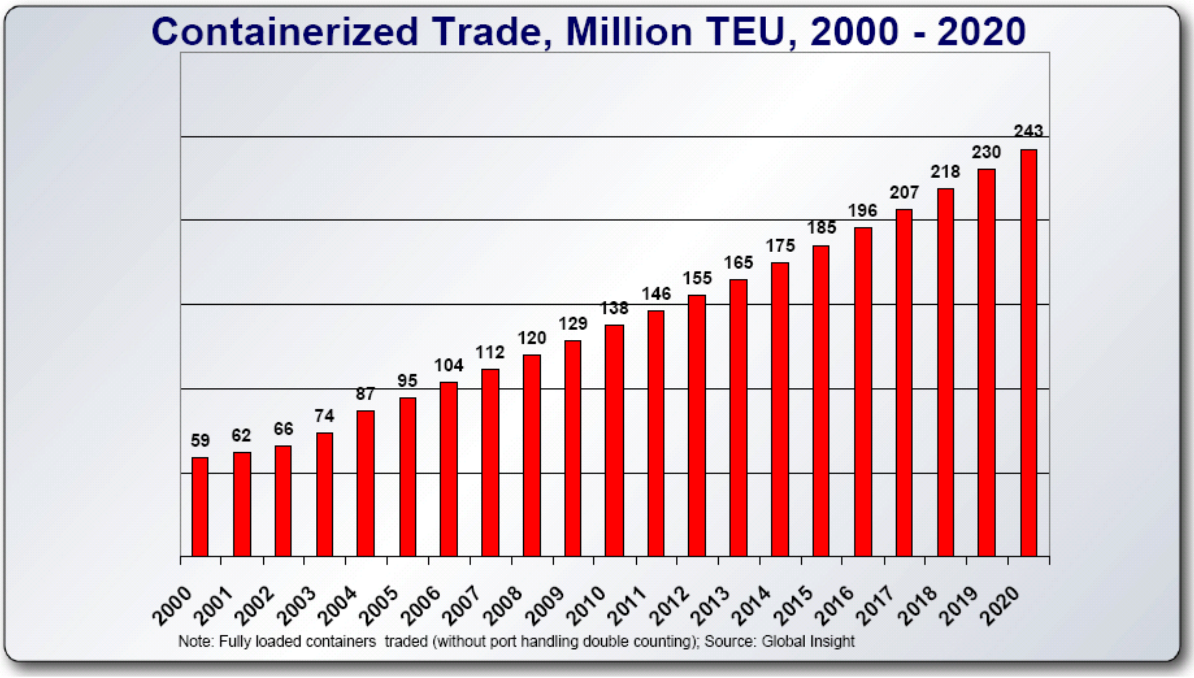


Figure 19 Global Containerized Trade in million TEUs between 2000-2020 (Bingham, 2007)

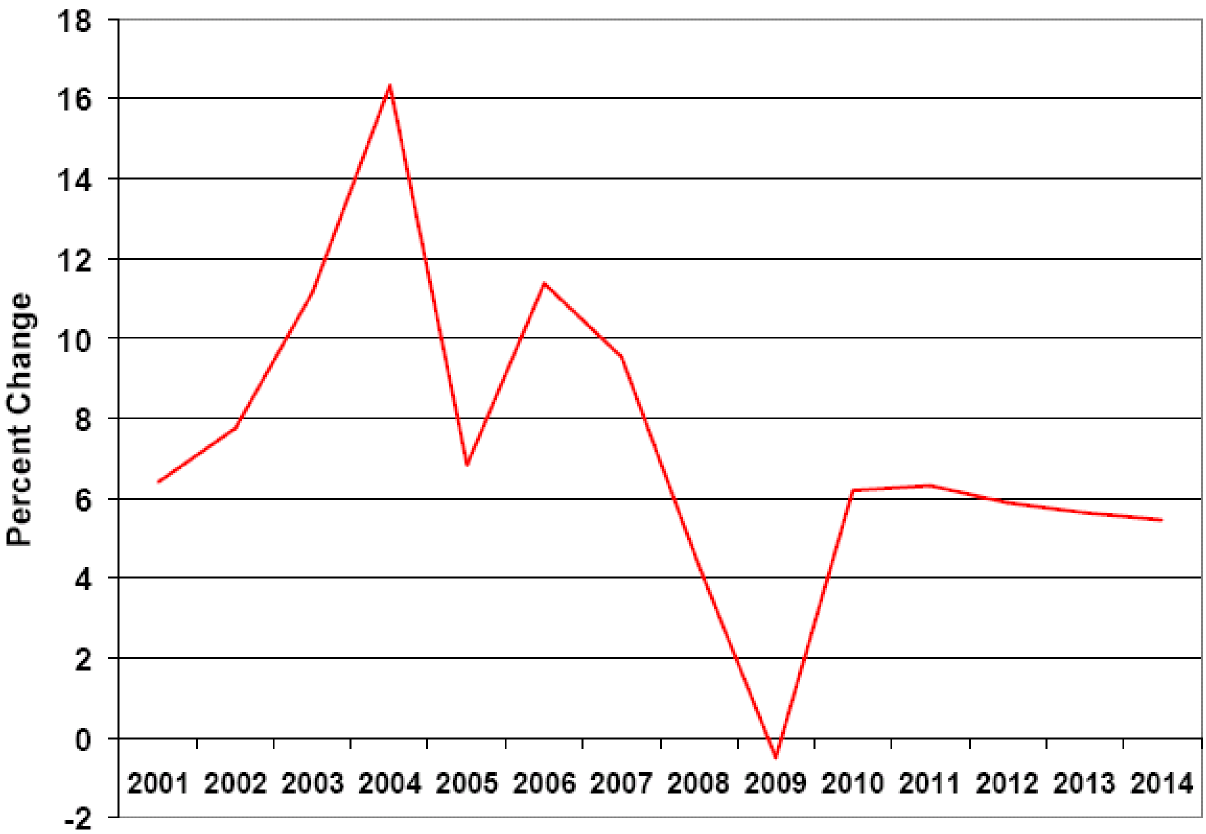


Figure 20: Global Containerized Trade growth percentages 2001-2014 (Bingham, 2009)

Appendix B: Newspaper's headlines 'crisis in the PoR'

30/12/2008 "2009 lastig jaar voor haven Rotterdam" (*2009 will be a difficult year for the Port of Rotterdam*) http://www.volkskrant.nl/vk/nl/2680/Economie/article/detail/931813/2008/12/30/2009-lastig-jaar-voor-haven-Rotterdam.dhtml

30/12/2008 "Rotterdamse haven verwacht krimp in 2009" (*Port of Rotterdam expects shrinkage in 2009*) http://vorige.nrc.nl/economie/article2107941.ece/Rotterdamse_haven_verwacht_krimp_in_2009

31/12/2008 "Na topjaar wacht Rotterdamse haven tegenspoed" (*After a peakyear, the Port of Rotterdam faces distress*) http://www.volkskrant.nl/vk/nl/2680/Economie/archief/article/detail/928986/2008/12/31/Na-topjaar-wacht-haven-Rotterdam-tegenspoed.dhtml

09/04/2009 "Overslag Rotterdamse haven daalt 10,8 procent" (*Throughput in the Port of Rotterdam drops 10,8 percent*) http://www.volkskrant.nl/vk/nl/2680/Economie/article/detail/328416/2009/04/09/Overslag-Rotterdamse-haven-daalt-10-8-procent.dhtml

10/04/2009 "Haven Rotterdam draait nog slechter dan al werd verwacht" (*Port of Rotterdam performes even worse than expected*) http://www.volkskrant.nl/vk/nl/2680/Economie/archief/article/detail/327573/2009/04/10/Haven-Rotterdam-draait-nog-slechter-dan-al-werd-verwacht.dhtml

15/07-2009 "Overslag Rotterdamse haven fors gedaald" (*Throughput in Port of Rotterdam drops significantly*) http://vorige.nrc.nl/economie/article2300969.ece/Overslag_Rotterdamse_haven_fors_gedaald

16/07/2009 "Haven Rotterdam: de bodem is bereikt" (*Port of Rotterdam: the bottom has been reached*) http://www.volkskrant.nl/vk/nl/2680/Economie/archief/article/detail/339917/2009/07/16/Haven-Rotterdam-bodem-is-bereikt.dhtml

29/07/2009 "Leegstand in haven door Tweede Maasvlakte" (*Vacancies in port due to second Maasvlakte*) http://www.volkskrant.nl/vk/nl/2680/Economie/archief/article/detail/344185/2009/07/29/Leegstand-in-haven-door-Tweede-Maasvlakte.dhtml

30/12/2009 "Havens slaan minder over dan vorig jaar" (*Less troughput in ports compared to last year*) http://vorige.nrc.nl/economie/article2447926.ece/Havens_slaan_minder_over_dan_vorig_jaar

Appendix C: Port Performance measures for a lean port

Table 2
Proposed measures for evaluating the 'multimodal process'

1. Timeliness in picking up shipment and in delivering it
2. Reliability of transit time/transport availability
3. Responsiveness of transport suppliers in meeting customers' requirements
4. Adaptability of existing processes to customers' requirements
5. Flexibility of operations
6. Accuracy of information regarding status of shipment
7. Accuracy in processing information
8. Compliance with customers' requirements
9. Value for money
10. Notification of any changes in the multimodal process
11. Level of damages in the shipment
12. Overall transport cost
13. Lead-time to service delivery
14. Level of conflict with other processes
15. Employee interaction with customers

Table 3
Measures of port effectiveness—the case of a ship's discharge at port

'*Port discharge process*' performance indicators	1. Ship's waiting time to be berthed 2. Berth availability 3. Ship's waiting time to start discharging operations 4. Handling rate of discharge operations 5. Time waiting for cargo to be transferred from one mode to another (time in storage and time from quay to storage) 6. Time spent in transferring cargo from storage to net mode of transport (including loading time) 7. Time spent in carrying out logistics activities required by customers that add value 8. Time for goods to be cleared (if such is to be done at port level) 9. Time spent by cargo awaiting departure of next mode of transport (road or rail) 10. Overall time of cargo in port 11. Annual costs incurred by the port 12. Degree of flexibility in using resources 13. Degree of process adaptability in meeting customer requirements 14. Port costs by unit of cargo handled (TEUs if containers, tons if break-bulk or bulk cargo)

Table 4
Measures of transport operators' effectiveness—the case of ship operation

'*Ship process*' performance indicators	1. Ship's time spent in route deviations 2. Time spent carrying out ship repairs due to engine breakdowns 3. Total time delays 4. Keeping track of goods on board 5. Ship's capacity utilisation 6. Annual cost of sea transport 7. Ship costs by unit of cargo carried (TEUs if containers, tons if break-bulk or bulk cargo) 8. Overall transit time 9. Degree of flexibility in using ship's resources 10. Degree of process adaptability in meeting customer requirements 11. Number of voyages performed per year

Table 5
Measures of infrastructure effectiveness—the case of road infrastructure

'*Road infrastructure process*' performance indicators	1. Delays caused by road works 2. Delays caused by congestion 3. Easiness of entry and exit from highways 4. Design of road network 5. Inter-connectivity of road networks at a national and international level

Appendix D: Currently used PPIs for different port products

Table 3: PPIs for the cargo transfer product

Type of PI	PPI	Example of port that collects this PPI
Output indicators	Throughput volumes Value added of port Investment level in port Market shares in hinterland regions	Virtually all ports Belgian & Dutch ports Antwerp Long Beach
Upgrading indicators	Number of 'first port of call' services Value of goods passing though the port EDI use in port	Halifax Most ports in US Antwerp
License to operate indicators	Modal split hinterland traffic Index of port dues at 'real prices' Custom revenues from port	Rotterdam Dampier Long Beach

Source: Annual Reports port authorities

Table 4: PPIs for the port logistics product

Type of PI	PPI	Example of port that collects this PPI
Output indicators Upgrading indicators	Warehouse area (m^2) Time to majo consumer markets	Antwerp and Rotterdam New Orleans
License to operate indicators	No indicators found	—

Table 5: PPIs for the port manufacturing product

Type of PI	PPI	Example of port that collects this PPI
Output indicators	Value added in port related manufacturing Investments in port manufacturing	Dutch & Belgian ports Dutch ports
Upgrading indicators	Number of major chemicals available in port (compared to other major chemical manufacturing sites –mostly ports)	Antwerp
License to operate indicators	Emissions of greenhouse gasses	Rotterdam

Table 6: PPIs for the port as a whole

Type of PI	PPI	Example of port that collects this PPI
Output indicators	Value added of port Investment level in port	Belgian & Dutch ports Antwerp
Upgrading indicators	Certification of management programmes Average wage port industries compared to regional economy	Stockholm Tacoma
License to operate indicators	Number of environmental accidents Water quality in port Employment in port region Economic impact of a port	Queensland Valencia Long Beach Most large ports

Appendix E: New PPIs for different port products

Table 7: New PPIs for the cargo transfer product

Port product	Type of PI	New PPI
Cargo transfer	Output	Ship turn around time Connectivity index
	Upgrading	Throughput per square meter
	License to operate	Consumer benefits from lower transport costs

Table 8: New PPIs for the port logistics product

Port product	Type of PI	New PPI
Port logistics	Output	Percentage of goods to which value is added in port region
	Upgrading	Land price Value added (or employment) per square meter
	License to operate	-

Table 9: New PPIs for the port manufacturing product

Port product	Type of PI	New PPI
Port manufacturing	Output	Investment level manufacturing sites
	Upgrading	Productivity port industries Wage level port manufacturing industries
	License to operate	-

Table 10: New PPIs for the port as a whole

Port product	Type of PI	New PPI
Port as a whole	Output	-
	Upgrading	New establishments Number of patents Education levels employees Wage level port industries
	License to operate	Housing prices in vicinity of port

Appendix F: NL and EU27 import and export 2000-2001

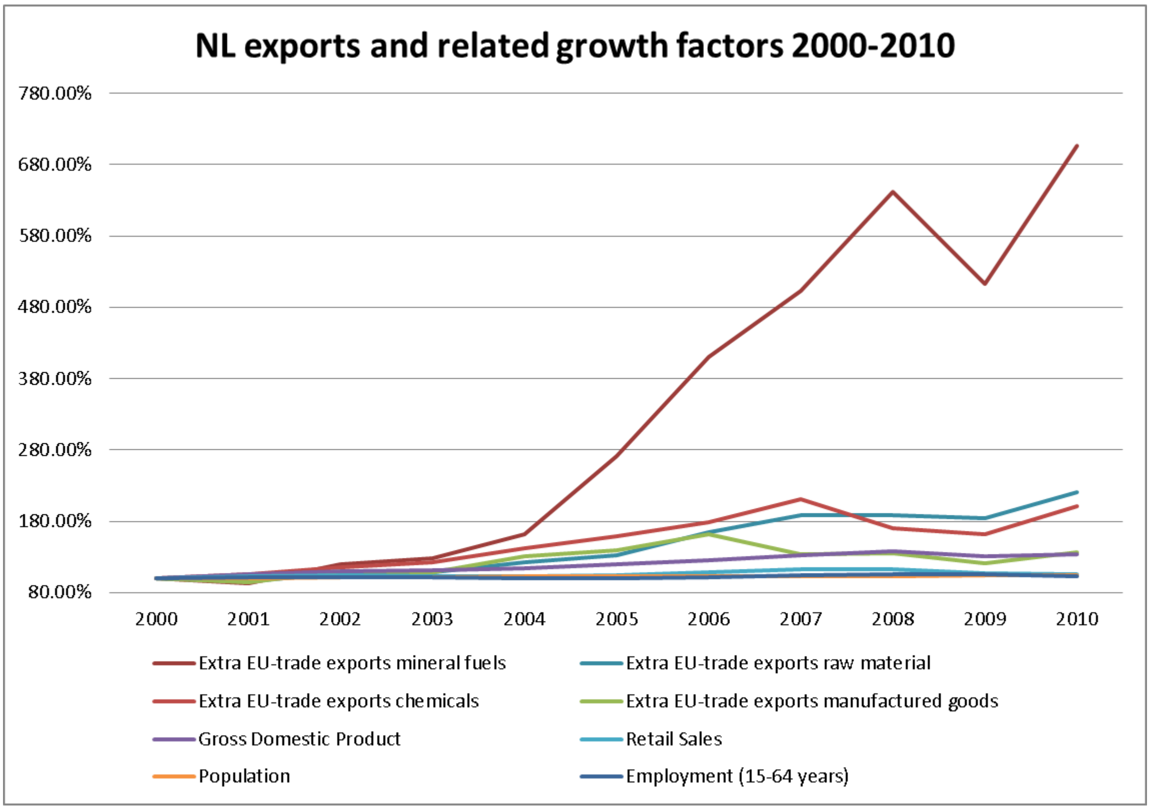


Figure 21: Dutch exports and related growth factors 2000 – 2010 (Eurostat, 2012a)

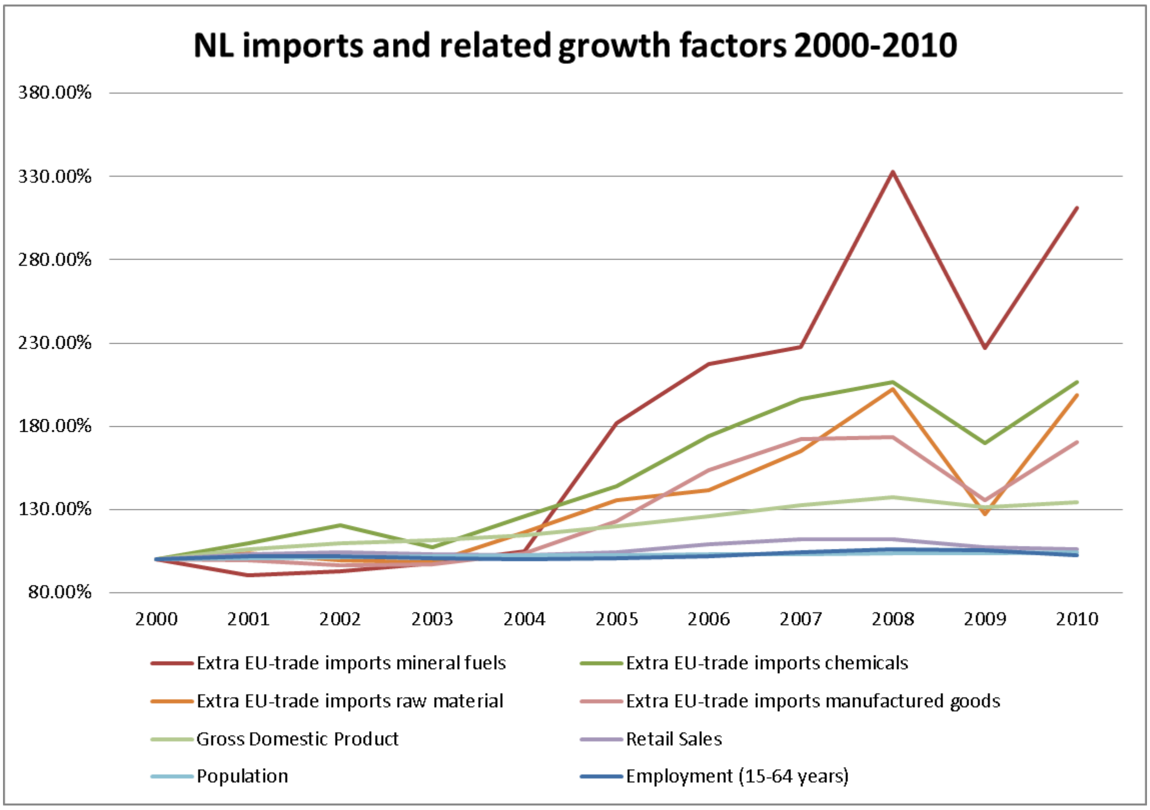


Figure 22: Dutch imports and related growth factors 2000 – 2010 (Eurostat, 2012a)

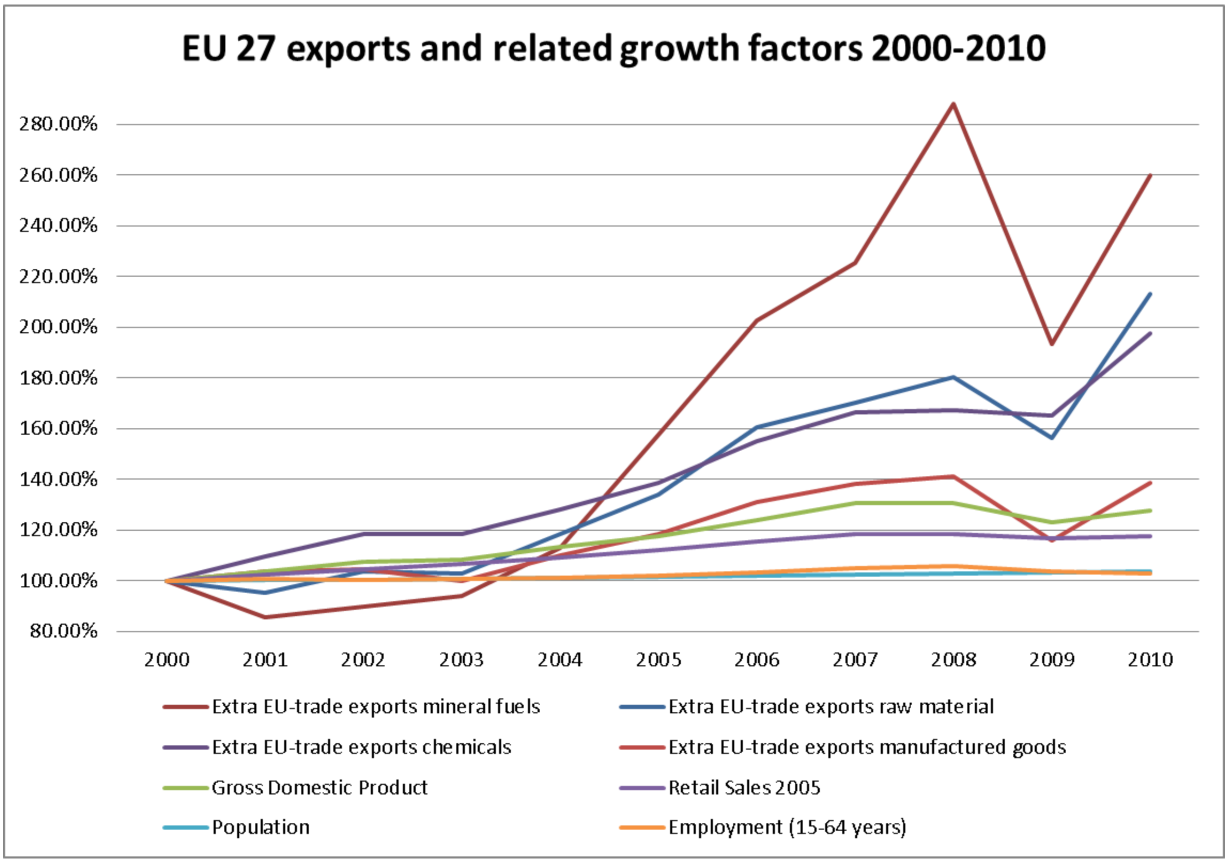


Figure 23: EU27 exports and related growth factors 2000 – 2010 (Eurostat, 2012a)

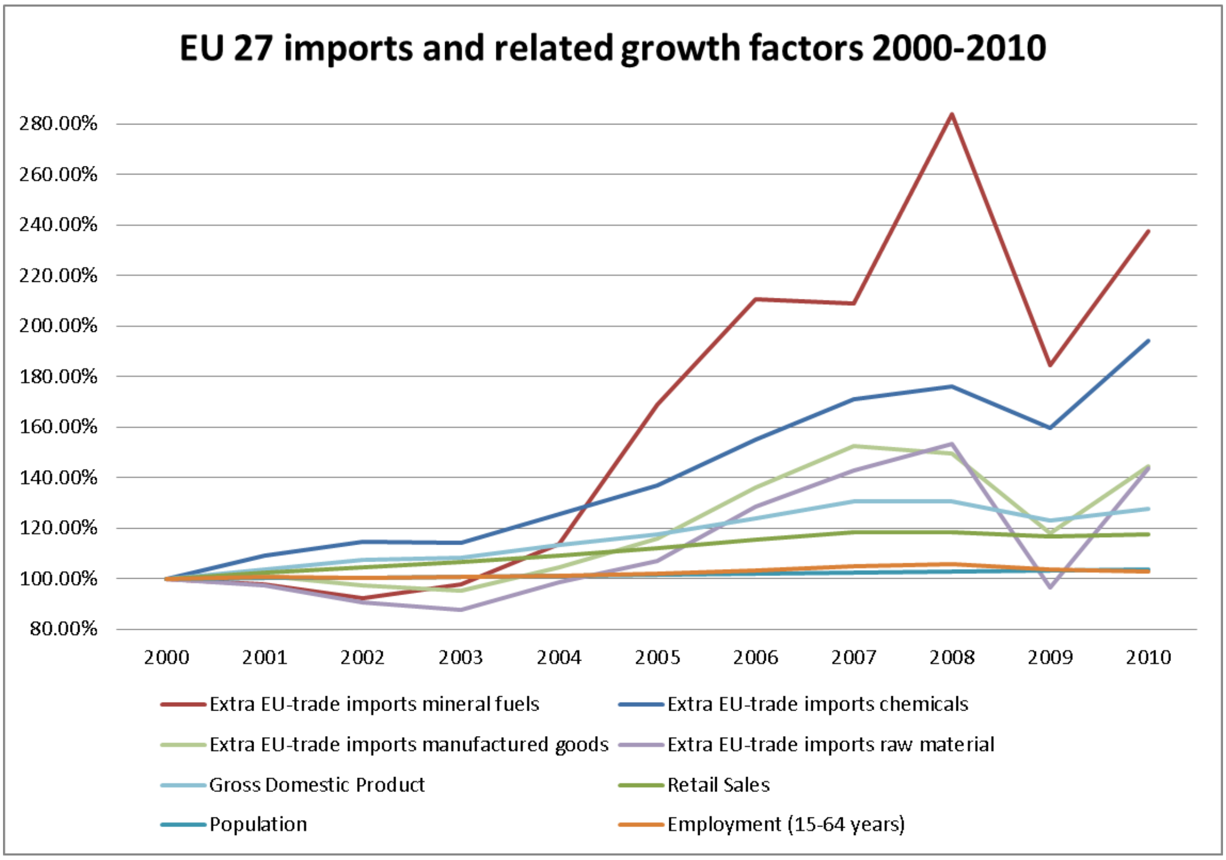


Figure 24: EU27 imports and related growth factors 2000 – 2010 (Eurostat, 2012a)

Appendix G: NL and EU27 Transport Statistics

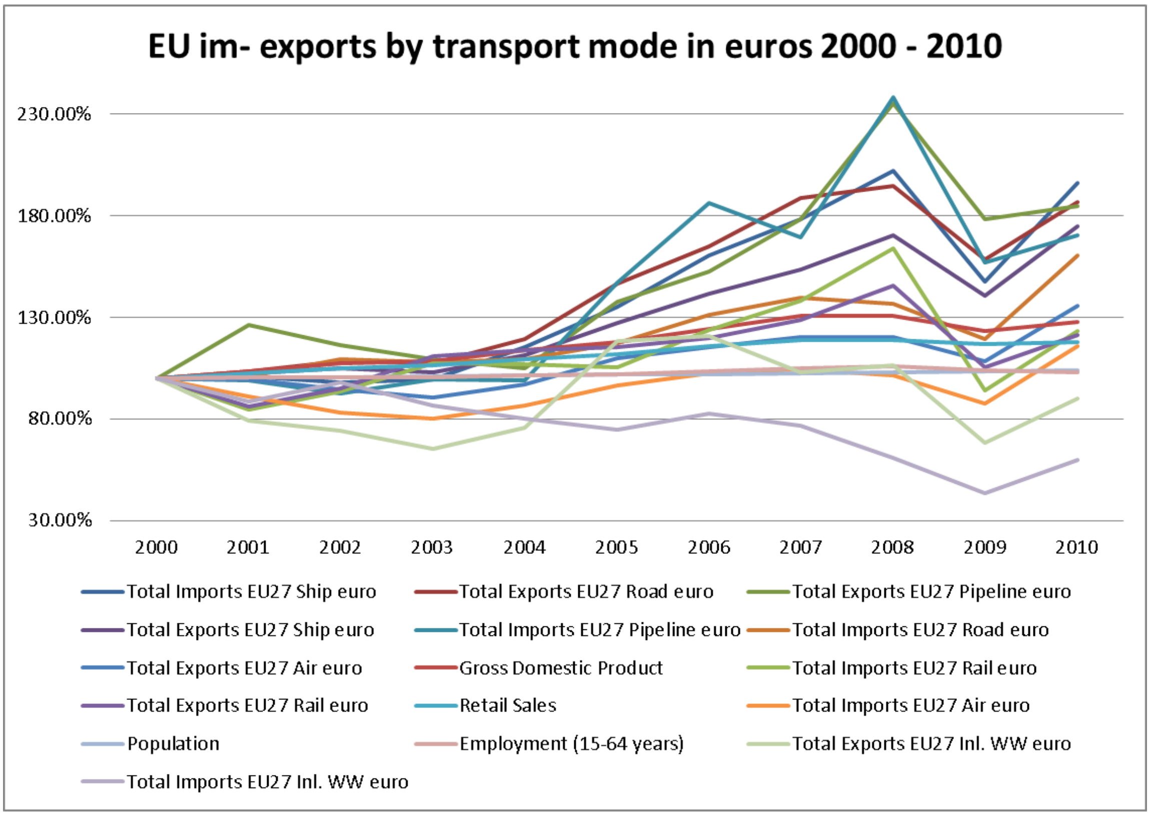


Figure 25: EU27 imports and exports by transport mode in euros (Eurostat, 2012a)

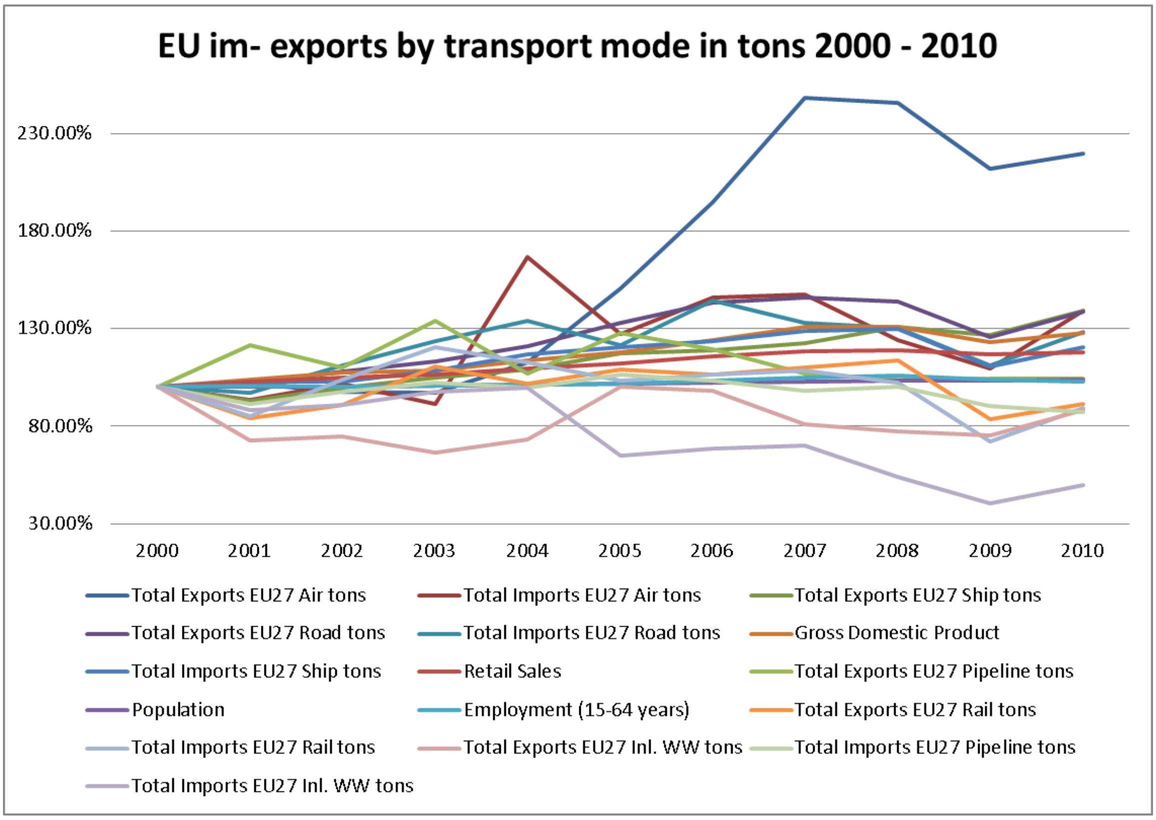
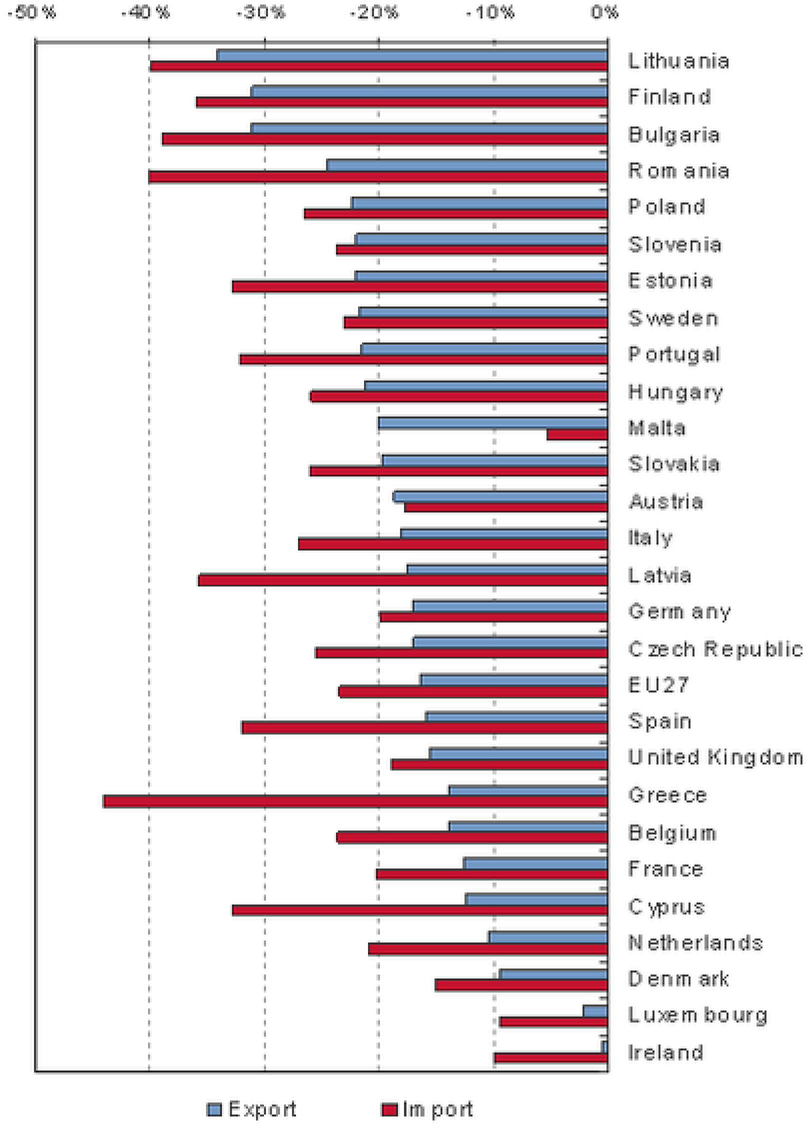


Figure 26: EU27 imports and exports by transport mode in tons (Eurostat, 2012a)

Appendix H: Growth in Extra-EU trade for EU27 (2008-2009)



Source: Eurostat (tet00038)

Figure 27: Growth in Extra-EU trade for EU27 (2008-2009) (Eurostat, 2012b)

Appendix I: Brent Oil Price 2008-2010

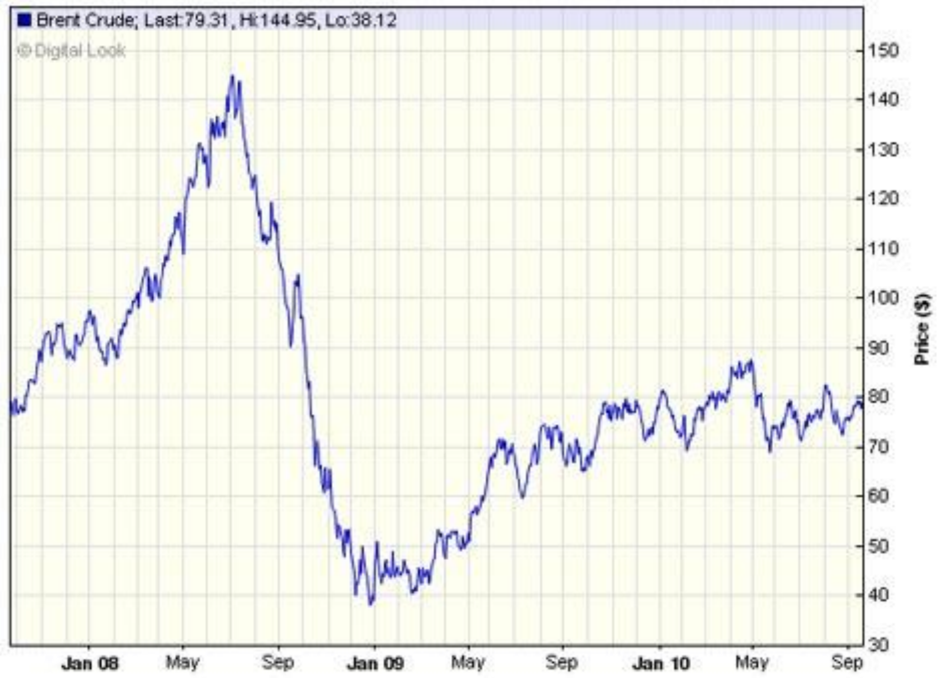


Figure 28: Brent Oil Price 2008-2010 (This is Money, 2012)

Appendix J: Number of Persons Employed in the PoR 2002-2009

Main Industry and Subsectors	**Number of Persons Employed**								**% difference**
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**'08-'09**
Node	***52.081***	***52.390***	***50.796***	***53.302***	***55.419***	***59.321***	***59.661***	***56.708***	***-4.9%***
Transport	**32.177**	**33.095**	**31.341**	**33.613**	**35.425**	**38.765**	**38.629**	**36.120**	**-6.5%**
Maritime Transport	4.155	4.241	4.159	4.204	4.367	4.254	3.997	3.860	-3.4%
Inland Waterway Transport	6.337	6.202	6.064	6.174	5.867	6.126	5.800	5.583	-3.7%
Road Transport	20.310	21.425	19.853	21.930	23.933	27.184	27.551	25.470	-7.6%
Rail Transport	1.304	1.156	1.197	1.240	1.195	1.142	1.228	1.157	-5.8%
Pipeline	73	71	68	65	63	60	53	51	-4.6%
Transport Related Services	**10.816**	**10.510**	**10.568**	**10.598**	**10.829**	**11.257**	**11.428**	**11.241**	**-1.6%**
Handling/Storage	**9.088**	**8.786**	**8.888**	**9.091**	**9.165**	**9.299**	**9.605**	**9.348**	**-2.7%**
Locational	***34.047***	***33.344***	***32.790***	***32.542***	***32.271***	***31.993***	***32.150***	***31.193***	***-3.0%***
Industry	**22.345**	**21.648**	**20.817**	**20.119**	**19.500**	**19.222**	**19.519**	**19.274**	**-1.3%**
Food Industry	2.557	2.522	2.739	2.912	2.868	2.898	2.803	2.630	-6.2%
Petroleum Industry	3.222	3.192	3.163	3.111	3.071	3.196	3.356	3.409	1.6%
Chemical Industry	5.181	5.029	4.924	4.873	4.851	4.675	4.495	4.377	-2.6%
Metal and Metal Products Industry	3.243	2.984	2.727	2.707	2.837	3.024	3.249	3.163	-2.7%
Transport Equipment Industry	2.922	2.449	1.782	1.453	1.511	1.613	1.690	1.710	1.2%
Electricity Generation	1.955	2.159	2.243	1.994	1.851	1.841	1.958	2.051	4.8%
Other	3.267	3.314	3.241	3.069	2.513	1.976	1.970	1.935	-1.8%
Wholesale	**6.625**	**6.591**	**6.874**	**7.177**	**7.387**	**7.322**	**7.213**	**7.142**	**-1.0%**
(non-) Business Services	**5.078**	**5.106**	**5.100**	**5.247**	**5.385**	**5.450**	**5.419**	**4.778**	**-11.8%**
Total	***86.128***	***85.734***	***83.586***	***85.844***	***87.690***	***91.314***	***91.812***	***87.902***	**-4.3%**

Table 13: Development in direct seaport related employment per sector 2002-2009 for the PoR (Nijdam, M., Van der Lugt, L. and Bakker, D., 2011)

Appendix K: Added Value in the PoR 2002-2009

Main Industry and Subsectors	**Added Value (mln euro in current prices)**								**% difference**
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**'08-'09**
Node	***4.985***	***4.959***	***5.154***	***5.794***	***6.268***	***6.998***	***7.324***	***6.240***	***-14.8%***
Transport	**2.243**	**2.331**	**2.377**	**2.679**	**2.819**	**2.965**	**3.035**	**2.489**	**-18.0%**
Maritime Transport	620	673	816	986	940	805	742	447	-39.8%
Inland Waterway Transport	328	360	338	331	334	345	386	364	-5.8%
Road Transport	1.068	1.135	1.054	1.193	1.374	1.642	1.708	1.492	-12.6%
Rail Transport	69	61	64	67	69	69	76	68	-11.0%
Pipeline	158	102	106	102	104	105	123	118	-3.7%
Transport Related Services	**1.159**	**1.128**	**1.187**	**1.284**	**1.405**	**1.587**	**1.661**	**1.511**	**-9.0%**
Handling/Storage	**1.582**	**1.501**	**1.590**	**1.831**	**2.044**	**2.447**	**2.627**	**2.240**	**-14.8%**
Locational	***4.916***	***5.294***	***5.860***	***6.860***	***6.510***	***7.012***	***7.857***	***5.182***	***-34.0%***
Industry	**3.972**	**4.335**	**4.827**	**5.749**	**5.310**	**5.766**	**6.603**	**4.048**	**-38.7%**
Food Industry	183	194	224	257	245	264	313	306	-2.4%
Petroleum Industry	1.359	1.632	1.941	2.703	2.168	2.386	2.904	1.128	-61.2%
Chemical Industry	1.563	1.601	1.778	1.867	1.918	2.043	2.220	1.432	-35.5%
Metal and Metal Products Industry	181	168	162	177	193	228	280	266	-5.1%
Transport Equipment Industry	137	112	91	80	89	94	99	90	-8.2%
Electricity Generation	353	424	424	463	516	597	628	682	8.6%
Other	195	204	207	203	181	154	159	144	-9.8%
Wholesale	**504**	**499**	**554**	**614**	**664**	**680**	**659**	**602**	**-8.7%**
(non-) Business Services	**440**	**460**	**479**	**496**	**536**	**566**	**594**	**532**	**-10.4%**
Total	***9.901***	***10.253***	***11.013***	***12.654***	***12.778***	***14.011***	***15.181***	***11.422***	**-24.8%**

Table 14: Development in direct added value per sector 2002-2009 for the PoR (Nijdam, M., Van der Lugt, L. and Bakker, D., 2011)

Appendix L: Number of Business Establishments in the PoR 2002-2009

Main Industry and Subsectors	Number of Business Establishments								% difference
	2002	2003	2004	2005	2006	2007	2008	2009	'08-'09
Node	***774***	***767***	***762***	***758***	***764***	***766***	***756***	***733***	***-3.0%***
Transport	**69**	**70**	**71**	**73**	**87**	**99**	**96**	**91**	**-5.7%**
Maritime Transport	69	70	71	73	80	86	84	79	-6.5%
Inland Waterway Transport					7	13	12	12	0%
Road Transport									
Rail Transport									
Pipeline									
Transport Related Services	**575**	**570**	**567**	**566**	**565**	**556**	**549**	**533**	**-3.0%**
Handling/Storage	**130**	**127**	**125**	**119**	**113**	**112**	**111**	**110**	**-0.9%**
Locational	***671***	***658***	***649***	***650***	***658***	***650***	***635***	***610***	***-3.9%***
Industry	**278**	**272**	**270**	**274**	**274**	**270**	**270**	**262**	**-3.1%**
Food Industry	12	12	12	13	13	13	13	13	0.0%
Petroleum Industry	9	9	9	9	9	9	9	9	0.0%
Chemical Industry	39	39	40	42	45	46	46	46	0.0%
Metal and Metal Products Industry	94	91	88	89	88	86	87	83	-4.0%
Transport Equipment Industry	72	67	61	61	67	71	73	73	0%
Electricity Generation	5	6	11	14	15	15	15	14	-6.9%
Other	48	49	50	48	39	30	29	25	-15.5%
Wholesale	**312**	**304**	**301**	**299**	**303**	**296**	**282**	**274**	**-3.0%**
(non-) Business Services	**81**	**82**	**79**	**77**	**82**	**85**	**83**	**75**	**-9.6%**
Total	***1.444***	***1.424***	***1.411***	***1.407***	***1.422***	***1.416***	***1.391***	***1.343***	**-3.5%**

Table 15: Development in direct seaport related business establishments per sector 2002-2009 for the PoR (Nijdam, M., Van der Lugt, L. and Bakker, D., 2011)

Appendix M: Indirect Effects from the PoR 2002-2009: Added Value

Main Industry and Subsectors	Indirect Added Value (mln euro in current prices)								% difference
	2002	2003	2004	2005	2006	2007	2008	2009	'08-'09
Node	***1,689***	***1,771***	***1,835***	***2,018***	***2,188***	***2,502***	***2,265***	***2,011***	***-11.2%***
Transport	**896**	**1,038**	**1,069**	**1,209**	**1,295**	**1,471**	**1,162**	**1,005**	**-13.6%**
Maritime Transport	417	515	552	608	631	704	361	309	-14.2%
Inland Waterway Transport	112	116	116	126	133	144	164	127	-22.9%
Road Transport	330	374	368	439	495	586	598	532	-11.1%
Rail Transport	21	20	22	25	25	25	27	24	-9.5%
Pipeline	15	13	11	11	12	12	12	13	1.9%
Transport Related Services	**422**	**402**	**420**	**439**	**488**	**554**	**583**	**538**	**-7.8%**
Handling/Storage	**371**	**331**	**346**	**370**	**405**	**477**	**520**	**468**	**-9.9%**
Locational	***3,202***	***3,369***	***3,369***	***3,608***	***3,949***	***4,407***	***5,163***	***4,371***	***-15.3%***
Industry	**2,836**	**3,001**	**2,978**	**3,191**	**3,491**	**3,918**	**4,656**	**3,886**	**-16.5%**
Food Industry	105	117	132	140	147	164	179	163	-9.0%
Petroleum Industry	992	1,042	976	1,054	1,094	1,385	1,840	1,541	-16.3%
Chemical Industry	1,100	1,154	1,157	1,285	1,486	1,627	1,725	1,401	-18.8%
Metal and Metal Products Industry	77	72	73	79	89	112	143	132	-7.8%
Transport Equipment Industry	99	86	67	63	71	79	90	97	8.0%
Electricity Generation	326	381	421	422	476	447	573	453	-21.0%
Other	137	148	152	148	129	105	105	99	-6.1%
Wholesale	**178**	**175**	**193**	**210**	**227**	**238**	**238**	**225**	**-5.3%**
(non-) Business Services	**188**	**192**	**198**	**207**	**231**	**250**	**269**	**260**	**-3.3%**
Total	***4,891***	***5,140***	***5,204***	***5,626***	***6,137***	***6,908***	***7,428***	***6,382***	***-14.1%***

Table 16: Development in indirect added value per sector 2002-2009 for the PoR (Nijdam, M., Van der Lugt, L. and Bakker, D., 2011)

Appendix N: Indirect Effects from the PoR 2002-2009: Employment

Main Industry and Subsectors	**Indirect number of Persons Employed**								**% difference**
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**'08-'09**
Node	***22,703***	***22,945***	***23,011***	***24,174***	***26,332***	***29,161***	***25,823***	***22,837***	***-11.6%***
Transport	**12,551**	**13,879**	**13,768**	**14,726**	**15,992**	**17,601**	**13,645**	**11,909**	**-12.7%**
Maritime Transport	5,484	6,636	6,920	7,217	7,562	8,215	4,104	3,452	-15.9%
Inland Waterway Transport	1,730	1,719	1,642	1,635	1,741	1,812	2,004	1,548	-22.8%
Road Transport	4,808	5,080	4,774	5,430	6,241	7,141	7,084	6,474	-8.6%
Rail Transport	309	274	288	307	312	300	316	294	-6.9%
Pipeline	221	169	145	138	137	132	136	141	3.3%
Transport Related Services	**5,535**	**5,124**	**5,242**	**5,315**	**5,838**	**6,453**	**6,588**	**5,980**	**-9.2%**
Handling/Storage	**4,618**	**3,942**	**4,001**	**4,132**	**4,502**	**5,107**	**5,590**	**4,948**	**-11.5%**
Locational	***28,352***	***27,801***	***27,436***	***27,003***	***27,742***	***29,698***	***30,806***	***29,461***	***-4.4%***
Industry	**22,658**	**22,323**	**21,825**	**21,220**	**21,537**	**23,233**	**24,348**	**23,408**	**-3.9%**
Food Industry	1,618	1,709	1,878	1,925	1,907	2,089	2,139	1,954	-8.7%
Petroleum Industry	5,919	5,839	5,473	5,512	5,718	6,577	7,332	7,308	-0.3%
Chemical Industry	6,755	6,439	6,275	6,198	6,528	6,952	6,933	6,319	-8.9%
Metal and Metal Products Industry	1,014	925	921	982	1,102	1,225	1,398	1,333	-4.6%
Transport Equipment Industry	1,987	1,643	1,255	1,111	1,237	1,742	1,509	1,605	6.4%
Electricity Generation	3,210	3,534	3,829	3,425	3,301	3,271	3,706	3,645	-1.6%
Other	2,155	2,233	2,195	2,068	1,744	1,378	1,331	1,244	-6.6%
Wholesale	**2,693**	**2,541**	**2,679**	**2,800**	**3,005**	**3,095**	**3,001**	**2,816**	***-6.2%***
(non-) Business Services	**3,001**	**2,937**	**2,931**	**2,983**	**3,200**	**3,370**	**3,456**	**3,237**	**-6.3%**
Total	***51,056***	***50,745***	***50,447***	***51,176***	***54,074***	***58,859***	***56,628***	***52,298***	***-7.6%***

Table 17: Development in indirect seaport related employment per sector 2002-2009 for the PoR (Nijdam, M., Van der Lugt, L. and Bakker, D., 2011)

Appendix O: Baltic Dry Index 2006-2011

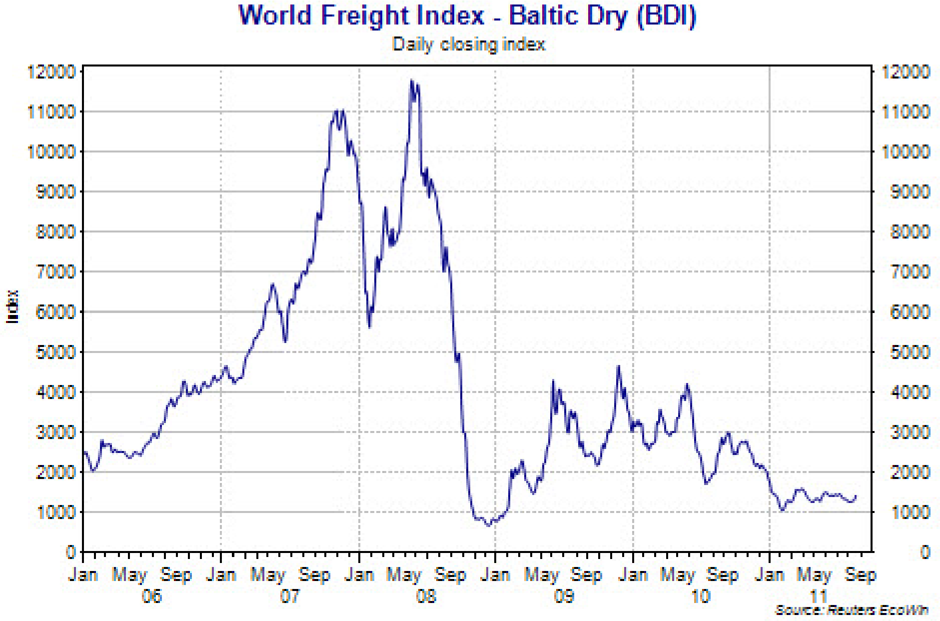


Figure 29: Baltic Dry Index 2006-2011 (Baltic Exchange, 2012)

Appendix P: Energy Prices - Eon and CBS (2004-2011)

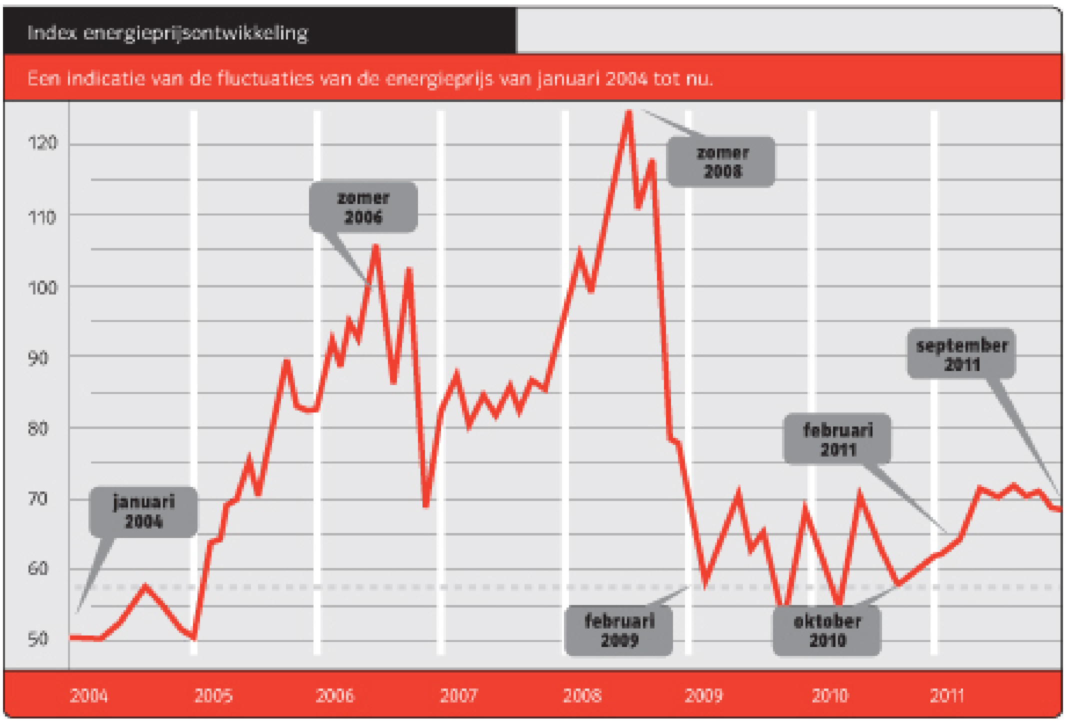


Figure 30: Dutch consumer energy prices 2004-2011 (Eon, 2012)

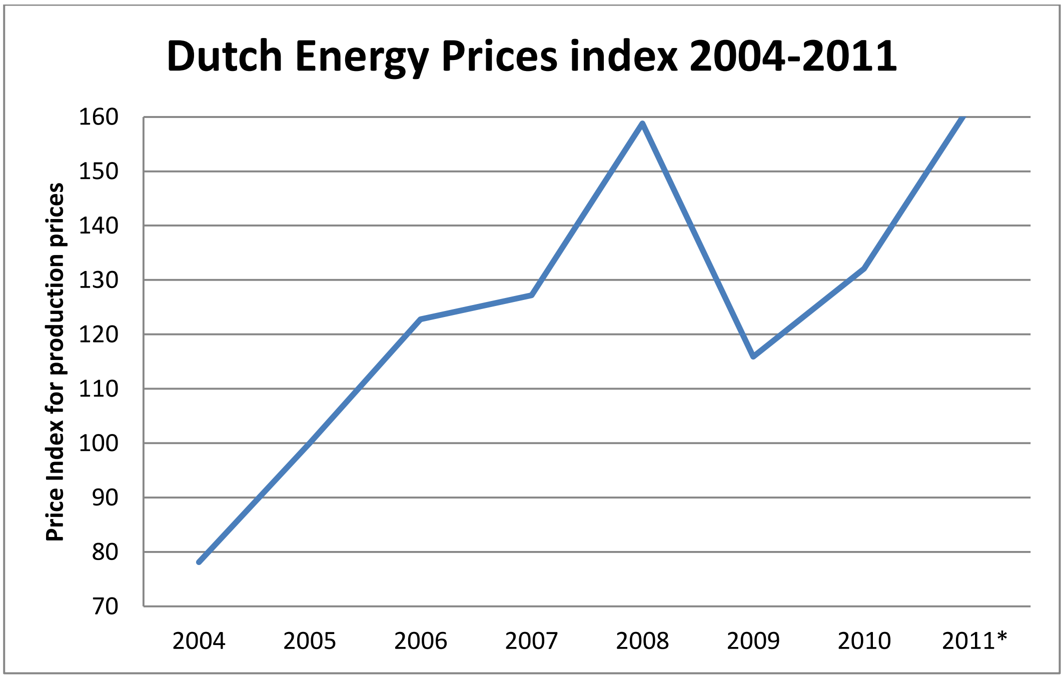


Figure 31: Dutch Energy Prices (indexed) 2004-2011 (CBS, 2012)