EUROMED MANAGEMENT

Les enjeux stratégiques du slow steaming

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***Séminaire* EMAR-IFSTTAR**
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Jeudi 9 Juin 2011

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0. Agenda

1. Principe général du Slow Steaming

2. Vers une généralisation du Slow Steaming?

3. Cas pratique et implications pour les ports

4. Conclusions

0. Agenda

Cette présentation est une synthèse (+ extension) de travaux précédents:

- Notteboom T., and Cariou P., (2011). Chapter 11. Bunker Adjustment Factor in Liner Shipping. In K. Cullinane (eds), *International Handbook of Maritime Economics*, Edward Elgar, Cheltenham, UK, Northampton, MA, USA, 223-255.

- Cheaitou A. and Cariou P., (2011). Containership speed and fleet size optimisation with semi-elastic demand: An application to Northern Europe-South America trade, *International Association of Maritime Economist Conference*, Santiago de Chile, 25-28 of October 2011, Forthcoming.

- Cariou P., (2011). Is slow steaming a sustainable means of reducing CO2 emissions from container shipping, *Transportation Research Part D* (16), 260-264.

Remerciements: Jack Devanney (Center for Tankship Excellence, USA), Takeshi Nakazawa (World Maritime University, Sweden) and Harilaos Psaraftis (National Technical University of Athens, Greece)

1. Principe général du Slow Steaming

P1. Principe général = vitesse optimale des navires

a. La puissance requise pour le moteur principal est une fonction cubique de la vitesse (10% réduction de vitesse = 27% réduction de la puissance)

b. La consommation en tonne-mile est une fonction carrée de la vitesse (10% réduction de vitesse = 19% de la consommation)

Ces deux règles de base ont cependant des limites.

1. Principe général du Slow Steaming

Pour des réductions de vitesse > 10%, le rendement du moteur (SFC) décroît. Or la majorité des porte-conteneurs en activité furent conçus pour une vitesse d'environ 20-25 kt.

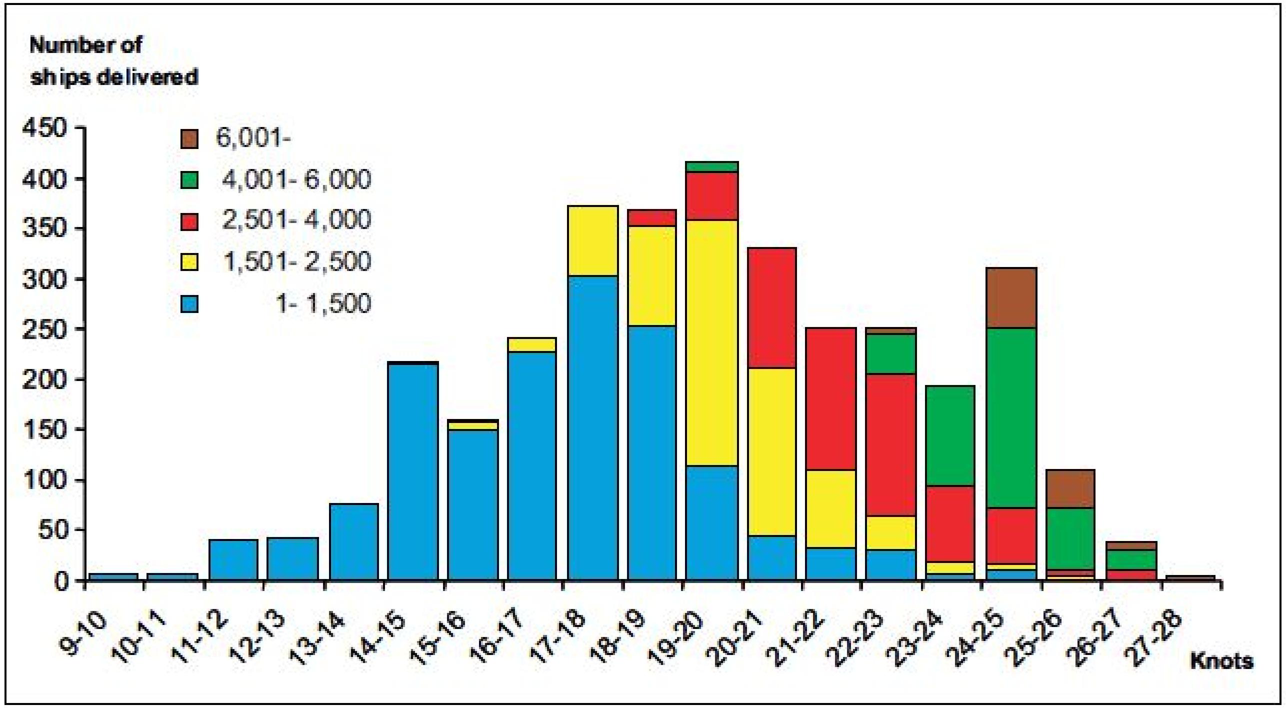
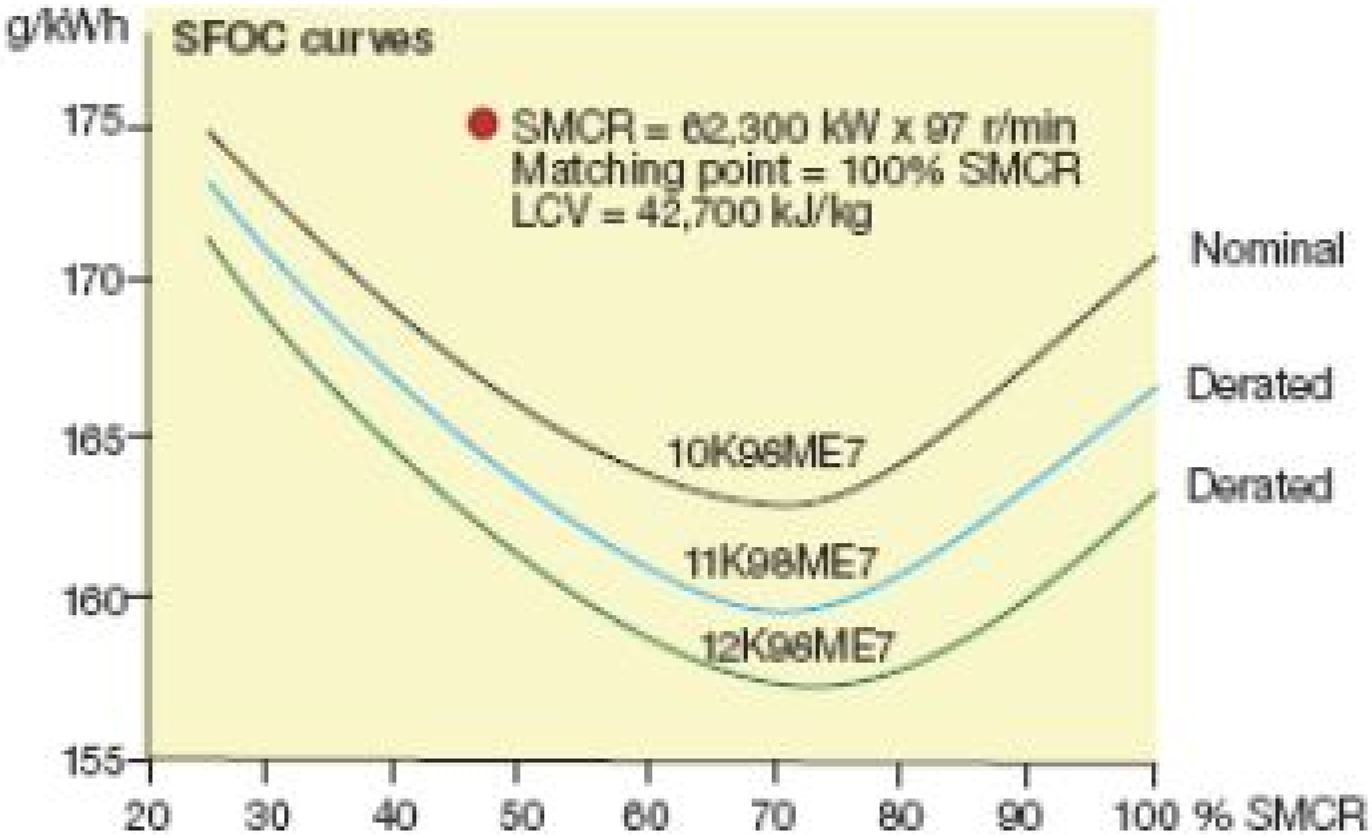


Fig. 2a: Average ship speed of container ships delivered from 1960-2004 (number of ships)

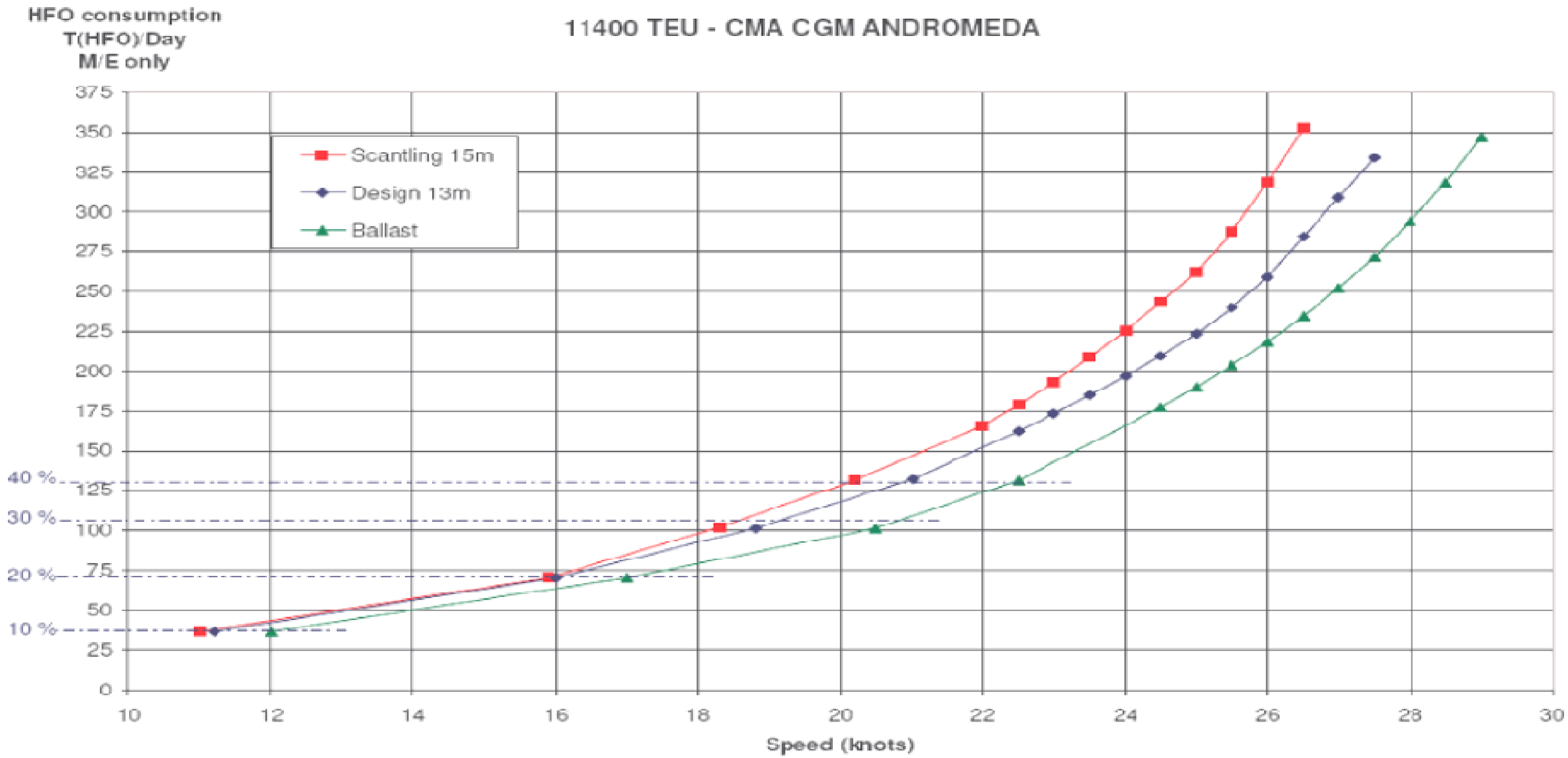
Source: MAN B&W Diesel A/S, Copenhagen, Denmark

1. Principe général du Slow Steaming



Source: MAN B&W Diesel A/S, Copenhagen, Denmark

1. Principe général du Slow Steaming

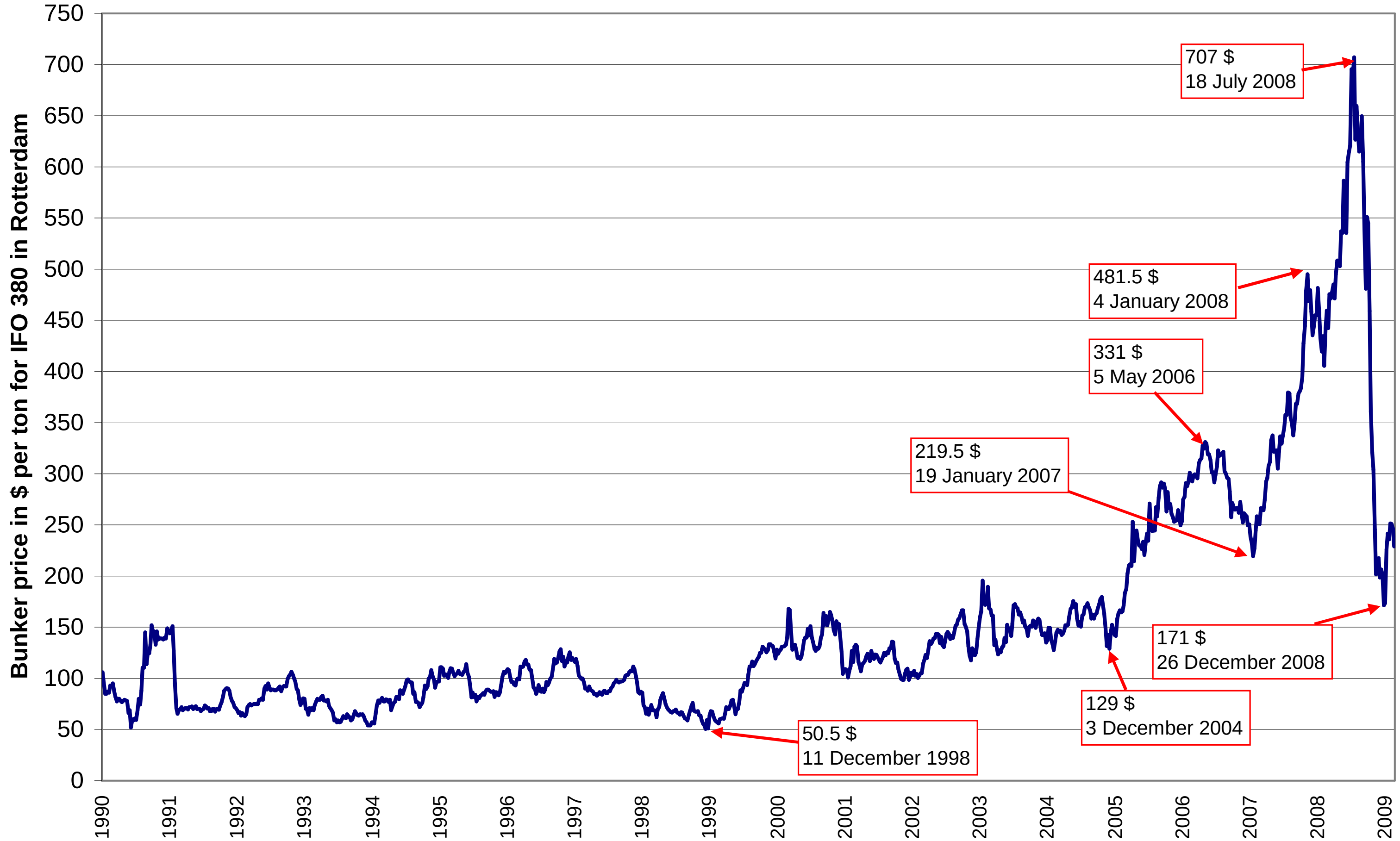


Typical fuel consumption curve for 11400Teu vessel, CMA CGM

Source: Copil (2011, Mai)

1. Principe général du Slow Steaming

P2. Le coût en carburant représente de 30 à 50% du coût d'une ligne et fluctue significativement.



Source: Notteboom et Cariou (2011)

1. Principe général du Slow Steaming

P3. Pour la ligne régulière, la vitesse ne peut être ajustée de façon continue car une fréquence hebdomadaire au port est requise - décision voulue ou contrainte par « port windows »

Service A/R (en jours) A	Fréquence hebdomadaire (en jours)	N (en navires)	Distance (en nm) B	Temps incompressible (en jours) C	Temps en mer (en jours)	Vitesse (en kt) = B/ ((A-C)*24)
49	7	7	10860	19	15	15,1
~~53~~	~~7~~	~~7,6~~	~~10860~~	~~19~~	~~17~~	~~13,3~~
56	7	8	10860	19	18,5	12,2

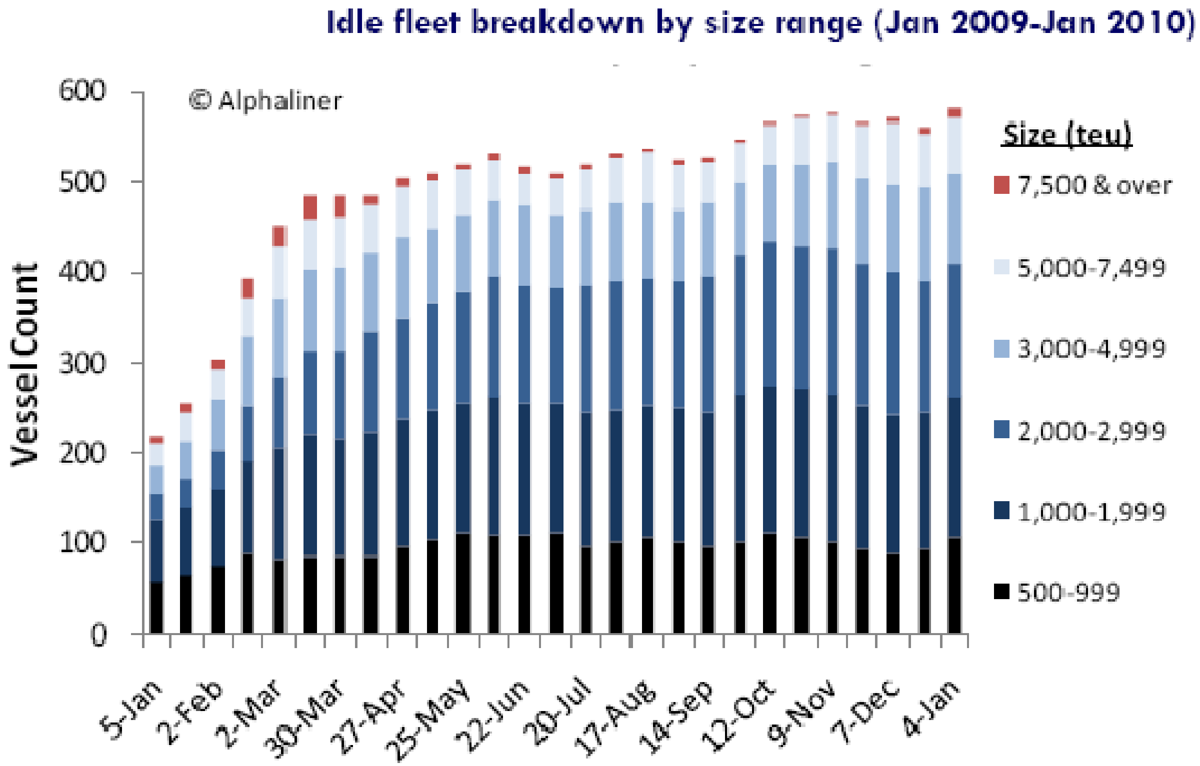
1. Principe général du Slow Steaming

Les gains en carburant à attendre sont donc fonction de la proportion temps en mer *vs* coût/temps incompressible...

Source: Service FAL1- CMA-CGM Website (5 Juin 2011)

1. Principe général du Slow Steaming

… et Les économies de carburants ($) sont à mettre en balance avec le coûts additionnels liés à l'ajout des navires.



Source: Alphaliner Newlsetter (2010)

1. Principe général du Slow Steaming

P4. L'allongement du transit time ne doit pas inclure une baisse significative de la demande sous peine de conduire à une réduction des revenus supérieure à la baisse des coûts.

L'impact du slow steaming sur la demande dépend (voir section 2):

- de la réponse des concurrents et la répercussion ou non dans le prix du transport;

- de la sensibilité de la demande de transport au Transit time.

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1. Principe général du Slow Steaming

En 2008, les 4 conditions nécessaires étaient réunies ***pour certains marchés***.

1. Les navires étaient récents et le coût du « de-rating » plutôt limité;

2. Le prix du fuel était élevé et le temps en mer suffisamment long;

3. La surcapacité générale impliquait que de nombreux navires étaient disponibles;

4. Le ralentissement général de l'activité induisait que les chargeurs s'inquiétaient peu de l'allongement du transit time.

1. Principe général du Slow Steaming

Table 4.4 **The slow steaming cost advantage Asia-N Europe trade**

	8 ships			9 ships			10 ships		
	Service Fundamentals								
Round Voyage Distance (Miles)	21,000			21,000			21,000		
Speed (Knots)	24.0			20.1			17.3		
Sea Days	36.5			43.5			50.5		
Port & Canal Days	19.5			19.5			19.5		
Round Voyage (days)	56.0			63.0			70.0		
Nominal Capacity	8,000	10,000	12,000	8,000	10,000	12,000	8,000	10,000	12,000
Fuel Consumption (tpd)	215	221	257	126	130	151	81	83	96
Ship Cost per day (long term time charter)	$48,500	$53,000	$57,500	$48,500	$53,000	$57,500	$48,500	$53,000	$57,500
	Estimated Voyage Costs per Round Trip (US$ million)								
Fuel price per tonne (Q3 2010, Rotterdam)	**$441**	**$441**	**$441**	**$441**	**$441**	**$441**	**$441**	**$441**	**$441**
Fuel*	3.46	3.56	4.14	2.42	2.49	2.90	1.80	1.85	2.14
Ship Cost	2.72	2.97	3.22	3.06	3.34	3.62	3.40	3.71	4.03
Port & Canal Costs	1.40	1.66	1.90	1.40	1.66	1.90	1.40	1.66	1.90
Total	**7.58**	**8.19**	**9.26**	**6.87**	**7.49**	**8.42**	**6.60**	**7.22**	**8.06**
Annual Total (52 round voyages pa)	**394**	**426**	**481**	**357**	**390**	**438**	**343**	**375**	**419**
Annual Saving v 8 ships				**37**	**36**	**44**	**51**	**50**	**62**

* Excludes MDO costs

Source: Drewry Research

2. Vers une généralisation du Slow Steaming?

Impact of slow steaming on CO_2 emissions by trade (2008, 2010)[a]

	Number of services	% services slow steaming	Mean size in TEU	CO_2 emissions in 000 tons	% 2010/2008
Multi-trade	63	57.1	5,994	47,500	-16.5
Europe/Far East	28	78.6	7,720	12,900	-16.4
Asia/North America	52	42.3	5,142	29,400	-9.7
Europe/North America	22	22.7	3,469	5,778	-6.7
Australasia/Oceania	17	23.5	3,490	6,275	-4.1
Latin America/Caribbean	73	20.5	2,823	16,200	-4.8
Middle East/South Asia	87	23.0	3,802	22,900	-6.7
South/East Africa	16	31.3	3,007	5,460	-5.9
West Africa	29	20.7	2,106	4,510	-9.1
Total	387	35.4	4,485	**150,921**	**-11.2**

[a] Table 3 in Cariou (2011) based on Alphaliner database (January 2010).

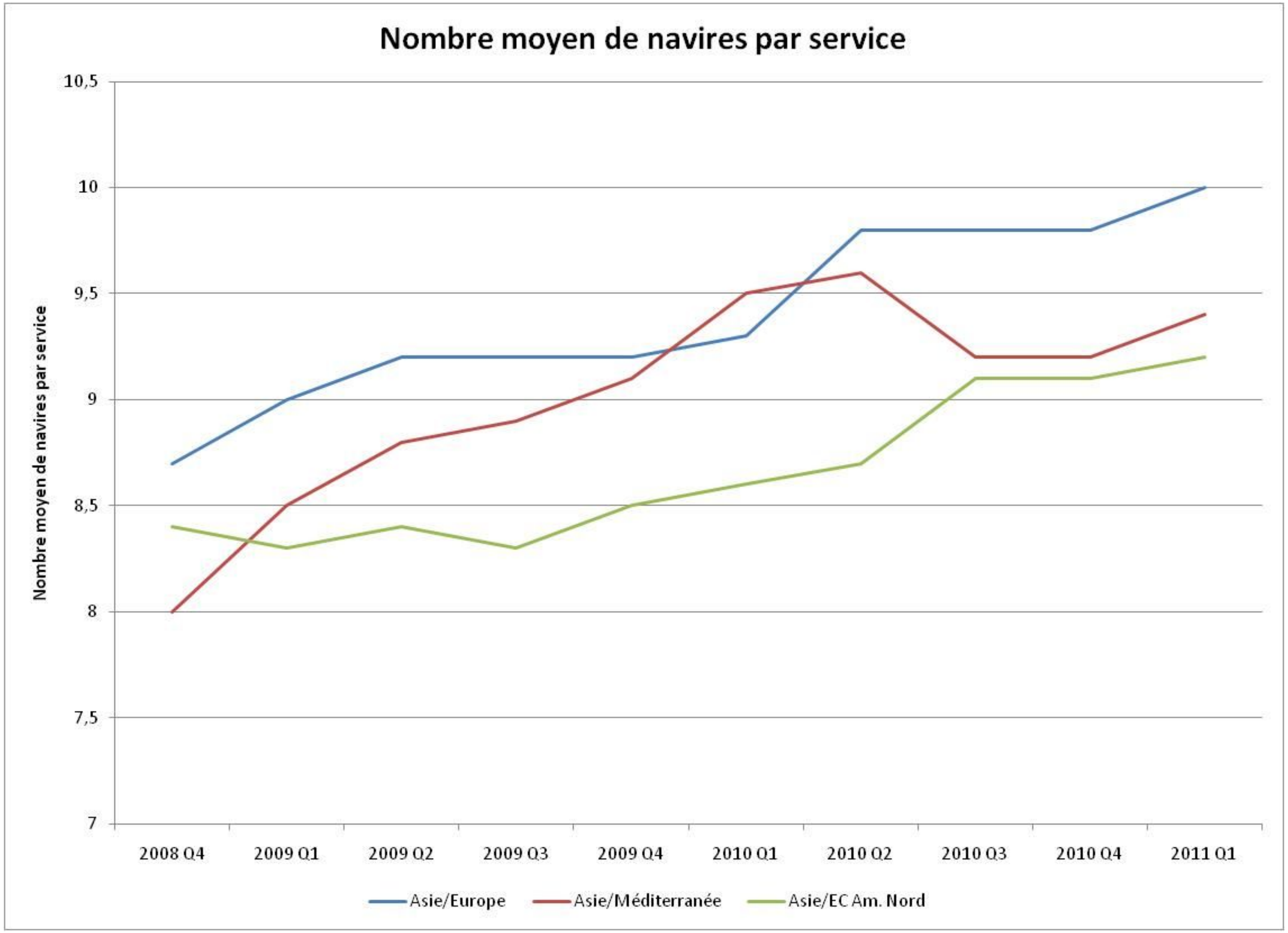
2. Vers une généralisation du Slow Steaming?

Services in July 2008 and October 2010 of the set of 90 O/D relations considered with port of loading Antwerp (average values per route)

	Services	Distances	Size in TEU		Transit time in days		Commercial speed in kt	
	#	In nm	2010	2010/08	2010	2010/08	2010	2010/08
Africa	15	4731	3903	+55%	17,8	+2%	19,6	-2%
Far East	24	11183	9308	+23%	29,1	+14%	18,4	-16%
India/Pakistan	9	7165	4505	+14%	24,8	+19%	19,1	-10%
Latin/S. America	23	5765	4180	+13%	18,1	+5%	19,8	-4%
North America	12	5096	4283	+4%	17	+2%	19,5	-4%

Notes:
(a) Including the diversion distance to call at en-route ports of call on liner service
(b) Including total sailing time, total port time at intermediate ports of call on liner service and canal transits
Source: Cariou and Notteboom (2011)

2. Vers une généralisation du Slow Steaming?



Source: Cariou from Drewry Container Forecaster (2010-2011)

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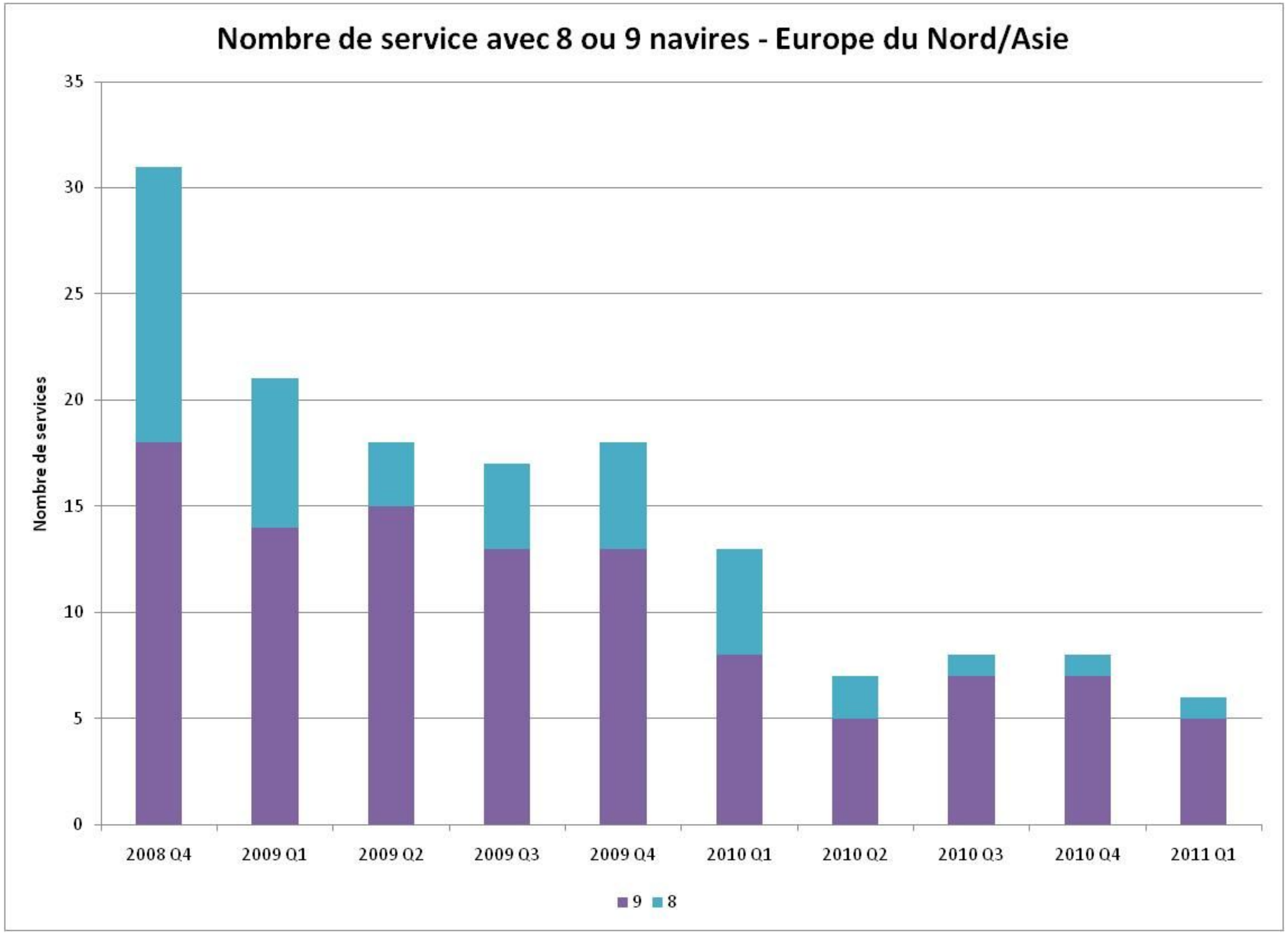

Source: Cariou from Drewry Container Forecaster (2010-2011)

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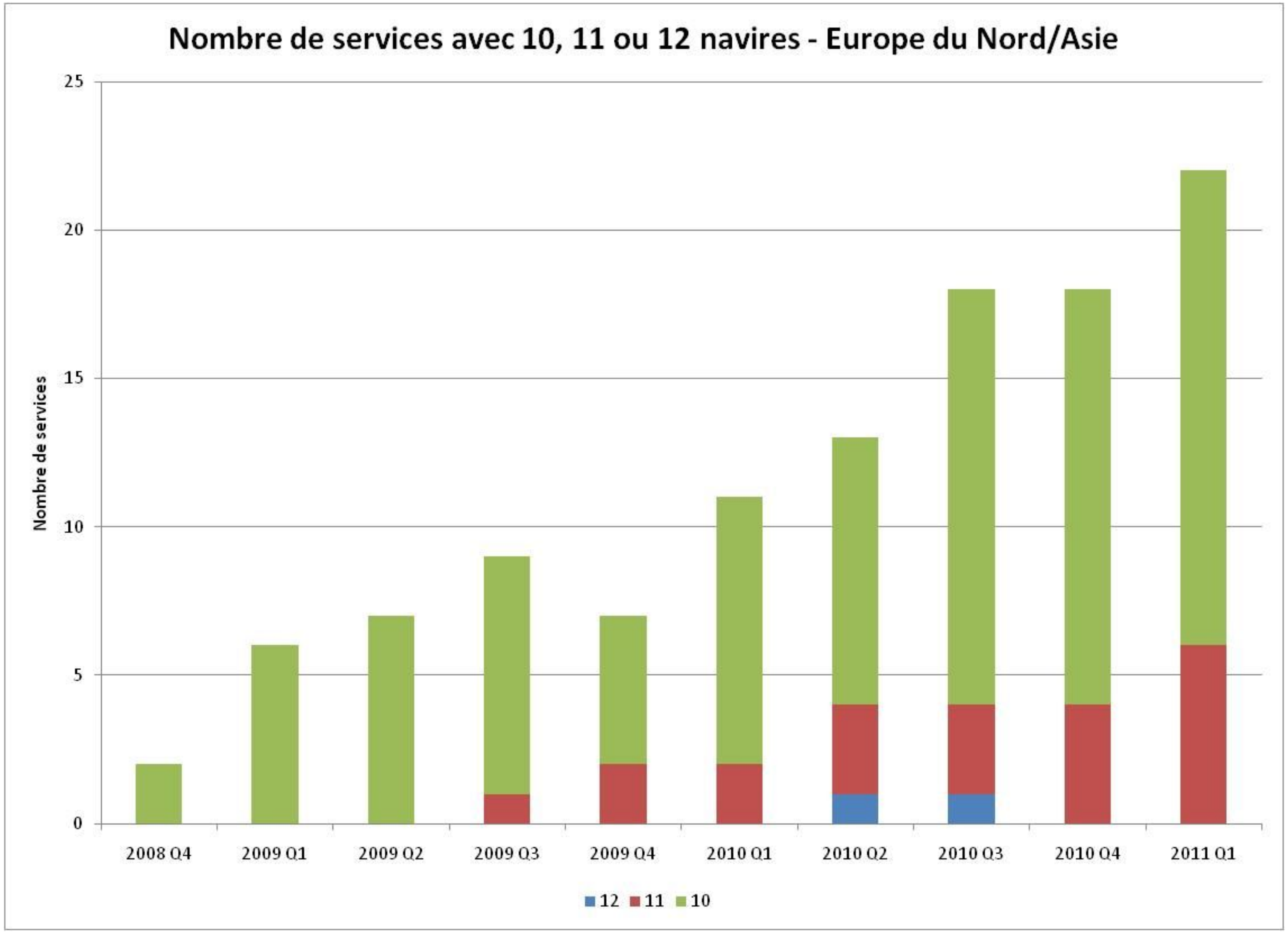

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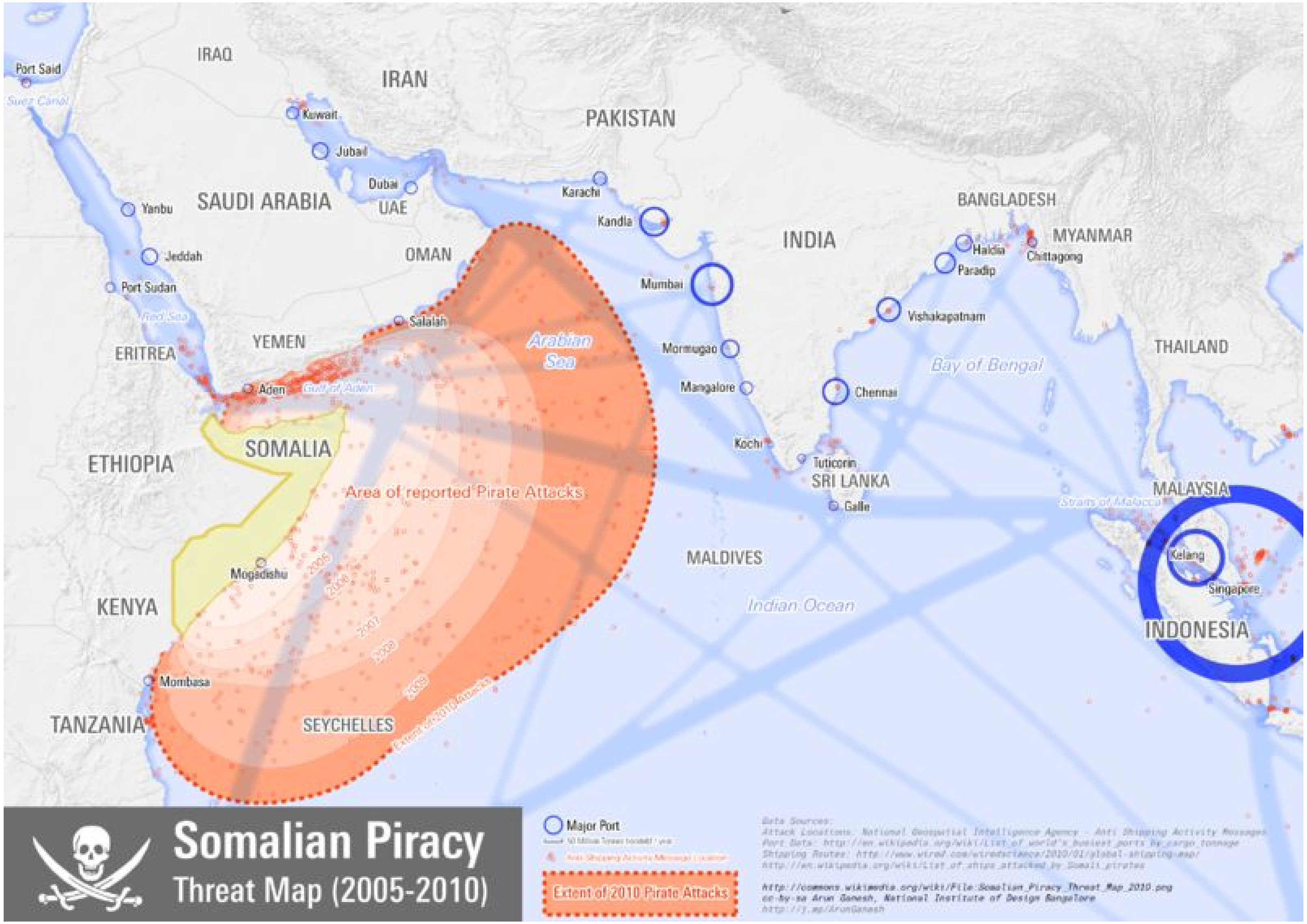

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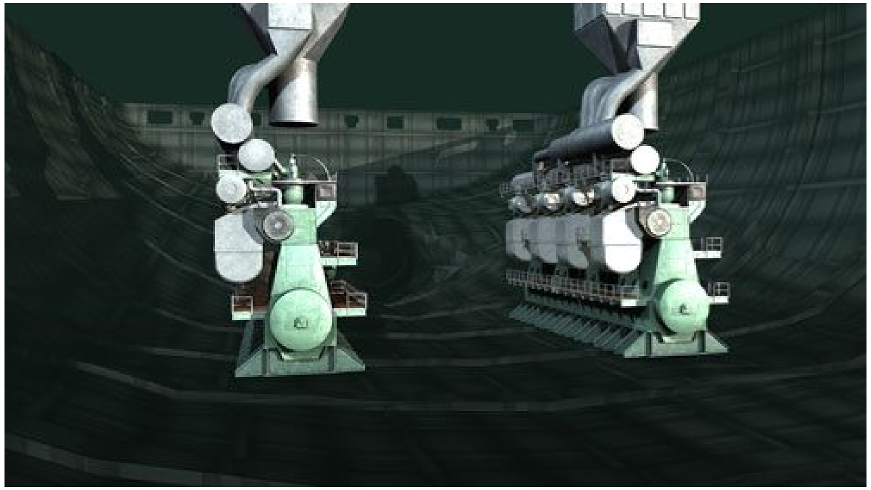
2. Vers une généralisation du Slow Steaming?

Maersk Line chief operating officer Morten Engelstoft, “Slow steaming is here to stay” (Lloyd’s List, 7 July 2010).

Car prix du carburant va s’accroître à terme + renchérissement du fait des réglementations environnementales « Bunker tax ou EMTS »

Reflété dans investissements = MAERSK 18,000 evp triple **E**:
- **E**conomy of scale
- **E**nergy efficiency
- **E**nvironmentally improved

2. Vers une généralisation du Slow Steaming?



Les gains du Triple E (par rapport à Emma Maersk – 14000 evp)

- Un design pour 23 kt au lieu de 25 soit 65-70 megawatts contre 80.
- Une vitesse de rotation inférieure avec des palmes plus grandes en diamètre (9.8 m. contre 9.6) mais en moins grand nombre (6 contre 4).

2. Vers une généralisation du Slow Steaming?

2. Vers une généralisation du Slow Steaming?

CHICKEN
AMERICA'S FAVORITE

NATIONAL CHICKEN COUNCIL
1015 FIFTEENTH STREET NW, SUITE 930
WASHINGTON, DC 20005
PHONE: 202-296-2622
FAX: 202-293-4005

With the advent of ocean-going vessels adopting slow-steaming, these carriers are actually saving money from the incremental fuel surcharges they continue to bill shippers. Further, carriers, such as those participating in the WTSA, continue using the fuel surcharge schedule and invoice the shipping public based on an outdated, non-science based formula.

There is also a problem with ocean-going carriers changing vessel rotations to more effectively deploy their vessels while at the same time delivering measurably worse transit service for the U.S. export market. Instead of implementing a universal vessel speed for the round trip voyages, many carriers only apply the slow-steaming to the export trip from the United States. Imports are kept, for the most part at the performa transits from the past while export service is denigrated with no reduction in cost to the shippers. U.S. exports, such as chilled/frozen chicken, are being used to cross-subsidize fuel related costs for foreign imports.

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2. Vers une généralisation du Slow Steaming?

Another serious negative impact of slow-steaming is the affect it has on shelf-life for perishable food items, like chilled poultry, meat, and produce. In a number of markets these items are sold to arrive early in the week so that can enter the market for sale and consumption the same week the vessel arrives. When carriers move arrival dates due to slow-steaming, it alters the delivery date past when customers are willing to accept the cargo which creates fewer sales and/or higher inventories for the receiver and lost shelf-life for the consumer.

2. Vers une généralisation du Slow Steaming?

MANAGING RISK DNV

Optimum speed – from a shipper's perspective

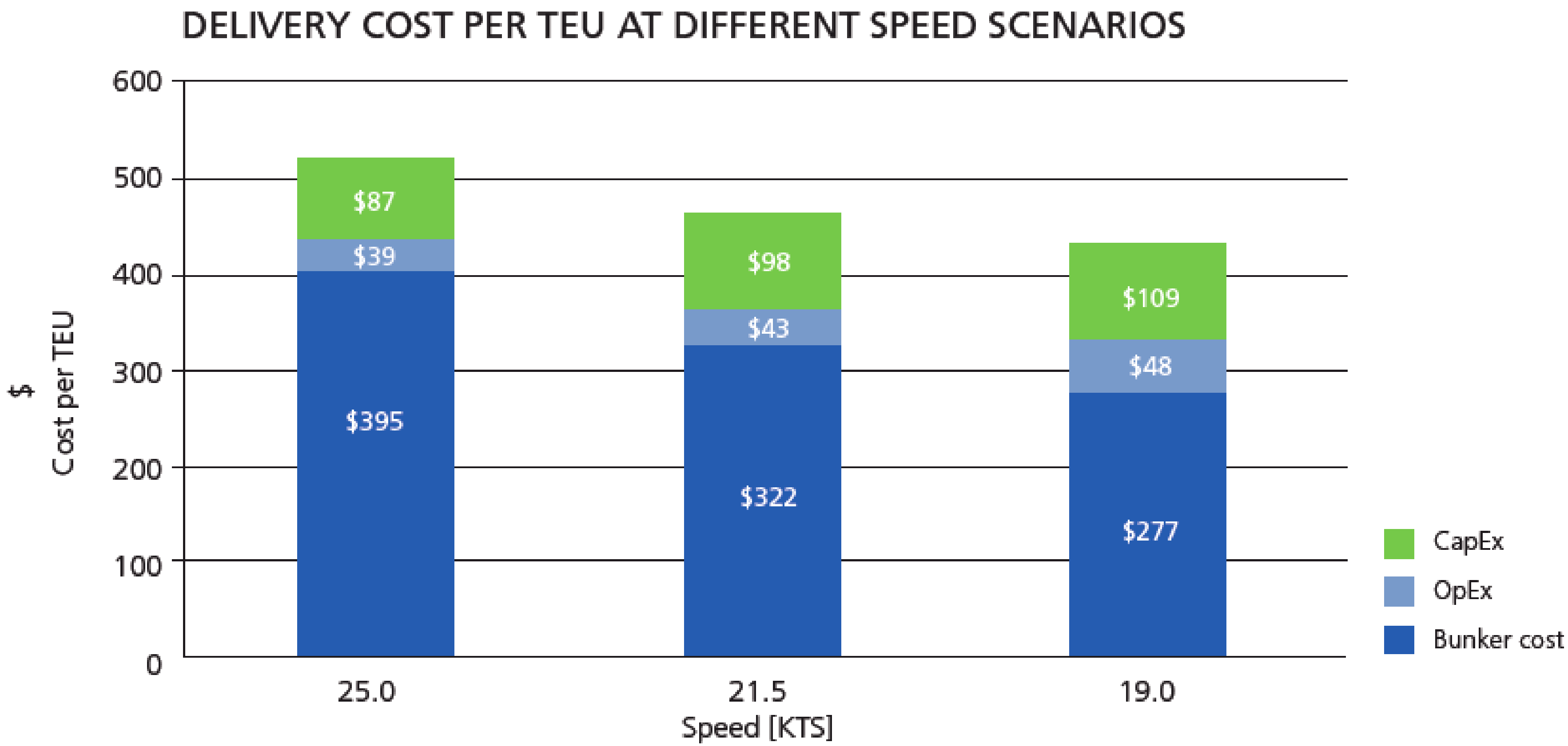
"To slow steam or not to slow steam" has been the question for some time now. There are many advantages and disadvantages in reducing the operating speed, but are the shippers' points of view being taken care of?

TEXT: INGAR BERGH

container ship update

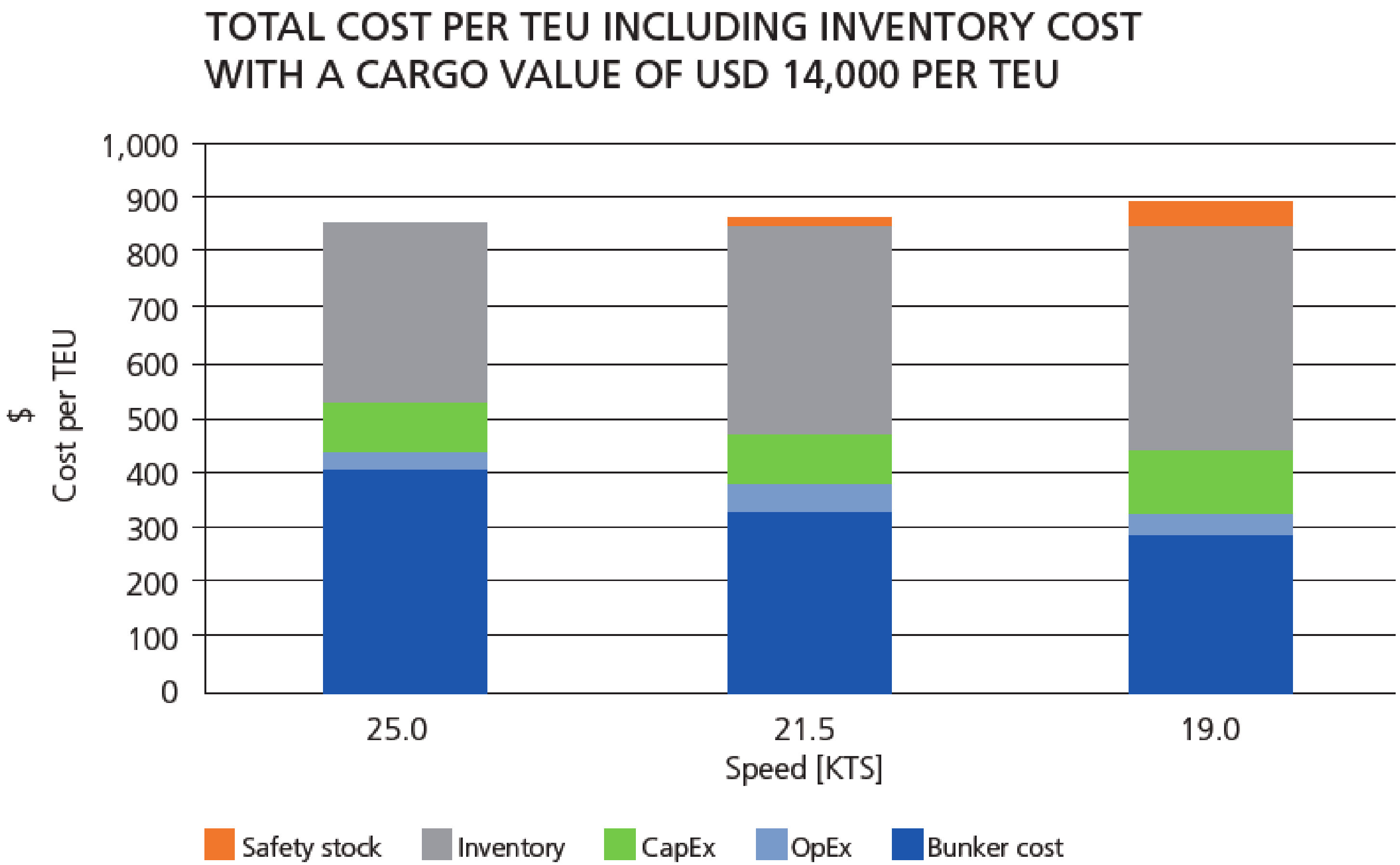
NEWS FROM DNV TO THE CONTAINER SHIP INDUSTRY No 02 2010

2. Vers une généralisation du Slow Steaming?



›› Figure 1: The average cost per TEU at 25 knots (8 ships), 21.5 knots (9 ships) and 19 knots (10 ships).

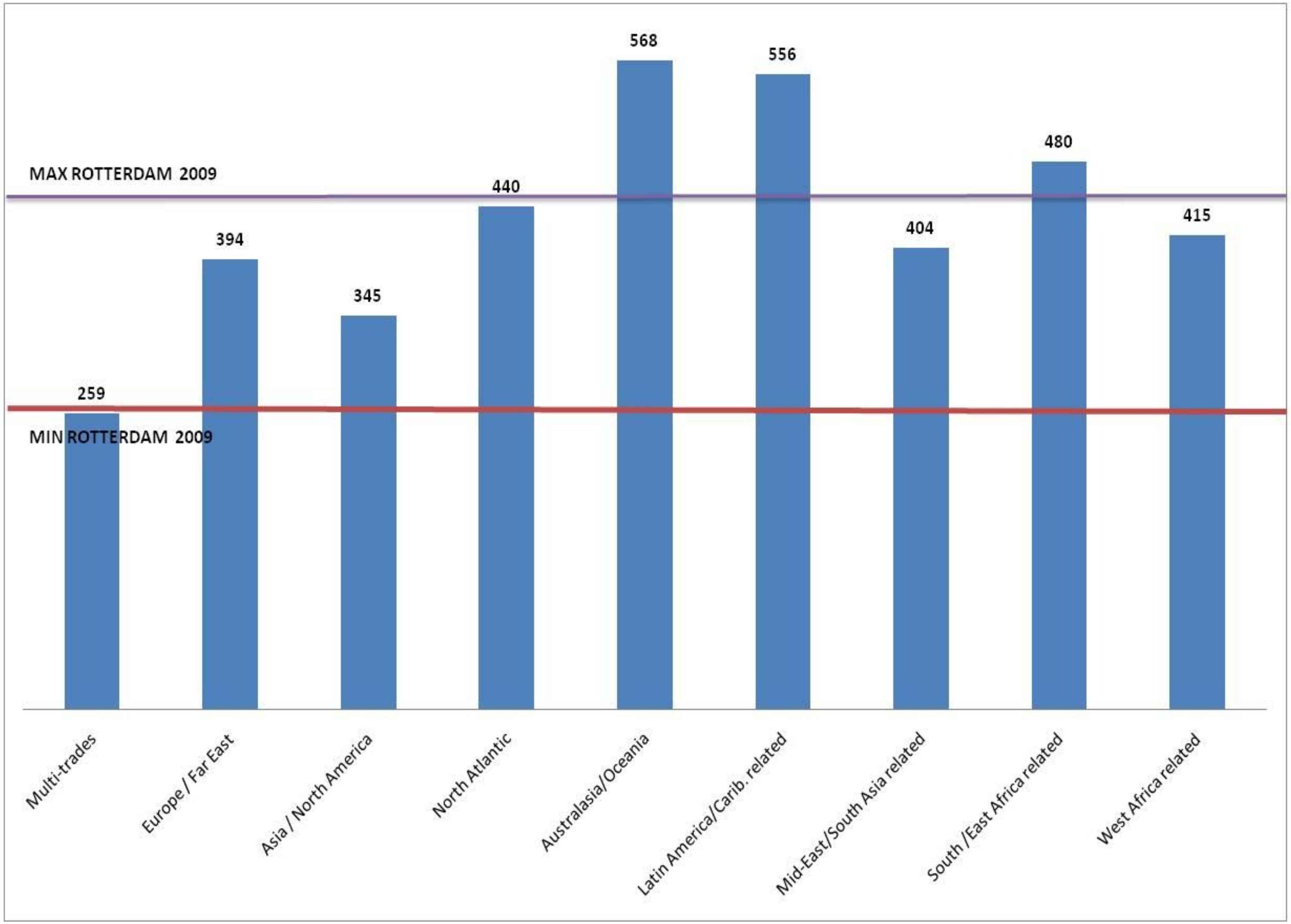
2. Vers une généralisation du Slow Steaming?



›› Figure 2: The average cost per TEU at 25 knots (8 ships), 21.5 knots (9 ships) and 19 knots (10 ships), including the shipper's inventory cost at a cargo value of USD 14,000 per TEU. For SS inventory only, the change from full speed is included.

2. Vers une généralisation du Slow Steaming?

Bunker break-even point per trade (2010)



Source: Cariou (2011)

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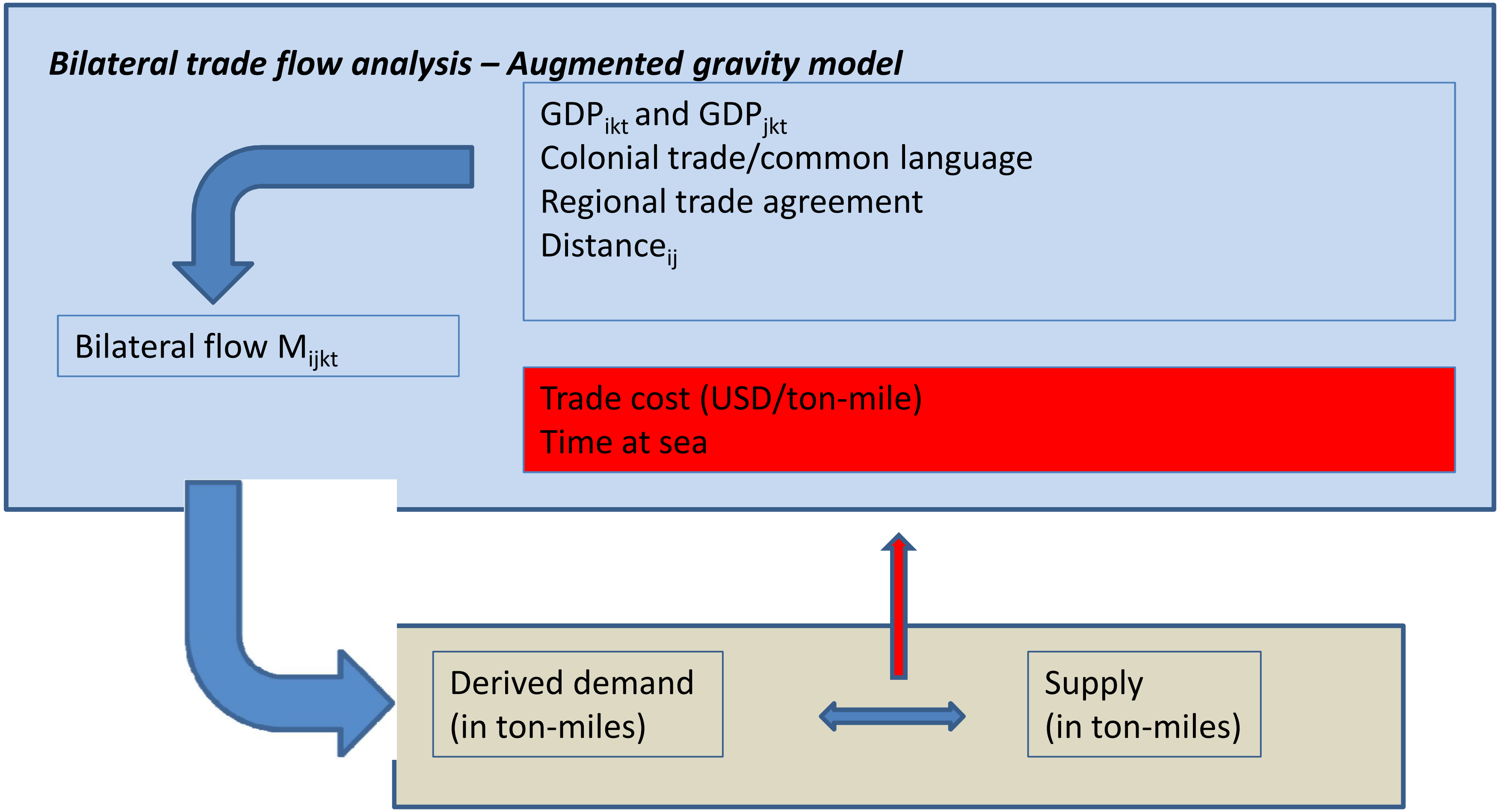
2. Vers une généralisation du Slow Steaming?



2. Vers une généralisation du Slow Steaming?

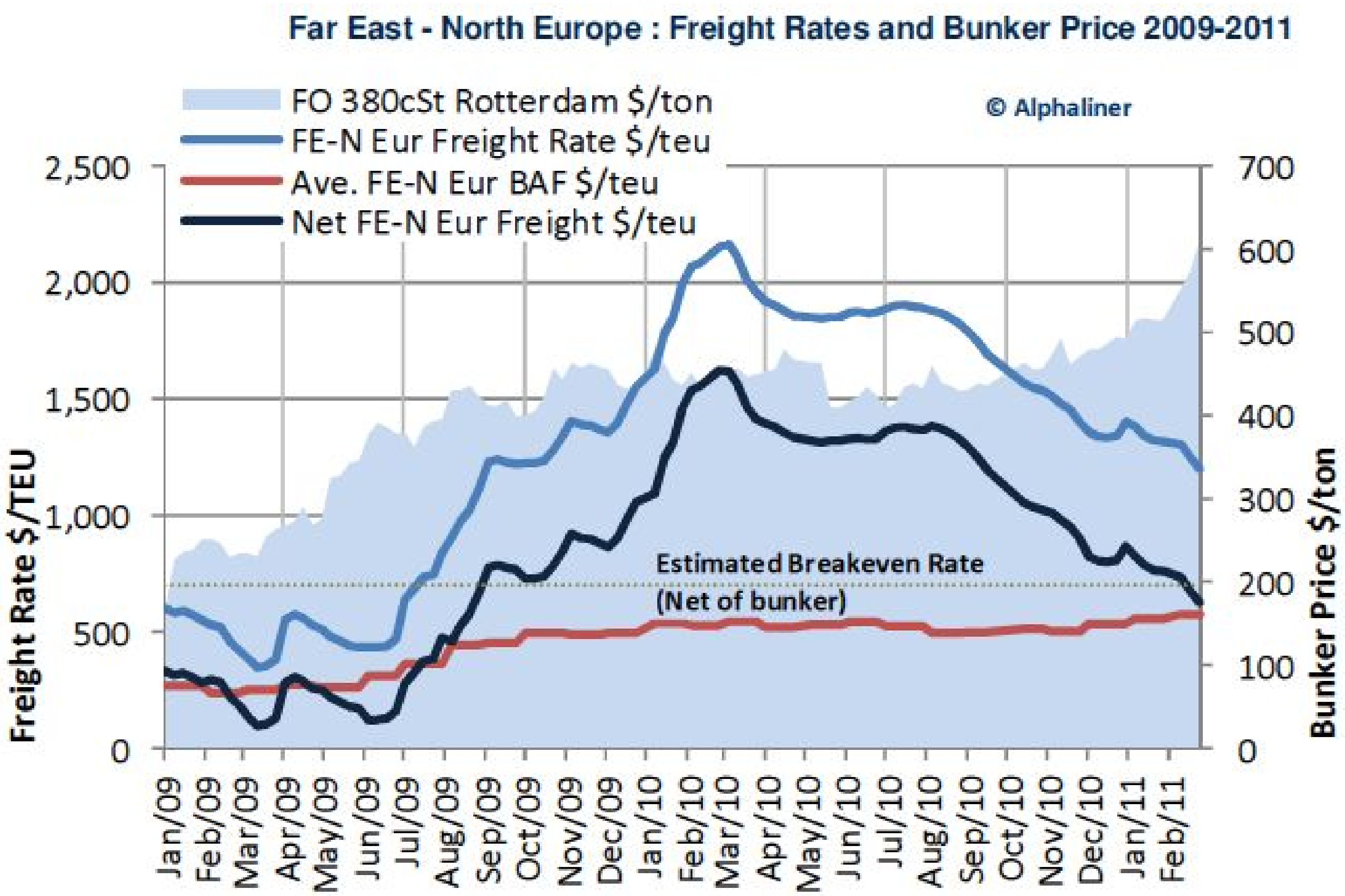
	(1)	(2)
		Aggregated dat
trcost	-0.803***	-0.776***
	(0.021)	(0.019)
dist	-0.709***	
	(0.053)	
colony	1.451***	1.438***
	(0.261)	(0.298)
land	-0.463***	-0.490***
	(0.159)	(0.122)
language	0.421***	0.789***
	(0.071)	(0.056)
$\ln(Y_{it}Y_{jt})$	0.930***	0.800***
	(0.063)	(0.065)
rta	1.336***	0.605***
	(0.155)	(0.177)
Shipping time		-0.686***
		(0.050)

-10% coût du transport
= +8% importations en valeur

+ 10% transit time
= -7% importations en valeurs

Source: Korinek et Soudrin (2009), OECD Working paper.

2. Vers une généralisation du Slow Steaming?



Source: Alphaliner Newletter (2011, issue 9).

2. Vers une généralisation du Slow Steaming?

« Back

Your selections:

From:
France (Atlantic)
Austria (Atlantic), Belarus, Belgium, Czech Republic, Denmark, Estonia, Finland, Germany, Hungary (Atlantic), Iceland, Ireland, Latvia, Lithuania, Luxemburg, Netherlands, Norway, Poland, Slovakia, Sweden, Switzerland, United Kingdom, Russia (Baltic).

To:
China
Hong Kong, Indonesia, Japan, Korea, South, Mongolia, Philippines, Singapore, Taiwan, Thailand, Vietnam, Brunei, Cambodia, Myanmar (Burma), Malaysia, Russia (Pacific).

Bunker charge per unit:

Container type:	Current charges: (Jun)	Upcoming charges: (Jul)
20'dry container	USD 270	USD 260
40'dry container	USD 540	USD 520
40'high cube dry container	USD 540	USD 520
45'high cube dry container	USD 540	USD 520

USD Change displayed currency?

Print

Source: http://baf.maerskline.com/

2. Vers une généralisation du Slow Steaming?

Bunker price change x Trade specific constant = BAF

Trade specific constant = Bunker consumption x Transit time x Imbalance factor

Vessel Bunker consumption:	0.02560 mt/TEU/day
Transit Time:	35.6 days
Imbalance factor:	0.50
Bunker price change:	654 (Price) - 65 (Bunker base element) = 589 USD
BAF:	270 USD / TEU
Future bunker price:	634 USD

Source: http://baf.maerskline.com/

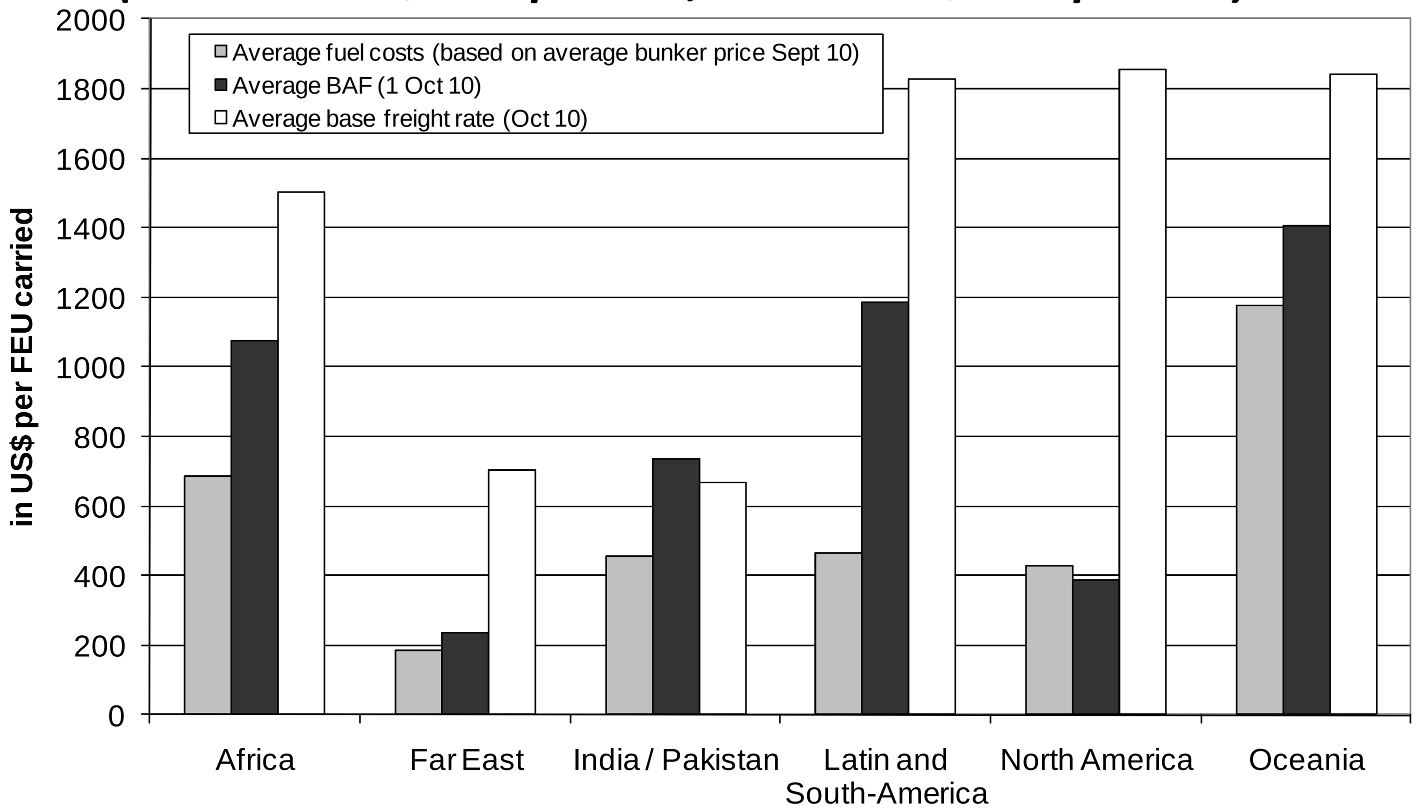
2. Vers une généralisation du Slow Steaming?

Fuel consumption at sea of the main engine in July 2008 and October 2010 in tons/day

	2010 at design speed	2010 at commercial speed	Maersk Line*
Africa	98	95	191
Far East	261	131	238
India/Pakistan	146	83	160
Latin/S. America	138	86	218
North America	151	84	156
Oceania	111	77	106

Source: Cariou and Notteboom (2011)

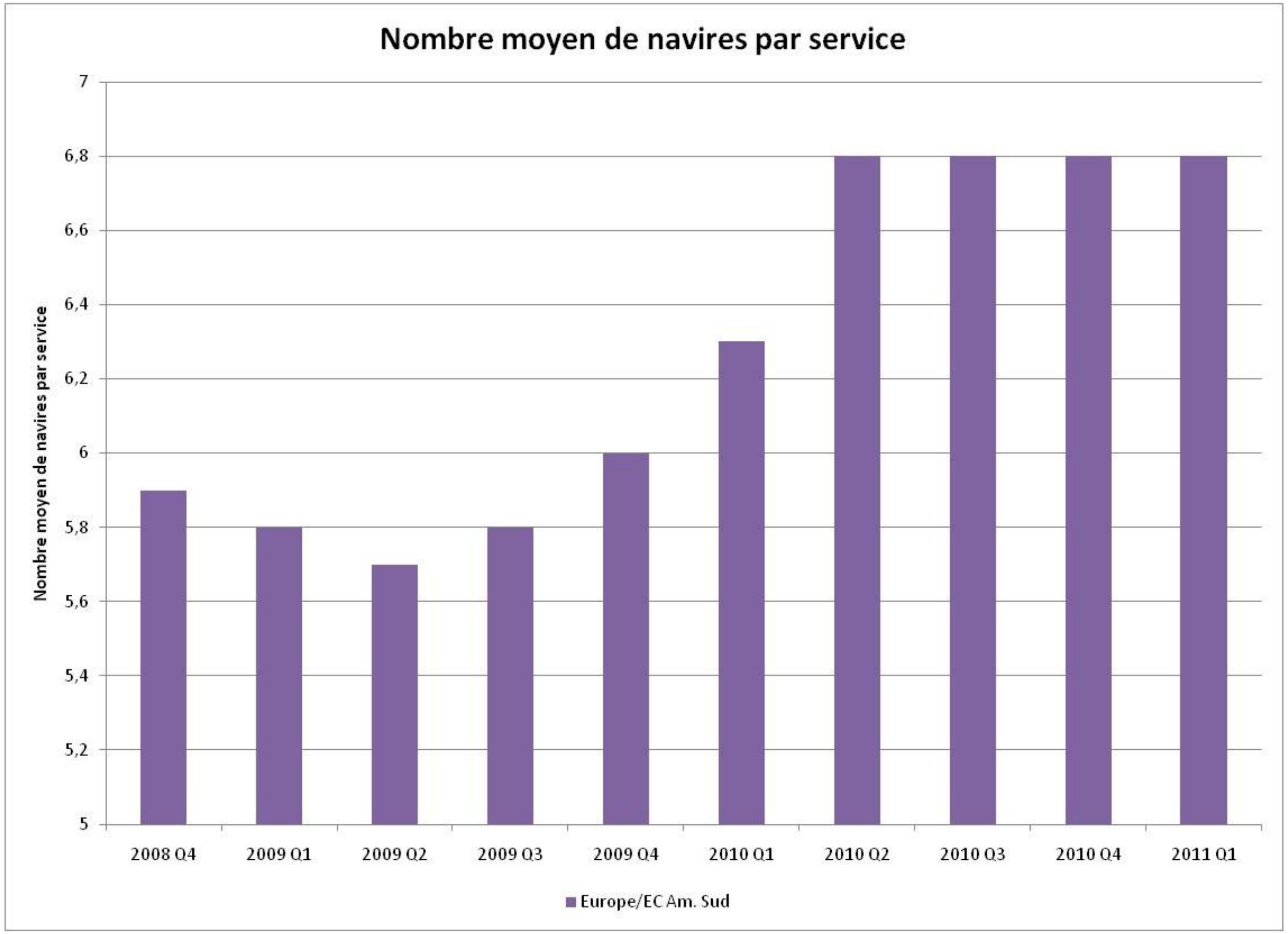
Estimated fuel costs and reported BAF in October 2010
(IFO380 = US$ 435 per ton, MDO = US$ 680 per ton)



Source: Cariou and Notteboom (2011)

3. Cas pratique et implications pour les ports

Exemple Europe du Nord/Côte Est Amérique du Sud => Pourquoi cette ligne?



Source: Cariou from Drewry Container Forecaster (2010-2011)

3. Cas pratique et implications pour les ports

Table 1: Northern Europe (A)/East Coast of South America (B) Safran service

Number of vessels[a]	7
Total capacity [TEU][b]	5905
Main engine power [kW][b]	41 186
Auxiliary engine power [kW][c]	2 433
Design speed [knots][b]	23.3
Reefer capacity [TEU][b]	1 365
Vessel age [year][b]	2.5

[a] From Hamburg Süd website schedule (Sept. 2010)
[b] From Lloyd's Register Fairplay (2010)
[c] From Buhaug et al. (2009)
[d] From Sea Distance (2011) for a Rotterdam/Santos return trip
[e] Estimated from data.

The service calls in 5 European ports (Rotterdam, Tilbury, Hamburg, Antwerp, Le Havre) and 4 South American ports (Santos, Buenos Aires, Montevideo, Rio Grande do Sul)

Cycle distance [Nautical Miles][d]	11 810
Speed at sea [knots][e]	15.1
Intercontinental time at sea per cycle[days][a]	30
Cycle time [days][a]	49
Weekly demand (dry) A to B [TEU][a]	3 774
Weekly demand (dry) B to A [TEU][a]	3 585
Weekly demand (frozen/fresh) B to A[TEU][e]	797/398

Source: Cheaitou & Cariou (2011)

3. Cas pratique et implications pour les ports

$$\Pi = \rho_d - CB_d^M - CB_d^A - CV_d - CD_d$$

The average daily bunker cost for the main engine for all the vessels

The bunker fuel consumption for the main engine per vessel cycle depends on the fuel Consumption (IFO 380cst) per day at sea F^M [tons/day] and the fuel consumption (IFO 380cst) per day in the range F^{MR} [tons/day]. F^M is (Corbett et al., 2009)

$$F^M = (SFOC^M EL^M PS^M)\left(\frac{V_i}{v_{DS}}\right)^3$$

The average daily bunker cost for the main engine for all the vessels operating on the cycle is obtained by multiplying the average daily bunker fuel consumption per vessel on the cycle by the bunker fuel price and by the number of vessels operating on the cycle:

$$CB_d^M = C_b^M\left(\frac{\frac{S}{24}F^M + \frac{S^R}{24}F^{MR}}{7W}\right)N = C_b^M\left(\frac{SF^M + S^R F^{MR}}{168}\right)\ [USD/day]$$

The average daily bunker cost for the auxiliary engine for all the vessels

The auxiliary engine average fuel consumption per day on the cycle, F^A, is constituted of a fixed component, F^A_F and a variable component, F^A_V .

The latter depends on the number and types of reefer containers loaded onboard.

The daily consumption per reefer container (F^Z and F^F) is the product of the container refrigeration system power [kW], the energy conversion constant (0.23 fuel Kg/kWh) (Ramos, 2010) and 24 [h/day]. The container refrigerating system power [kW] is equal to 5.2 kW for the frozen products (-18°C) and 7.2 kW for the fresh products (+2°) per TEU (CS Shipping Containers, 2011; Fitzgerald et al., 2011).

$$F^A = SFOC^A EL^A PS^A$$

$$F^A = F_F^A + \frac{(q^{ZAB}+q^{ZBA})F^Z+(q^{FAB}+q^{FBA})F^F}{2}$$

$$CB_d^A = C_b^A F^A N$$

3. Cas pratique et implications pour les ports

The daily fixed operating cost for all the vessels

The total daily fixed cost for all the vessels operating on the cycle is obtained by multiplying the daily fixed operating cost per vessel, C_v, by the number of vessels in the service, N:

$$CV_d = C_v N$$

The average daily container depreciation cost for all the vessels

The daily depreciation rate per container, dp^d or dp^R [USD/day], is calculated from the container purchasing price, PP [USD] and its economic lifecycle duration, LC [days] assuming a linear depreciation. For dry containers we assumed that PP = 2500 USD/TEU and LC = 20 years (dp^d = 0.342 USD/day/TEU) while for reefer containers PP = 9000 USD/TEU and LC = 12 years (dp^R = 2.054 USD/day/TEU) (Foxcroft, 2010).

$$CD_d = N\left[\frac{dp^d(q^{dAB}+q^{dBA})}{2} + dp^R\, max(q^{RAB}; q^{RBA})\right]$$

3. Cas pratique et implications pour les ports

We consider two cases for demand: inelastic and semi-elastic.

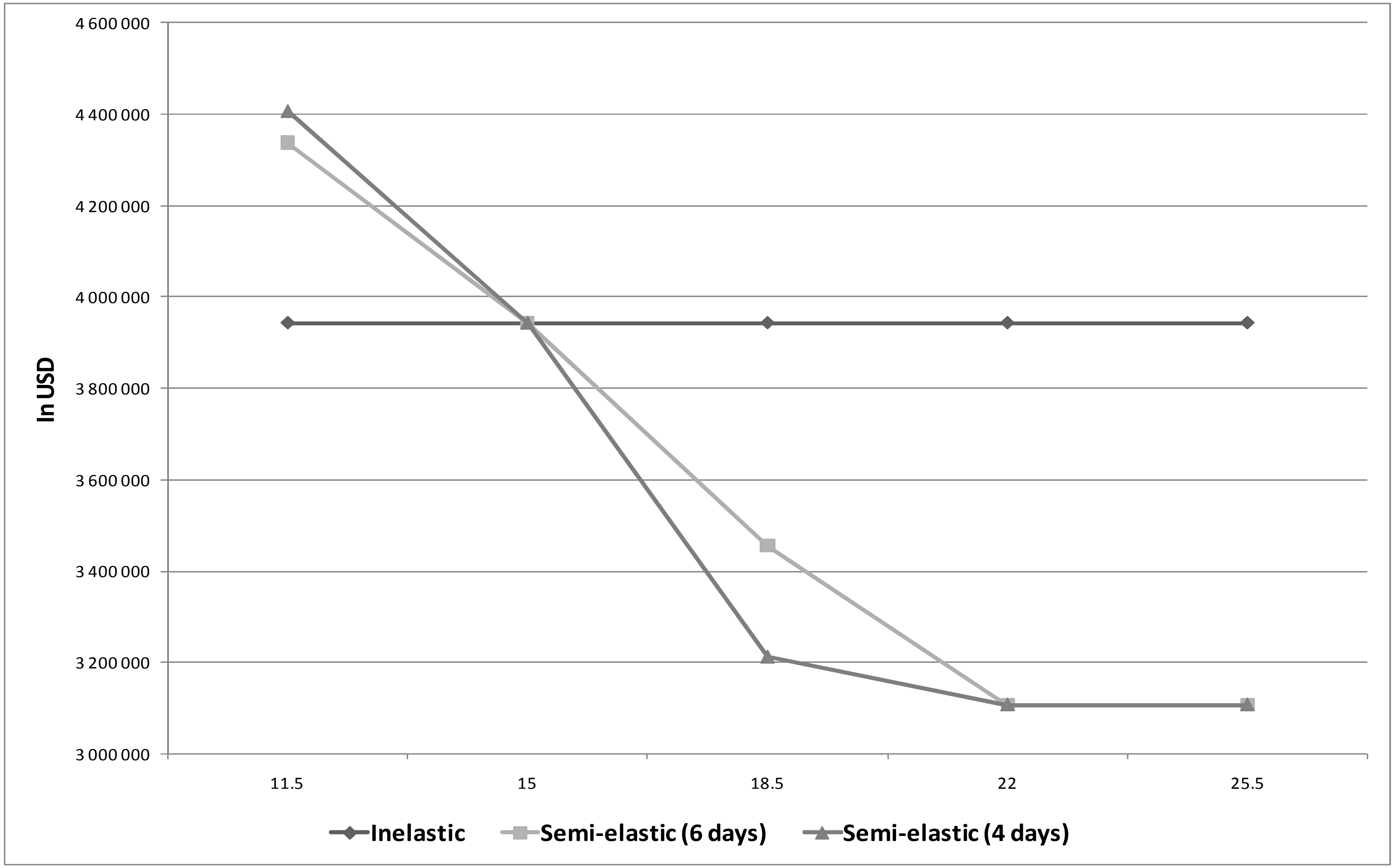
In the case of inelastic demand, the weekly transportation demand of dry, frozen and fresh containers remains constant at a level corresponding to the current situation.

In the case of semi-elastic demand, the transportation demand for fresh products is a function of the deviation (α^F [days]) from the standard intercontinental transit time ($S_{Standard}$), while that for dry and frozen products remains inelastic.

$$d^{FAB} = d_0^{FAB}\left(\frac{S_{Standard}+\alpha^F-S}{\alpha^F}\right)^+ \ and\ d^{FBA} = d_0^{FBA}\left(\frac{S_{Standard}+\alpha^F-S}{\alpha^F}\right)^+$$

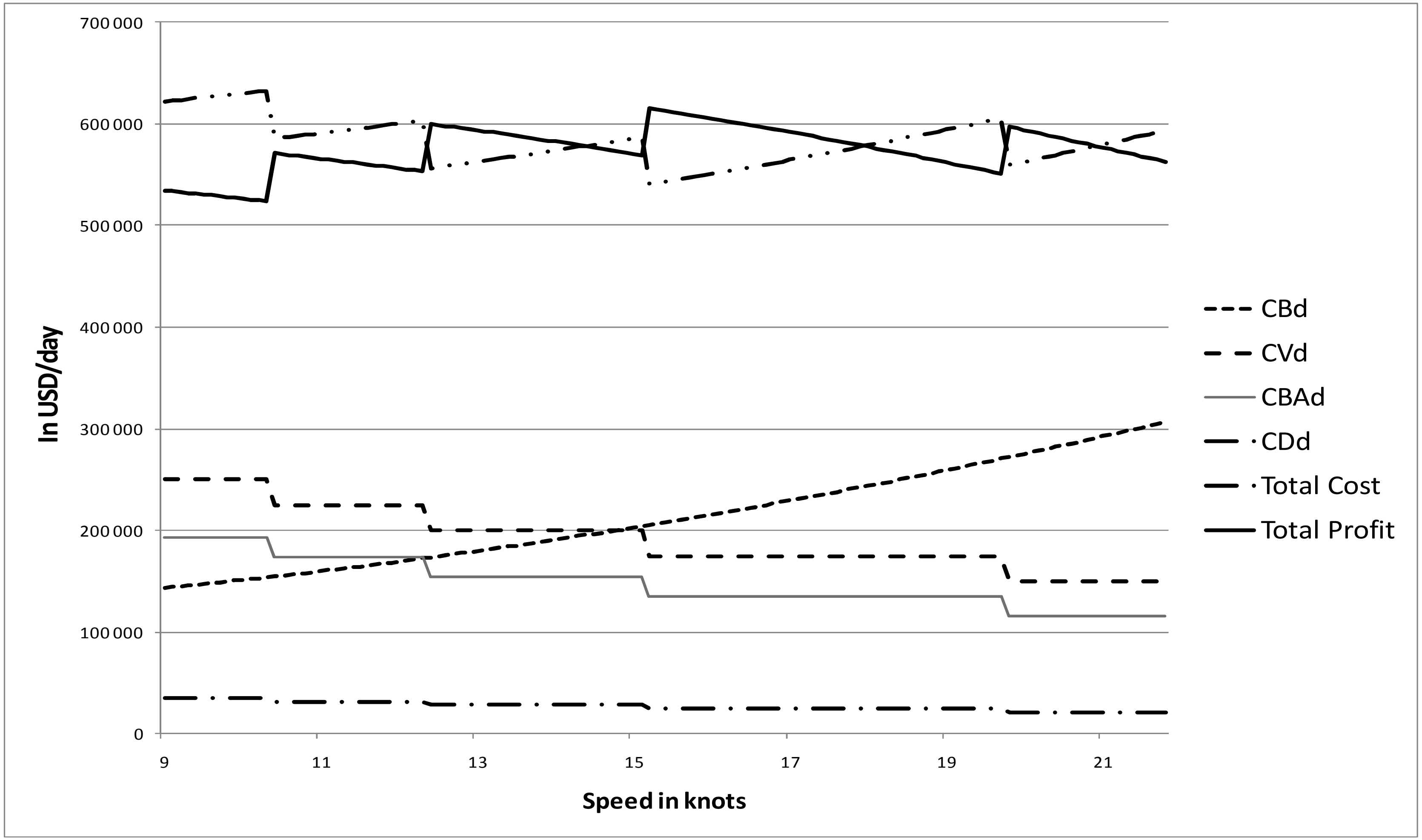
3. Cas pratique et implications pour les ports

Total revenue in USD on South America to Northern Europe as a function of transit time



Source: Cheaitou & Cariou (2011)

Average total daily cost and profit on the cycle as a function of vessel speed in knots with inelastic demand



Source: Cheaitou & Cariou (2011)

3. Cas pratique et implications pour les ports

Total profit in USD with inelastic demand as a function of bunker price

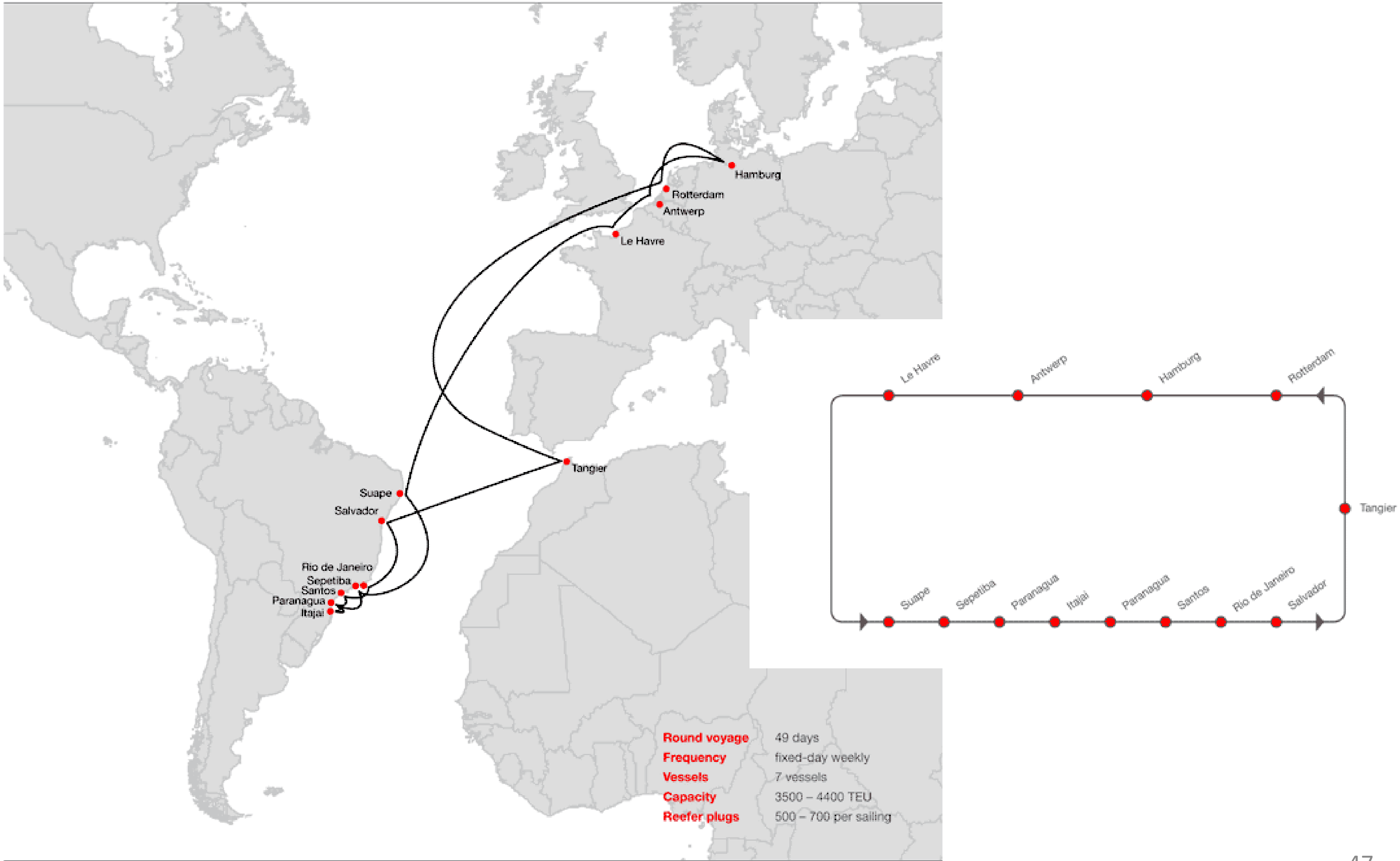
N	V in knots	S/48 in days	Bunker fuel price (USD/ton)		
			100	500	1000
6	19.7	11.5	**907 719**	597 515	209 761
7	15.1	15.0	888 620	**616 067**	**275 375**
8	12.2	18.5	862 728	600 647	273 046
9	10.3	22.0	833 993	571 018	242 299
10	8.9	25.5	803 863	534 411	197 596

Total profit in USD with semi-elastic demand (4 days) as a function of bunker price

N	V in knots	S/48 in days	Bunker fuel price (USD/ton)		
			100	500	1000
6	19.7	11.5	**968 004**	**642 090**	234 697
7	15.1	15.0	888 620	616 067	**275 375**
8	12.2	18.5	772 208	543 373	257 328
9	10.3	22.0	732 548	512 317	237 027
10	8.9	25.5	704 424	482 465	205 016

3. Cas pratique et implications pour les ports

BRAZIL EXPRESS SERVICE



Source: Hamburg Süd Website (5 Juin 2011)

3. Cas pratique et implications pour les ports

EUROPE – SOUTH AMERICA EAST COAST

EUROPE – SOUTH AMERICA EAST COAST [transit time in days] SOUTHBOUND

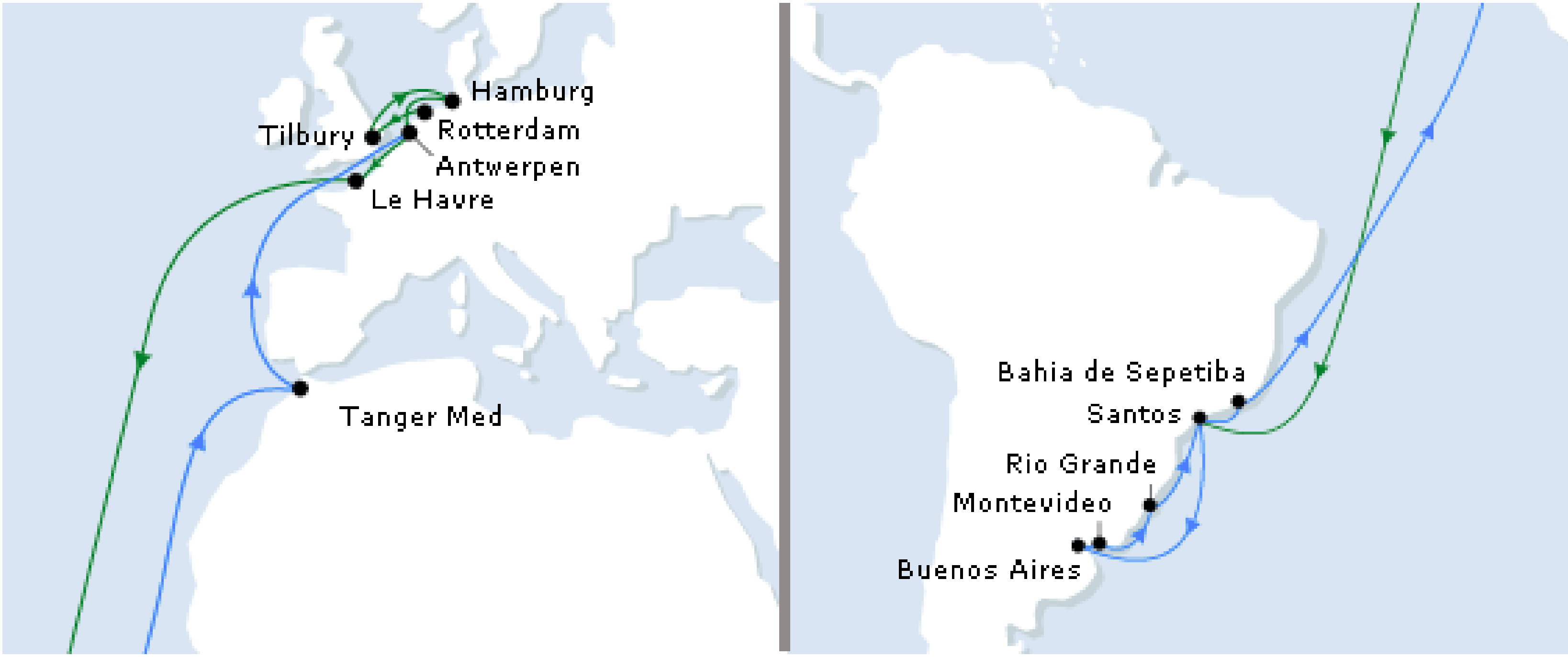
FROM \ TO		Suape	Sepetiba	Paranagua	Itajai	Salvador
		Sun	Wed	Sat	Sun	Tue
Rotterdam	Wed	18	21	24	25	34
Hamburg	Sun	14	17	20	21	30
Antwerp	Mon	13	16	19	20	29
Le Havre	Wed	11	14	17	18	27

SOUTH AMERICA EAST COAST / MOROCCO – EUROPE [transit time in days] NORTHBOUND

FROM \ TO		Tangier	Rotterdam	Hamburg	Antwerp	Le Havre
		Fri	Wed	Sat	Mon	Tue
Itajai	Mon	18	23	26	28	29
Paranagua	Wed	16	21	24	26	27
Santos	Fri	14	19	22	24	25
Rio de Janeiro	Sat	13	18	21	23	24
Salvador	Wed	9	14	17	19	20
Tangier	Sat	–	4	7	9	10

Source: Hamburg Süd Website (5 Juin 2011)

3. Cas pratique et implications pour les ports



Source: Service South America – North Europe Plate Sling - CMA-CGM Website (5 Juin 2011)

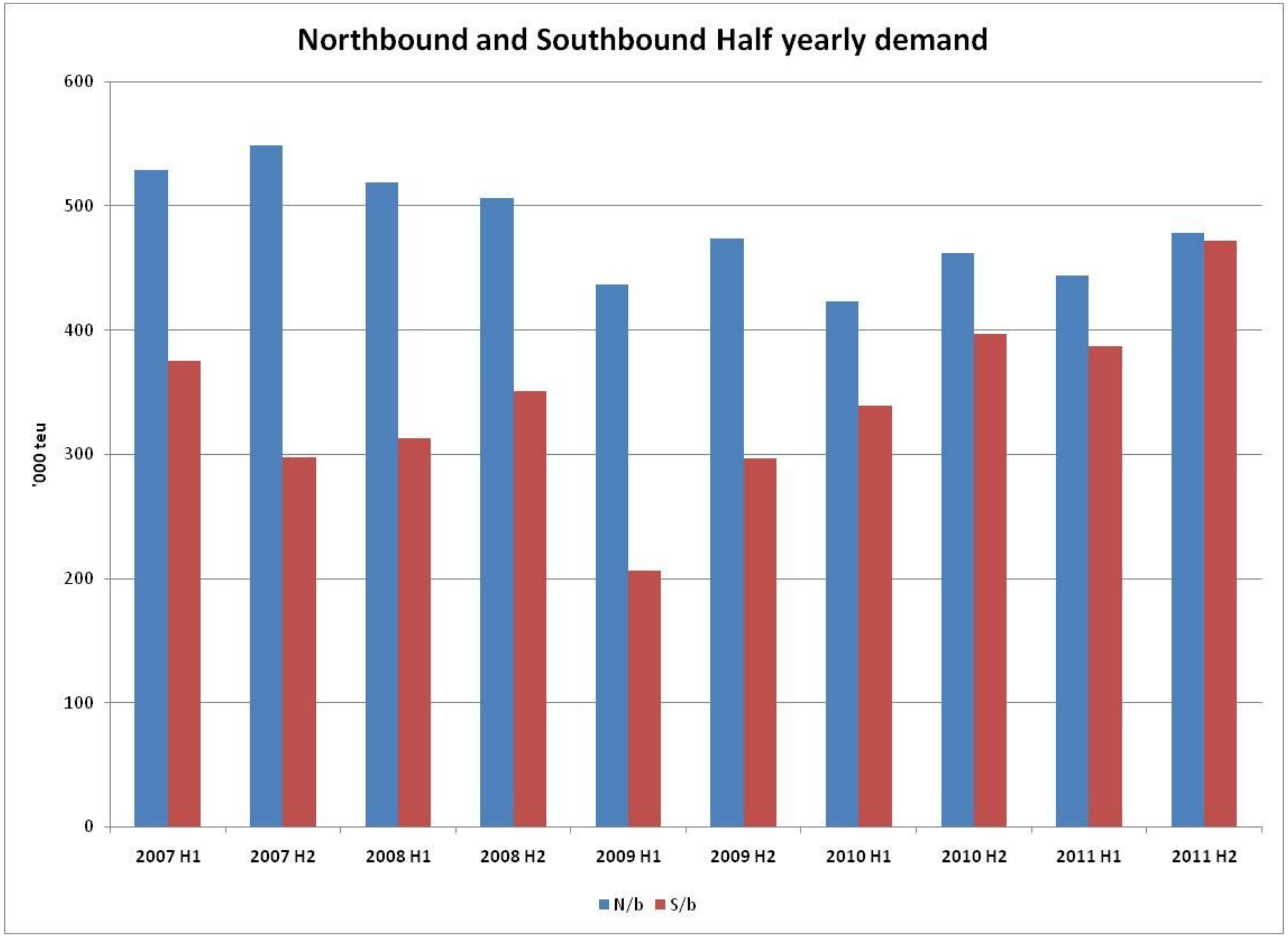
Implications pour les ports

- Une amélioration/stabilisation des services pour Europe du Nord/Amérique du Sud (S/b)

- Une forte détérioration des services pour Amérique du Sud/Europe du Nord (N/b) avec aujourd'hui Transbordement.

-Une détérioration encore plus forte pour Le Havre, dernier port touché pour la remontée (trafics reefers les plus rémunérateurs).

3. Implications pour les ports



Source: Cariou from Drewry Container Forecaster (2010-2011)

Conclusions

La réaction des *chargeurs* est la clé de la généralisation ou non du slow steaming (et non pas uniquement l'évolution du prix du fuel);

Les armateurs en décidant *conjointement* de réduire la vitesse des navires prennent le pari que l'impact sur la demande sera faible (ce qui semble vérifié jusqu'à présent) ou que les gains vont plus que compenser la chute des trafics (*Yield Management*).

Il ne fait dès lors aucun doute que *certains ports/pays* vont y perdre et que cela ne peut, à terme, que renforcer la concentration des trafics sur un nombre limité de ports et notamment pour des ports de transbordement.

EUROMED MANAGEMENT

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