MONITORING CONTAINER FLOWS THE LINK BETWEEN TRADE AND MARITIME FLOWS

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ABSTRACT

This paper explores the link between maritime flows and trade from a macro-economic modelling perspective. The aim is to investigate the suitability of structural forecasting models for maritime cargo flow projections. The justification for such an investigation derives from the lack of structural approaches within the maritime field, despite the plethora of sophisticated economy and trade models. In consideration of the limitations of any forecasting exercise an alternative framework is suggested which is believed to add value to market players by contributing to the understanding of potential traffic and volumes of trade. The structure of the paper is as follows. In chapter one the setting is described, within the wider context to which this paper makes part of, a report for the Flemish government in Belgium. Chapter two consists of a literature review on modelling and forecasting within the maritime and economics field, finally leading to a framework for the selection of the most appropriate model for maritime applications in chapter three. Chapter four presents some first results and the forthcoming work of this research in progress while chapter five concludes with some reflections on forecasting.

Keywords: forecasting, trade growth pattern, saturation

1 Setting the Framework

This paper makes part of a wider report prepared for the Flemish government in Belgium. The setting is described in terms of motivation and objective, followed by the core research question and finally its perceived expected impact.

1.1 Motivation and objective

Typically, the motivation to investigate seaborne trade flows originates from the growing though volatile volumes and shifting patterns of trade. These dynamic global trading conditions represent the environment within which legislative bodies i.e. governments and policy makers, but also markets i.e. the maritime sector, need to adjust and operate. In addition to these enduring trends, recent developments in the

global economy have raised additional question marks on the potentiality of significant changes in current supply chain routines. Problems hence arise due to the unpredictability of those trends and consequent lack of plausible quantification schemes. The resulting uncertainty and lack of trend indication hinder long term planning. Weak planning thereafter becomes a source of risk for the long, but also short to medium term performance of the stakeholders.

The objective of this report is to explore the variability and understand the growth pattern of maritime trade flows and contribute by the provision of insight to policy makers on relevant topics broadly defined as:

- Should a port expand in container terminals?
  - Will containerised trade grow further?
- Should a port/shipping company invest in the mega container-vessel market segment?
  - Will these vessels become common practice?
- Should a government/port consider the risk of a structural shift in current supply chain routines?
  - Will supply chains concentrate in the East of Europe?

1.2 Research Question

For the realization of the report's objective the underlying research question posed is namely whether seaborne trade growth figures and/or forecasts reported systematically from private institutions and global organisations are useful and reliable.

1.3 Expected Impact

The contribution of the report's objective is being assessed by its expected impact. The expected impact is interpreted according to policy recommendations which themselves depend on the final users typology, in this case primarily policy makers. The analysis could however be extended to include port authorities, shipping companies, terminal operators and freight forwarders. The element driving the majority of maritime players decisions results from the expectations of the near to long term future of traffic/volume. This involves the expectations on the actual level of trade and on market shares compared to their competitors. The focus here is only on the level of trade.

Core market players in most cases possess forecasts either through in house estimations or through purchase of commercial reports. The former provide guidance on a micro scale with the highest possible level of detail assumed by their full ownership of data. Appropriate schemes are consequently being prepared capable of providing solutions according to anticipated market conditions. The latter provide trend indication on a macro scale from a maritime perspective. The anticipation by the players is the macro scale from an economic perspective easily interpretable in a maritime context. The difference is the starting point of investigation i.e. maritime trade versus the economic mechanisms.

It is believed, that there is still a need for a better understanding of current, potential trade volumes and their growth patterns which as anticipated in this report should allow for a systematic risk management and hence strategic planning processes that consider the variability of flows.

2 Scanning the literature

The literature review explores the sources of growth figures and forecasts. It is split in two parts: A purely maritime and an exploratory within the trade and macro economics literature. The former explores applications explicitly dealing with the topic, within its setting, while the latter suggests that an indirect perspective might contribute to the existing literature from a macro economic standpoint. This part opts to explore techniques applied in the literature. Before the description of the two parts, a clarification on the output sought within the literature and the time span implications is given.

2.1 Desired Output: Time Span Implications

Maritime and trade projections are split in two blocks: One of total trade per country and one of bilateral trade, or alternatively within a maritime context, of a loop basis. A fundamental addition to this is time span, according to which the type of decision making critically depends on. For a complete monitoring of the maritime flows one would opt to acquire such information for the short, medium and long term. Depending on whose view point is being considered, the importance carried by each of the six different outputs varies according to the strategic behaviour of the core player under consideration. For example, a port authority in consideration of future investments might benefit more from information on the long term bilateral trade, while a liner company, which significantly benefits from its responsiveness to change, could make more use of short term total trade flows guidance. Given the dynamics and the current structure of the market a port authority tends to focus on the longer term strategic planning of the port while short term complications are rather beyond its influential power. In the medium term however the dynamics are more complicated where the common understanding of trends could assist in the interaction between port authorities and its main clientele. In the exploration of the available types of output provided by the maritime and macro-economic literature the availability of all the differentiated timing spans is accounted for.

2.2 Direct applications: Maritime

The impact of growing uncertainty in the maritime sector, led to the realization of the need for systematic solutions. Such concerns, materialized through the creation of several specialized “products” from a diverse set of actors. The core issues addressed include forecasting of maritime flows and port throughput. These, have been summarised in a non exhaustive list, found in tables 1a and 1b (see annex). Table 1a lists the non academic contributions within international organisations, consultancies and port authorities, while table 1b concentrates on academic output. The main observations drawn from table 1a are summarised to the following, focusing primarily on timing and methodology:

- International Organisations like the UNCTAD offer descriptive reviews published yearly. An interesting application is made by UNESCAP which primarily driven by development targets, performs forecasts that are region specific. This publication dates back to 2007. The methodology is based on linear relationships between container volumes and GDP. It should be noted that detailed information on the methodologies utilised is not specified;
- National organisations like the Dutch central plan bureau, based on the project "Welvaart en Leefomgeving een scenariostudie voor Nederland in 2040" projected container throughput for the Dutch ports in 2006. The time span was based on a previous study called "Four futures of Europe" corresponding to four different scenarios for 2020 and 2040. The core model used was the SMILE+ (Strategic Model Integral Logistics and Evaluation). Given the adjustments performed by technical experts to the model's output no documentation of the exact techniques is available;
- Established consultancies within the field offer a variety of specialised publications with both global coverage and region specific, often on a half yearly but also monthly basis. To the knowledge of the author the forecasting techniques utilised are mainly based on GDP and/or exchange rate movements, which determine the rate of change in demand. An exception is MDS transmodal whose forecasts are based on a database with detailed country origin-destination matrices on a product level. Although the last publication has been in 2007 with forecasts until 2015, the database has been updated and forecasts are extended to 2020. Naturally, in these cases too detailed information on the methodologies are not specified;
- Port Authorities are evidently interested in monitoring their own growth and make projections of their traffic. Some ports develop in-house forecasting tools like e.g. the port of Rotterdam. The approach is one of a product level monitoring of flows. However in this case too, neither detailed methodological information is available nor is a detailed forecasting report publically available;
- Shipping companies too typically develop in house schemes with the purpose of monitoring their growth per loop and consequently adjust their capacity utilization. In this case too these tools are confidential.

Evidently, tools do exist, providing trend indication. However, in most cases the methodologies are not documented i.e. consultancies publications or meant for internal use i.e. the case of the port of Rotterdam. The majority of those publications rely on a one-to-one relationship with GDP and cannot predict structural shocks. As such, they become useful during times of "Business As Usual" (BAU). The more sophisticated approach applied within MDS transmodal does not (to the author's knowledge) provide for regular timely updates readily utilizable from the interested market players. A choice between quality and timing is inevitable and well illustrated.
The academic world has also dealt with the topic of forecasting maritime flows. Within these contributions, the approach followed varies according to the objective. A substantial part of the investigations are descriptive but in this table (see table 1b in the annex) only an indicative list of papers utilising quantitative techniques have been considered. The main observations drawn from table 1b are summarised to the following, focusing primarily on the different types of methodologies:

- In the model developed by the Imperial University in the UK, "Container World", forecasting maritime flows is treated separately within a sub-model. The logic is one of systems dynamics whereby information is passed on to the other sub-models through feedback loops. However details on the methodologies are unknown. Similarly, Levine (2009) et al incorporate in their analysis a gravity model for the transportation of international sea containers;
- The ones dealing exclusively with the topic i.e. Meersman et al (2003) and Veenstra (2000), make use of sophisticated time series techniques, in particular Vector Autoregressive (VAR) or Vector Error Correction (VEC) models which are known for their longer term forecasting properties;
- Luo and Grigalunas (2003) utilise a simulation model, as an alternative to econometrical methodologies, wherein a conversion algorithm is used in order for the generated container volumes to estimate container port demand;
- In the "Worldwide container model", estimating maritime flows makes part of a wider objective and hence is set as fixed demand which allows to mainly build on a container routing investigation;

The core conclusion from the preceded brief literature review is the lack of documented structural approaches and/or scenario based forecasts for the main maritime routes on a product level. Nevertheless, tools have been constructed to address uncertainty on a macroeconomic level only not explicitly made for the maritime sector. This topic is addressed within the second part of the literature review.

2.3 Indirect applications: Trade

Traditional trade applications are now explored as a consequence of the nature of derived demand for transport. The investigation within the trade and macro-economic literature will be based on the aforementioned definition of desired output. The reason is that the models described are not meant to be evaluated on the basis of their properties or their applications since they have been constructed for different purposes. The commentary is based on their suitability for maritime applications on the basis of their current output range. This sub-chapter lays out the structure of the criteria chosen for the evaluation of the models under investigation. It concludes with a summary of the main findings.

2.3.1 Introductory notes

The analysis is based on table 1c (found in the annex). The criteria reported in it include reliability, output (composed of the report, trade projections and coverage), methodology (composed of the title and/or the specific model, the year of last publication and the features), forecasting (composed of application and time-spam), scenarios and documentation. Contributing information on the reasons for the aforementioned choices regarding their key items include:

- Reliability is measured according to perception. In this case it means that only major international organisations and national institutes are being considered i.e. EC, ECB, OECD, IMF, WTO, Bundesbank and CPB;
- Trade projections are being sought in order to check whether the models' outputs could be utilised for the purpose under investigation (see box 1);
- Coverage contributes to the above stating the countries/regions for which the output becomes available;
- The methodology applied is viewed with the purpose of classifying models in structural, with or without long term attributes, or time series models;
  - Some models have been highlighted since they do not directly provide for the desired output but given their interesting properties it has been judged necessary to include them;
- The addition of the presence of forecasting exercises or not is evidently added mainly for the clarification of the time span for which forecasts are applied;
- Scenarios are considered to the extent that they could be assumed as the basis for the creation of maritime related forecasts. However at this stage no further information on the type of scenarios is given;
- The column of documentation evaluates the possibility for future replication(s) of the selected model(s).

2.3.2 Descriptive Analysis

The individual descriptions of all items in the table can be found in the forthcoming report of the Research Centre Commodity Flows. In this paper the summary of the common trends observed within the field of the macro-economic modelling as reported in table 1c and from the perspective of potential use within the maritime field is given below:

- Most organisations use partly a multi country macro econometric model complemented by some kind of judgmental methodology;
- Most models are resource intensive and demand for huge amounts of data;
- The methodologies used and especially the sub-models composing those sophisticated large scale models have interesting principles that could be considered for replication within this investigation;
- Forecasting within such models is tackled with caution;
- The methodologies partially converge.

What is observed is that the spectrum of tools utilizable for maritime applications is vast including both econometric methodologies and indicators. With the empirical applications in mind, a more practical view of the tools utilizable within the industry follows in chapter 3 preceded by a summary of the macro-economic literature's main findings.

2.4 Summarising main findings

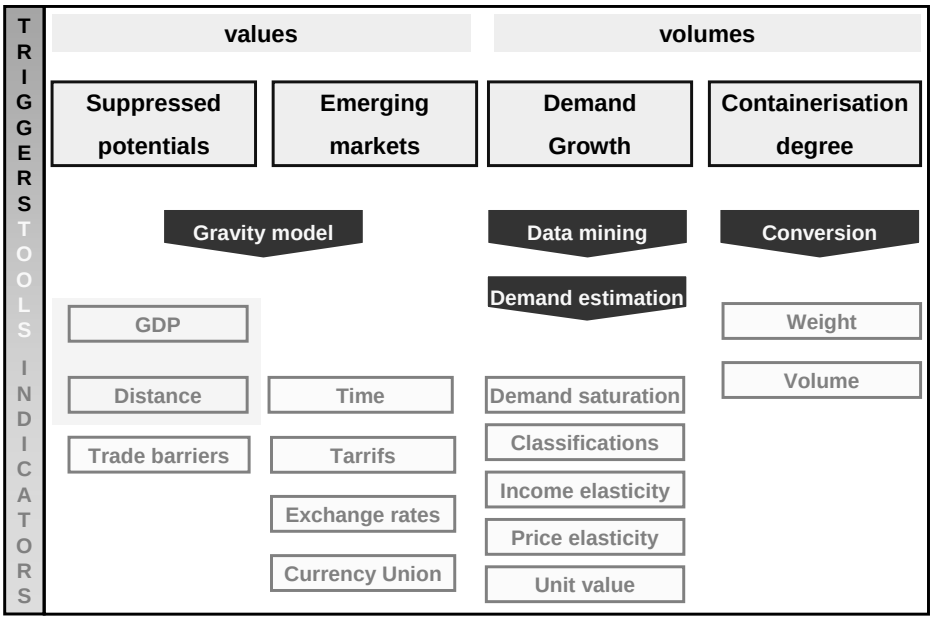
The main limitations encountered in the two parts of the literature review when opting to reduce or rather cope with uncertainty within a maritime framework could be interpreted in the following way:

- The commercial tools mainly provide direction under BAU conditions;
- Appropriate timing of publications using more sophisticated tools is not optimised. This is a reasonable consequence of the desired equilibrium between the level of detail and timing of such publications;
- Trade and macro-economic models do not provide for the desired output readily translatable into a maritime context;
- The forecasting power of those models is treated with caution;
- An attempt to replicate (after appropriately adjusting for the output) any of the macro-econometric models is neither feasible due to resource constraints nor desirable due to the unnecessary level of detail.

3 Suggested framework: a description

Trade growth potentials from the maritime perspective are understood through the streams of volume and loops, i.e. direction. The set of hypothesis under investigation considers 4 blocks of reasons for further trade growth to occur (see graph 1). From a volume perspective and for the trade between the EU 27 (plus Switzerland) and the rest of the world it is assumed that the maritime trade can grow through:

Graph 1: Current and potential maritime trade growth



- Trade impediments being lifted and hence releasing the trade potential for those countries;

- Growing demand from the EU 27 for goods sourced overseas;
- Containerisation degree considering especially the goods which are occasionally containerised but don't yet belong to the mature containerised goods category or countries with still a low containerisation degree.

At the same time growth potentials of maritime trade through shifting trade patterns could only be realised in the case of a shift taking place between countries which do require a deep sea transport leg. This could be observed in the case of:

- Trade impediments being lifted in countries which can compete with the traditional major exporters;
- Shifts in established routines within supply chain corridors.

The approach followed in this report replaces the structural models by a data mining exercise, a descriptive analysis based on market saturation and elasticity estimations. In particular, the bilateral trade between the European countries (EU 27 plus Switzerland) and a) the world, but also b) economies of maritime importance is analysed and the OD's are disaggregated in 3 digit SITC categories before being aggregated again on the 2 digit SITC. The expectation is that this exploratory approach could achieve a deeper understanding of the data at hand and hence provide a transparent view and more importantly assist in a more accurate interpretation of the current trading routines. This type of output could also be easily communicable to the key players in the field. The final choice on what and how to forecast will be primarily based on this exploratory part and the reported literature. In this paper only the containerization degree and demand growth blocks are described. Before proceeding however a clarification on the level of the analysis is deemed necessary.

3.1.1 Level of analysis: from disaggregated to aggregated flows

The choice on the level of analysis regarding product categories has been decided as being one of a disaggregated level. In particular, the three digits Standard International Trade Classification (SITC), revision two, of the UN has been chosen. [1]The justification is that valuable information is being lost due to the aggregation of product categories and has hence yet not fully been explored. Further reasons justifying this approach within the field of transport, maritime and trade research include:

Transport /Maritime[2]

- Container freight rates are charged on the basis of demand and not on the traditional method of "weight or measurement whichever is the greater";
- The type of cargo is an indicator of freight height[3];

[1] The choice of revision two was due to the historic coverage of flows.
[2] Based on experts opinion
[3] However during today's times the behaviour of the market experiences disruptions in its common workings. This is illustrated through the peculiarities in the charging of freight rates.

- Supply chain corridors differ according to product type.

Trade

- Empirical research (gravity, demand estimations, etc) has often shown that aggregated flows mask or distort the estimated impact of the explanatory variables;
- Demand saturation differs per product category;
- Patterns of consumption differ per product category as income level rises;
- Patterns of consumption differ per product category as unit price increases.

The disaggregated flows are aggregated to SITC-digit 2 and after being analysed they are further aggregated according to their maritime transport characteristics. Products are therefore classified as containerised, non-containerised and containerisable. The category “containerised” represents the mature containerised products. The category “non-containerised” represents the currently non containerised products. Finally the category “containerisable” represents the products that have occasionally been containerised. The reasoning for the differentiation between containerised and containerisable is the presence of occasional containerisation. What is being observed is that due to unforeseen events goods are occasionally being transported in containers. Especially due to the crisis and the consequent pressures for capacity optimisation this tendency has been even more pronounced. However an interesting complication relevant to these dynamics is that during times of very high charter rates cargo shifts also vice versa i.e. from containers to bulk. These conditions are however very hard to capture. The containerisation and demand growth blocks are explained in detail in the two forthcoming chapters.

3.2 Containerisation degree: Volume conversion and variability

The spectrum for containerised trade growth is explored although for a significant number of traders it has already been almost fully realized. This requires the construction of an additional database. Commonly, trade modelling stops at the level of values. In a maritime trade context however, volumes are required, which hence necessitates a conversion from value to volume. Apart from maritime related reasoning an additional explanation why volumes should be preferred is that they are a more reliable measurement. Values have often been quoted as misleading for the interpretation of trade growth figures for a number of reasons among which the unit value variation per product and per partner, CIF and FOB differences and technical problems in the reporting of the data.

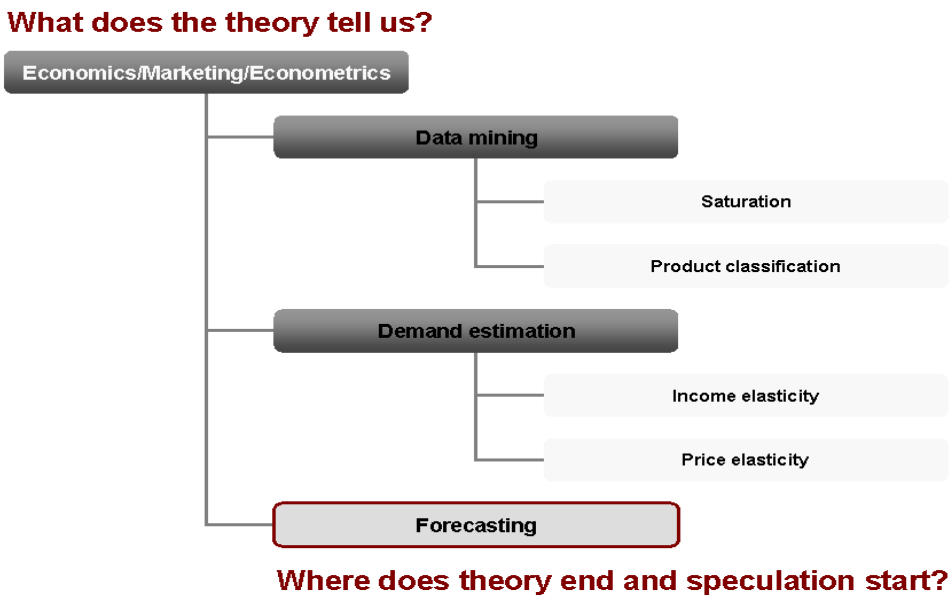
The construction of the database starts from the values (in US dollars) of trade sourced by the UN-comtrade for all five digits of product disaggregation. What is rather useful is that the latter provides for weight (in kg) figures, on a three to five digit level of disaggregation. For an accurate investigation of the containerised trade however volumes are required. For this purpose the density of the product categories is required, which is critical for the calculation of stowage factors. However this type of information is unattainable on the level of SITC classification. The approximation used in this report relies on common practices of today adjusted by practices created

for the needs of general cargo vessels. In particular, volumes are obtained originally through a rule of thumb of 1 TEU equals 13 ton when full and 9 otherwise. The "correction" of this rough estimation only became possible through the use of an additional database. This database includes commodity type, packaging and stowage factors measured in cubic feet, a volume per unit mass. Although the exact classifications between the two databases do not match the solution has been to consider only SITC-digit 2 (and even three when possible) classifications and work with the second database exclusively. With the help of descriptive statistics average categories are created. The database is supposed to be continuously enriched until a satisfactory level of detail becomes available. Until that level is reached the calculated volumes will underestimate true volumes. As explained in section 3.1 three categories are created. For the application of the above it is necessary to know what is currently being containerised. The creation of a third database is hence needed. Bearing in mind the particularities in this sub-market the aforementioned categories (section 3.1) have been created and applied to specific Origin-Destinations[4] on SITC-digit 2 level. The database is based on expert opinion for specific country cases.

3.3 Demand growth: potentials and risks

In this chapter the framework for the investigation of past, current and potential demand is based on a combination of data mining, saturation analysis and demand estimation techniques. This investigation is meant to conclude with the forecasting exercise judged as being most suitable under a set of considerations (see graph 2). It is believed that these aspects have not been adequately examined, to simultaneously include the necessary maritime coverage and/or level of detail and/or suitable measurement.

Graph 2: Demand growth



[4] It is observed that the degree of containerisation can vary per OD which consequently necessitates a case by case examination and correction of the generic classification. On the World level of investigation only weight will be examined.

For each of those parts a brief reference to the theory is given while the main focus is on the interpretation of the theory in transport and in particular maritime terms. The final output resulting from this approach is supposed to quantify the potential risk and/or opportunity for the maritime sector.

3.3.1 "Mining" demand

Data mining is carried out on the basis of the different classifications (see table 1). The generic database is created and appropriate aggregations are made. The groups made, divide European countries in groups interpreted as a division of hinterlands which correspond to the UN geographical split. "Risks" and "opportunities" are identified, explored and quantified. What is classified as risks is the products which represent trading segments with higher volatility and vice versa, opportunities include segments which exhibit rather invariable trading patterns. The three main questions raised for the making of the data mining are the following:

1. Saturation level: how saturated is the total and per partner demand for imports per product?
2. Lead time reduction: What and how large is the effect of the establishment of new logistics-chains routines as a result of the crisis.

These questions are tackled respectively in the following sub-chapters.

Table 1: Data mining

Input	**Database**				**Output**	
Trade flows	**Level**	**Aggregation**		**Quantity**	**"Risks"**	**"Opportunities"**
Annual	**Classification**	**Digit**	**group**	**Ton / m³**	**% in total**	
Imports World	SITC	■ Digit 3 ■ Digit 2	■ EU27 ■ HW ■ HS ■ HN ■ HE	ton	■ Saturated products	■ Non Saturated products
Imports Partners	SITC	■ Digit 3 ■ Digit 2		ton & m³	■ Saturated products ■ Non containerised	■ Non saturate products ■ Containerised ■ Containerisable
	BEC				■ Non Durable products ■ Fast moving products	
	ISIC					

Source: Own compilation

Notes
HW: AU, BE, FR, DE, LU, NL, CH and HS: CY, GR, IT, MA, PT, SL, SP and HN: DK, ES, FI, IE, LV, LT, SE, UK and HE: BG, CZ, HU, PO, RO, SV

3.3.2 How saturated is the current demand?

Given the unavoidable bias in modelling and particularly forecasting, a solid exploration based on economic theory is fundamental and a necessary complement. Hence, based on macroeconomic theory an exploration of the level of demand saturation of imported goods and their classification has been undertaken.
Demand saturation is investigated for imports per product category and examined on the total level of imports i.e. imports from the world and major trading partners[5]. The different estimations explore whether the data exhibit a linear a logistics growth or any other non-linear pattern. Estimation results are evaluated on the basis of econometric tests combined with experts opinion. In this report this type of investigation reveals the volume of saturated and non saturated products. It is meant to be used as a forecasting tool only when a reasonable fit of the data has been reached. However, the aggregation level of digit 2 and the overall difficulty in assessing the exact stage of development (for which the product life cycle approach has been criticized) should be taken into account. For saturated products, based on marketing theory of product life cycle, sales volume either stabilizes or declines. A possible interpretation from a transport perspective could be that non saturated products reveal further growth potential while within the saturated a) stability or maturity hints at supply chain routines that might not be disrupted any time soon and b) decline hints at potential risks.

3.3.3 Is there a meta-crisis trend on logistics chains routines? : a volume investigation

A trend worth monitoring is the response of logistics chains to the crisis. It is observed that responsive lead times are increasingly becoming a strategic objective. This is understood within a context of minimum inventory despite the risk of stock outs. It is however not clear yet whether such practices will become dominant in the field. The suggested exploratory look into this topic is by the classification according to the logistics properties of products. The traded goods under investigation are the non durable goods. These products pose a risk to the maritime sector to the extent that logistics requirements would impose shorter delivery time spans (through the proximity to final demand) despite the higher cost such a choice would represent as compared to the overseas sources. Examples of such industries include cosmetics and cleaning products, food, fuel, office supplies, packaging and containers, paper and paper products, personal products, rubber, plastics, textiles, clothing and footwear. The extraction of these categories is made through the use of alternative specifications i.e. the Broad Economic Categories (BEC) and the International Standard Industrial Classification of All Economic Activities (ISIC).

[5] Ideally consumption data per product category would have been used, however detailed information on local production consumed locally or generally consumption per product category are not available (to the knowledge of the author)

4 Groundwork and preliminary conclusions: the case of manufactured goods

Saturation of flows is investigated through a graphical exploration combined with data smoothing and finally a justification for a modelling exercise is given based on the acquired results. The objective of the modelling exercise would be to model change and check whether the data exhibit an exponential a logistical or any other non linear growth pattern. This step is crucial for the construction of a reliable forecasting model. Before that however the quality of the data needs to be evaluated.
At this initial stage the total trade of Europe 27 plus Switzerland (disaggregated per country) with the rest of the world is under investigation. The purpose is to explore each country's total importing activity in order to draw some preliminary conclusions on the potential presence of saturation within the specific product category. The report aggregates the countries per hinterland groups as defined in table 1.
The graphical exploration plots the longitudinal panel data on a two digit SITC classification level. The scatter plots illustrate the data in their disaggregated form with the flows per partner and product category, and grouped per product category. A final scatter plot aggregates products and partners all together.
The product category chosen is SITC revision two product category six which includes manufactured goods classified chiefly by material. Since the interest lies in the containerised flows assumptions need to be made on the degree of containerisation represented in this product category (see table 2). These assumptions are based on what is believed to be common practice in current maritime transportation and on targeted expert opinion.

Table 2: Product description and containerisation degree

Code	Product description	Weights	C	NC	CA
61	Leather, leather manufactures, n.e.s., and dressed furskins	0,131791	C		
62	Rubber manufactures, n.e.s.	1,351726	C		
63	Cork and wood manufactures (excluding furniture)	3,499054	C		
64	Paper, paperboard and articles of paper pulp, of paper or of paperboard	17,88264		NC	
65	Textile yarn, fabrics, made-up articles, n.e.s., and related products	2,846903	C		
66	Non-metallic mineral manufactures, n.e.s.	23,31811	C		
67	Iron and steel	38,15162		NC	
68	Non-ferrous metals	6,776748			CA
69	Manufactures of metals, n.e.s.	6,041417		NC	
6	Manufactured goods classified chiefly by material TOTAL (%)	100	31	62	7

Source: own compilation based on SAS output and targeted expert opinion

Within category six the containerisation degree has been calculated in percentage form based on the input of table 2. Weights have been applied to account for volume

(in this case based on only weight). It should be noted that the contribution of each subcategory to the total is dependent on the origin and destination chosen. In this case the starting point is the trade from the world of HW. From the concluding figures it would seem that category six is a largely non containerised category with containerisation (including containerisable products) representing 38 per cent.

A "quick and dirty" attempt to fit a curve to the data was through a smoothing interpolation method within SAS enterprise guide[6] (see annex graph 1 for an example of the plots produced for HW [7]). Beyond the graphic confirmation of the dataset's non linearity an additional application of a linear mixed model in particular a linear individual growth model which did not converge (a typical consequence of non linearity) reconfirmed the evident. The details on the mixed model's estimation are not going to be reported here. The levels of investigation are three: a) product digit 1 level for all countries, b) product digit 2 level for all countries and c) product digit 2 per country. Preliminary remarks on the scatter plots:

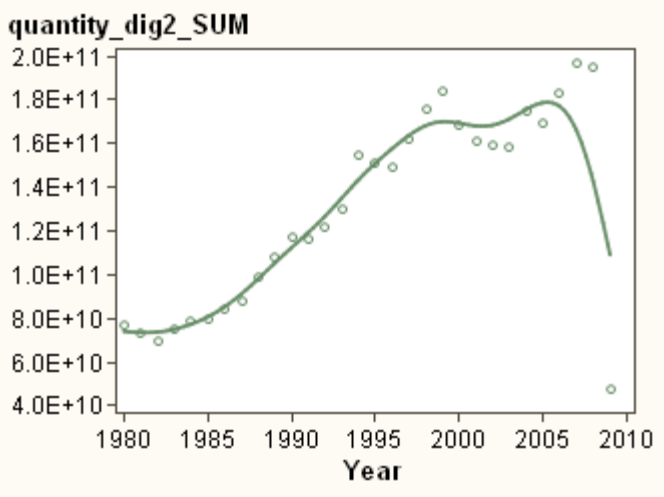
- None of the plots could be described by a straight line;
- None of the plots fully exhibit trade growing exponentially;
- All plots show the effect of the financial crisis on the data for 2009 where steep declines are noted;
- For the majority of products a similar pattern between the countries within the group of hinterland west (HW) and between the groups of hinterland south (HS), north (HN) and east (HE) is observed;
- For the majority of product categories a more pronounced growth pattern is visible for the group of Eastern Europe;
- In the majority of cases a segmented fit for the data seems to apply;

The description of the plots illustrates the group HW given the core view point of the report being the western European maritime players. Graph 3 shows the case of category six for all the countries in the group of Western Europe. From a quick look at the graph one could assume the presence of an S-shaped curve until the year 2002 followed by a second one in the case of discarding the events of 2009 hence leading to the suspicion of a potential double logistic sigmoid curve. This hypothesis should be tested with a model application.

[6] This method produces a cubic spline that minimizes a linear combination of the sum of squares of the residuals fit. The value used was 50 in a max of 99.

[7] Some peculiarities have been noted in the dataset of Switzerland. The raw data confirmed some violent fluctuations of products within the category 681-689. Given the type of products (non ferrous metals among which uranium and silver or platinum) these fluctuations might be considered acceptable. Further exploration would be needed if moving further to a modelling application.

Graph 3: Total dig.1 all countries



Source: own compilation produced with SAS

From this type of exploration on the aggregate level with world as a trading partner saturation of trade in this category is worth exploring further in terms of model application but also product coverage and partner selection. The focus will hence be reduced to specific trading partners like Asian countries commonly representing the loop Asia-Europe of major shipping companies and it will expand to include more product categories.

5 Reflections on forecasting and forthcoming work

This paper deals with forecasting techniques, a highly referenced topic within many fields. Applications range from highly sophisticated to simple time series extrapolations. Despite the realized limitations in such exercises they still remain a widely usable tool within industries and not just within academic contexts. However, what is commonly being observed is that model outputs are complemented by experts opinion when possible.

On the basis of the reviewed literature within the field of macroeconomics one of the conclusions reached is that the dynamics of structural approaches are very complex and restricted from data availability. Beyond the impossible task of forecasting the occurrence of a disruption in the global economy it seems that the current models are undergoing a process of improvement by being frequently tested after the occurrence of a shock in order to be validated and often callibrated. It is believed that an attempt to forecast by simplifying these highly resource intensive structural techniques will probably deliver poor added value for applications within the industry. On the other hand time series even highly sophisticated techniques are critisized for their lack of theoretical underpinnings.

Hence, in the case of the maritime sector, based on the purpose and available resources of this study a framework for the selection of the most appropriate model has been suggested. It is based on a theoretical framework combined with strong empirical evidence. The level of investigation is one of a three digit product disaggregation which has been empirically proven to give better insights given the

large variation between product categories. After gaining a better insight on the variability of the trade flows and the level of risk or opportunity this volatility represents in volumes the choice of the appropriate growth model can be made with a higher level of certainty. The goal is for such an approach to lead to more reliable and useful forecasts for the maritime industry.

ANNEX

Annex Table 1a: Maritime Transport – (Non)commercial products

Type	Source		Output	Coverage	Forecast
International organisations	UNCTAD	Review of Maritime Transport	volume of merchandise trade (exports and imports)	World, EU 27, North America, Africa, Middle East, America (South, Central) , Asia, China	
	UNESCAP	Regional Shipping and Port Development	annual growth rate for container trade volumes	Global, ESCAP economies	2015
			share in world container (exports and imports)	ESCAP member economies, East Asia share of ESCAP	
			route trade volume	Asia-Europe	
			trade imbalance	Transpacific, Transatlantic,Europe-Asia, Europe-MidEast, Asia-MidEast	
National organisations	CPB	CPB Memorandum: Aanpassing WLO scenario's voor het containervervoer	container turnover deep sea	Dutch ports	2020, 2040
			container turnover feeeder		
			container turnover short sea		
Consultancies	Drewry	Container forecaster	container traffic	world	2010-2013 (quarterly)
			container activity (change in total port handling & TEU)	North America, Europe (North, West, South, Eastern), Far East, Middle East, Latin America (Caribbean, South), Asia (South East, South), Africa	
	OSC	East Asian containerport markets to 2020	containerport demand forecasts	North East Asia, South East Asia, East East Asia	2020
			(non) transshipment container handling demand		
		The European and Mediterranean container port markets to 2015	container handling demand (exports and imports)	North Europe, South Europe and Mediterranean	2015
			transshipment demand		
		World Containerport Outlook to 2015	container handling demand (exports and imports)	East Asia, China, North Europe, South Europe/Med, America, Middle East, Sub Saharan, Australasia	2015
			total containerport demand		
			container transshipment demand		
	MDS	World Freight Model	quarterly loaded TEU	Asia-Europe/Med, Transpacific, Transatlantic, to/from Sub-Saharan, to/from Australasia excluding Americas	2014
		China trade briefing-January 2010	loaded TEU	China	2011
		China's cargo growth: how long will it last?	route growth rate	Asia-Europe	2012
	Clarkson	Container Inteligence quarterly	container trade	Global, Far East-Europe, Transatlantic, Other	2009-2010 (quarterly)
			container exports and imports	Global, Europe (NW, Med), Asia, America (North, Latin America & Caribbean), Australia & New Zealand, per route	
			container exports and export growth	Europe (NW, Med, Central/Eastern, Baltic, CIS), Asia, America (North, Latin, Central & Caribbean), Australasia, Middle East, Africa	
			port throughput	World, Europe (North, Med), America North, Asia	
Port Authorities	Rotterdam	Summary Port vision	port throughput	port of Rotterdam	2010/2020
		Havenplan 2020	goods flows	dry bulk, crude oil & petrochemicals, base products, containers, roro, general cargo	

Notes

- Country level disaggregation in the column of coverage is not provided in the table.
- Drewry offers similar products for the other maritime markets i.e. Tanker, Dry Bulk, LPG, Chemical forecasters.
- OSC offers similar products for i.e. port markets in the Middle East, the Americas, and for the other maritime markets i.e. LPG, LNG, Bulk, Chemical, Tanker prospects and more specialized product categories i.e. fertilizers and refrigerated trade prospects.

Annex Table 1b: Maritime Transport – Academic contributions

Year	Author	Title	Objective	Methodology
2009	Levine et al	Estimating an Origin-Destination Table for US Exports of Waterborne Containerised Freight	Estimate number of containers that flow from origin country o to destination TAZ d	Multi-modal origin–destination table estimation problem as a linear program
				Gravity Equation
2008	Perrin et al	Worldwide Container model	Model the routing of worldwide container flows, including the choice of service, port and route in a network of service lines	Macroscopic; Routing container flows; Shortest path Algorithm
				Logit route choice model-current
				Path size multinomial logit-future
2008	Meersman et al	The relationship between economic activity and freight transport	Study of the stabilty of the freight elasticity over time	Panel data estimations
				Fixed effects method
2004	Woods et al	Container World	Improve strategic modeling of the container transport system	Complex Multi Agent Simulation
				International Trade Model
				Distribution Model
2003	Luo and Grigalunas	A spatial-economic multimodal transportation simulation model for US coastal container ports	Assess the potential demand for container ports and related multimodal transportation	Spatial, economic multimodal container transportation demand simulation model
2003	Meersman et al	Port throughput and international trade: have port authorities any degrees of freedom left?	Estimate relation between economic and port activity-relation between the port of Antwerp and international trade	Multivariate Time Series
				Unrestricted VAR
2002	Meersman et al	Forecasting potential throughput	Forecast iron ore traffic and container loadings and unloadings	VECM
2000	Veenstra and Haralambides	Multivariate autoregressive models for forecasting seaborne trade flows	Long term forecacts of four commodity markets trade flows	VAR
1996	Kavussanos	Highly disaggregated models of seaborne trade. An empirical model for bilateral dry-cargo trade flows in the World economy	Construct an empirical model estimating bilateral dry cargo seaborne import flows	Seaborne trade Constant Ratio of Elasticities of Substitution Homogenous/ Homothetic CRESH
1987	Dagenais and Martin	Forecasting containerized traffic for the port of Montreal (1981–1995)	Long term forecasting by commodity, by origin and by destination	Export/ Import functions
1982	Eriksen	The demand for bulk ship services	Isolate the effect of freight rates and commodity prices on trade pattern, for iron ore, coal and crude oil	Relative demand functions

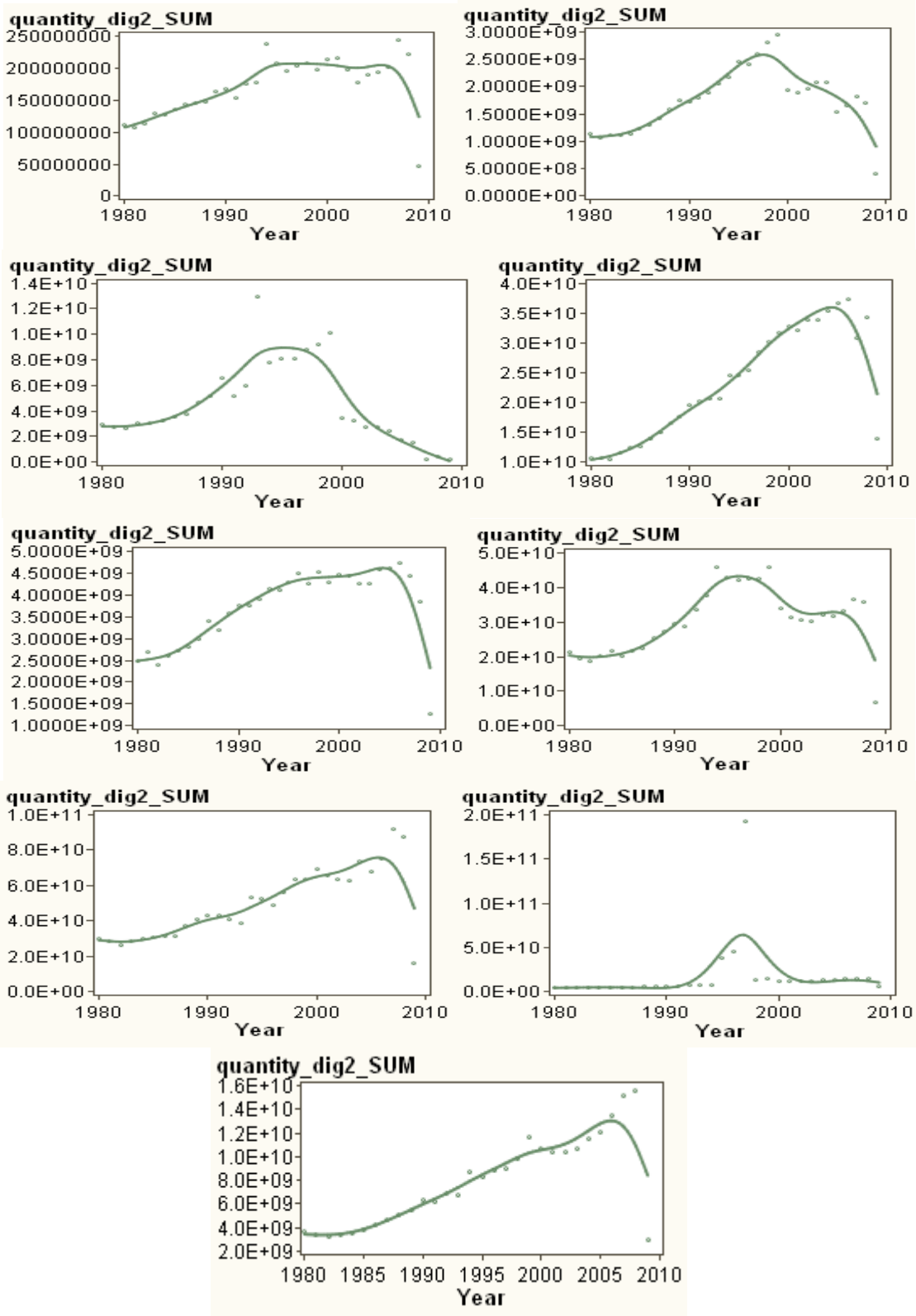
Annex Table 1c – Trade & Macro-economic Modelling

Criteria 1: Reliability	Criteria 2: Output			Criteria 3: Methodology			Criteria 4: Forecasting		Criteria 5: Scenarios	Criteria 6: Documentation
Source	Report	Trade projections	Coverage	Title/Model	Year	Features	Application	Timespam		
EC	European Economic Forecast	1) Exports (goods and services) 2) Imports (goods and services)	EU27 Croatia, FUROM, Turkey, US, Japan, Russia, China, EFTA		2009	1) statistical methods of varying degrees 2) performed by country desks 3) judgemental forecasting models 4) Three times iterative process	yes	2 years ahead	yes	no
		3) import growth	World							
		4) Export market growth	Extra EU							
		5) Trade Interactions/shock responce	EU15, US, Japan, Canada, Australia, Switzerland, Norway	QUEST III	2008	DSGE for an open economy	yes	medium-long term	yes	Average
	Interim forecast	Same as above	Germany, Spain, France, Italy, the Netherlands, Poland, UK		2009	1) indicator based 2) judgemental forecasting models	yes	Current year	no	no
	Quarterly Report on the Euro Area	Same as above	EMU		2009	based on Economic and Interim forecast	yes	2 years ahead	no	no
ECB	ECB staff macroeconomic projections for the Euro area	1) Exports (goods and services) 2) Imports (goods and services)	EMU	An Area-Wide model (AWM) for the Euro Area	2001	1) long run properties consistent with a basic neoclasical steady state 2) short run dynamics specified in traditional "ad hoc" form, estimated on the basis of historical series	yes	2 years ahead	yes	Full documentation
				Multi-country model of the European System of Central Banks (ESCB)	2002					Full documentation
				Leading indicators and judgemental methods		based on technical experts				no
OECD	OECD economic outlook	1) Exports (goods and services) 2) Imports (goods and services)	OECD, World, Estonia, Slovenia, Israel, Chille, China exc Hong-Kong, India, Indonesia, Brazil, South Africa	INTERLINK*	1987	1) combination of semi annual macro-econometric models	yes	2 years ahead	yes	Average
				Trade linkages and Trade matrices in the OECD	2001	set of trade matrices summarizing the geographical nature of global trade				Average
				The new international trade model	2005	behavioural equations with long-run equilibrium-correction terms estimated for volumes and prices				Average
			OECD, China, Dynamic Asia, Other Asia, Africa,Middle East, Latin America, Eastern & Central Europe	Modeling Manufacturing Export Volumes Equations	2000	logarithmic dynamic error correction form equations estimated as a system	yes	2 years ahead	yes	Average
	Main Economic Indicators	1) Exports (goods) 2) Imports (goods)	OECD, China, Brazil,India, Indonesia, South Africa, Russia		2009		no	no	no	
			EMU, US, Japan	Small Global Forecasting Model	2002	1) demand side model 2) S-style output relationship 3) Phillips curve Inflation basis	yes	18 months	yes	Average

Table 1c (continued) – Trade & Macro-economic Modelling

IMF	WEO	1) Exports (volume of goods) 2) Imports (volume of goods)	Advanced, emerging and developing economies, Fuel/non fuel exporters	Aggregated projections from individual country desks	2009		yes	2 years ahead	no	no
		3) Trade in Goods	World							
		5) Trade Interactions shock responce		GEM	2004	1) stochastic dynamic general equilibrium 2) microeconomic structure 3) standard functional forms 4) flexible modular structure	yes	2 years ahead	yes	Average
WTO	**ITS**	1) Exports (merchandise) volume 2) Imports (merchandise) volume	Advanced, developing economies Euro area		2009		yes	Current year	yes	no
		3) Merchandise Trade volume	World							
		4) Exports (goods and services) 5) Imports (goods and services)	OECD, EMU	Forecasting Trade	2006	1) time series forecasting model 2) univariate AR 3) multivariate	yes	6-18 months	no	Full documentation
WB	Prospects for the Global Economy forecasts	1) Exports of goods and non-factor services 2) Imports of goods and non-factor services	World, 152 countries, High income, EMU, Developing, East Asia/Pacific, Europe /Central Asia, Latin America /Caribbean, Middle East/North Africa, South Asia, Sub-Saharan Africa		2010	1) aggregated country-specific forecasts 2) driven by the international investment cycle, macroeconomic policy considerations and other cyclical forces	yes	3 years ahead	yes	no
Bundesbank	Outlook for the German Economy- macroeconomic projections	1) Exports (goods and services) 2) Imports (goods and services)	Germany	MEMMOD	2009 2000	1) macro-econometric 2) neo classical long run properties 3) backward/ forward-looking expectations	yes	2 years ahead	yes	Full documentation
CPB-NL	Newsletter	1) Exports (goods volume) 2) Imports (goods volume)	World, Advanced economies, Emerging economies, Asia, Latin America, Transition countries, Africa & Middle East, EMU, EU15 (all), C&E Europe (all), US, Japan, Canada, Australia, New Zealand, China, Turkey, Switzerland, Norway, Iceland	SAFFIER	2009 2006	1) multipurpose model 2) combination of short (JADE) and medium term (SAFE) dynamics	yes	2 years ahead	yes	Average
		3)Trade in goods	World							
		4) Trade Interactions shock responce		WORLDSCAN	2006	1) stochastic 2) Dynamic General Equilibrium 3) micro-founded 4) open economy model	yes	20-40 years ahead	yes	Average
CPB-BE	Economic Forecasts	1) Exports (goods and services) 2) Imports (goods and services)	EMU, Non EMU western MS, Non EMU eastern MS, USA, Japan, rest of the world	NIME	2001	1) macro-econometric)Gauss-Saidel simulation type	yes	2 - 6 years ahead	yes	Average
		3) Trade Interactions shock responce		NIME and NEMESIS	2004	1) macrosectoral econometric model 2) framework model		25-50 years ahead		

Annex Graph 1 : Product sub-categories 6.1-6.9 (reading left to right)



BIBLIOGRAPHY

Anderson, J.E., Van Wincoop, E., (2004), Trade Costs, Journal of Economic Literature, 42(3), 691-751.
Baldwin, R., Taglioni, D., (2006), Gravity for dummies and dummies for gravity equations, NBER working papers, No.12516.
Bundesbank, (2000), Macro-Econometric Multi-Country Model:MEMMOD
Fagan, G., Henry, J., Mestre, R., (2001), an area wide model (AWM) for the Euro area, European Central bank working paper series, No. 42.
IMF, (2004), GEM: A new international Macroeconometric model, Research department
Jakaitiene, A., Stéphane, D., (2009)Forecasting the World economy in the Short-term, European Central bank working paper series, No. 1059.
Le Fouler, L., W. Suyker and D. Turner (2001), Trade Linkages and the Trade Matrices in the OECD Interlink Model, OECD Economics Department Working Papers, No. 310.
Lejour, A. Veenendaal,P., Verweij, G. van Leeuwen, N., (2006), WorldScan: a Model for International Economic Policy Analysis, CPB document , No.111.
Levine, B., Nozick, L., Jones, D., (2009), Estimating an origin–destination table for US imports of waterborne containerized freight, Transportation Research Part E 45, 611–626
Luo, M., Grigalununas, T., (2003), Spatial-Economic Multimodal Transportation
Meyermans, E., Van Brusselen, P., (2001), The nime model a macro econometric World model, Federal Planning Bureau Economic analyses and forecasts.
Murata, K. et al. (2000), Modelling Manufacturing Export Volumes Equations: A System Estimation Approach, OECD Economics Department Working Papers, No. 235.
Nordås, H., K., Geloso, M., (2008), Market Structure in the Distribution Sector and Merchandise Trade, OECD trade policy working papers, No.68.
Pain, N. et al. (2005), The New OECD International Trade Model, OECD Economics Department Working Papers, No. 440.
Perrin, J-F., Tavasszy, L., van Meijeren, J. Minderhoud, M., Burgess, A., Bowden, N., (2008), Worldwide container model, in ETC proceedings.
Rae, D. and D. Turner (2001), A Small Global Forecasting Model, OECD Economics Department Working Papers, No. 286.
Rattoa, M., Werner, R., Jan in ’t , V., (2008), QUEST III: An Estimated Open-Economy DSGE Model of the Euro Area with Fiscal and Monetary Policy , Economic Papers, No.335.
SAS Institute Inc. (2008), SAS/STATR 9.2 User’s Guide. Cary, NC: SAS Institute.
Simulation Model For US Coastal Container Ports, Maritime Economics & Logistics, 5, 158–178.
UNESCAP, (2007), Container Traffic Forecast.
Veenstra, A., Charalambides, (2001), Multivariate autoregressive models for forecasting seaborne trade flows, Transportation Research Part E37, 311-319

Willman, A., Estrada, A., (2002),The Spanish block of the ESCB Multi country model, European Central bank working paper series, No. 149.