How coupled economic activity and freight transport demand really is: concept of a new economic indicator

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Introduction

- Traditionally the relation between economic activity and freight Transport is used to make forecasts of future aggregate freight flows and volumes.

- Usually (GDP) is used as an indicator for economic activity

- But it is shown that: GDP is not the best indicator because
  - its composition changed and is still changing
  - some methods to link freight transport to GDP are not suited
  - the link between freight transport and economic activity itself has been changed.

- The general conclusion is that more specific disaggregate approaches are needed

Source: Meersman and Van de Voorde 2013

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What is the challenge?

- Economy implies freight transport!
  - How much?
  - How much of which specific goods?
  - How much of which specific goods by which economic activity?

We developed a „simple“ method and show:

how coupled we really are in terms of tonnage and ton kilometres.

Picture source: ec.europa.eu/transport/, adapted

Outline

1. Method to create the economic indicator

2. Correlation results for Germany

3. Discussion of the method, results and possible applications fields

The basic idea:

- Using disaggregated economic indicators to estimate freight generation based on supply and use tables

    1. Build weighting functions concerning products its supply or use
    2. Derive weighting factors from supply-use tables
    3. Weight GVA and calculate the indicators for goods (CPA-classified)
    4. Transform CPA classified goods into NSTR-24 classified goods
    5. Perform a regression analysis

Step 1: functions for production and consumption of products

- Supply – use – table is the base
  - Supply tables containing producers prices
  - Use tables containing purchaser prices

Products (CPA)	Industries (Nace) 1	…	59
1	€	€	€
…	€	€	€
59	€	€	€

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Step 1: functions for production and consumption of products

- We utalize supply tables to extract a weighted function for production
  - Using the supply tables' information per row enables us to know which industries produce the same products.
- We utalize use tables to extract a weighted function for consumption
  - Using the use tables' information per row enables us to know which industries use the same products.

Products (CPA) \ Industries (Nace)	1	…	59
1	€	€	€
…	€	€	€
59	€	€	€

Step 1: functions for production and consumption of products

- We utalize supply tables to extract a weighted function for production

- We utalize use tables to extract a weighted function for consumption

$$\widehat{\mathrm{EI}}_{\mathrm{i}} = \sum_{\mathrm{j}} \left(\alpha_{\mathrm{i,j}} \cdot \mathrm{GVA}_{\mathrm{j}}\right)$$

$\widehat{EI}$:	CPA classified economic indicator (€)
i:	index for products (CPA divisions)
j:	index for economic activities (NACE division)
α:	relevance of economic activity j for transportation of product i (for each option: use based, supply based, core industry based)
	$\sum_j \alpha_{i,j} = 1$ for each product i

Products (CPA)	Industries (Nace) 1	...	59
1	€	€	€
...	€	€	€
59	€	€	€

Step 2: Derive weighting factors for both functions

- We utalize the price information from supply use tables to extract weighted factors

- We utalize use tables to extract weighted consumption function

$$\widehat{\mathrm{EI}}_i = \sum_j \left(\alpha_{i,j} \cdot \mathrm{GVA}_j\right)$$

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Industries (Nace)

Products (CPA)	1	…	59
1	€	€	€
…	€	€	€
59	€	€	€

α = € scaled to 1 per row.

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Industries (Nace)

Products (CPA)	1	...	59
1	€	€	€
...	€	€	€
37	€	€	€

α = € scaled to 1 per row.

Step 3: Weight GVA and calculate the indicators

- GVA from general economic statistics avialable
- Two economic indicators can be calulated now
  - 1 supply table based
  - 1 use table based
- However CPA classified → we intend a NSTR classified indicator
  - CPA are products in Euro
  - NSTR are transported commodities in tons
  - We need a brigde matrix

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Step 4: Transform CPA – into NSTR-24

- We need a brigde matrix (a beta)

$$EI_k = \sum_i \left(\widehat{EI}_i \cdot \beta_{i,k} \right)$$

EI: economic indicator (€)

i: index for products (CPA divisions 1-37)

k: index for commodities (NST/R-24 with 24 sub-chapters)

β: weight of product (CPA) for commodity (NST)
$\sum_i \beta_{i,k} = 1$ for each commodity *k*

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Step 4: Transform CPA into NSTR-24

- We need a brigde matrix to re-classify CPA into NSTR

NST/R 24 k	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
CPA 2002 i																								
1	$\beta_{1,1}$	$\beta_{1,2}$	$\beta_{1,3}$																					$\beta_{1,24}$
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5																								
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37																								$\beta_{37,24}$

1. Allocate products to transported commodities (Emberger et al. 2010)

2. Quantify the aportionment by using a distribution

Step 4: Transform CPA –into NSTR-24

- We need a brigde matrix

NSTR24	CPA	β	NSTR24	CPA	β	NSTR24	CPA	β
01	01	0.33	13	27	0.51	24	01	0.1
02	01	0.36	14	26	0.88	24	05	0.2
03	01	0.12	15	14	1	24	12	1
03	05	0.34	16	24	0.09	24	15	0.1
04	02	1	16	25	0.06	24	16	0.8
04	20	1	17	24	0.01	24	17	0.3
05	17	0.07	17	25	0.01	24	18	0.3
05	18	0.07	18	24	0.85	24	19	0.3
05	19	0.07	18					
05	36	0.06	19					
05	37	0.07	20					
06	15	0.9	20					
06	16	0.2	20					
07	01	0.09	20					
07	05	0.46	20					
08	10	1	20					
09	11	0.01	20					
09	23	0.01	21					
10	11	0.99	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	23	0.99	22	26	0.07	24	33	0.67
11	13	0.92	23	17	0.63	24	34	0.1
11	27	0.25	23	18	0.63	24	35	0.1
12	13	0.08	23	19	0.63	24	36	0.34
12	27	0.03	23	36	0.6	24	37	0.25
13	28	0.68	23	37	0.68			

$$EI_{6,y} = \widehat{EI}_{15,y} \cdot 0.9 + \widehat{EI}_{16,y} \cdot 0.2$$

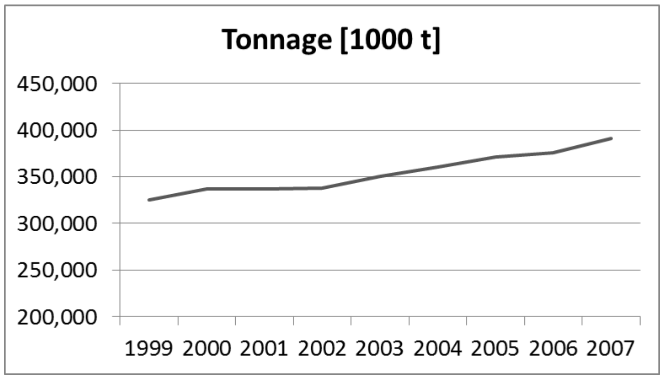
EI: economic indicator (€)

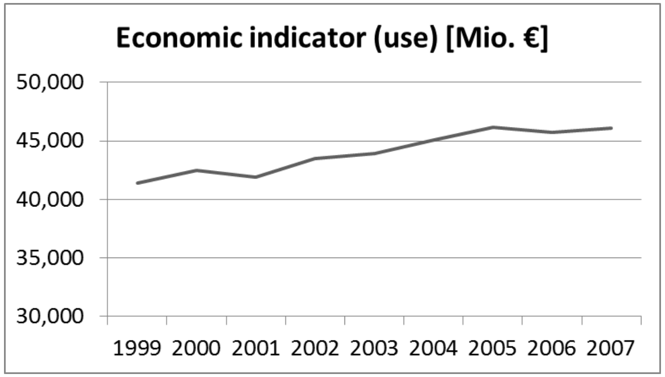
$\widehat{EI}$: CPA classified economic indicator (€)

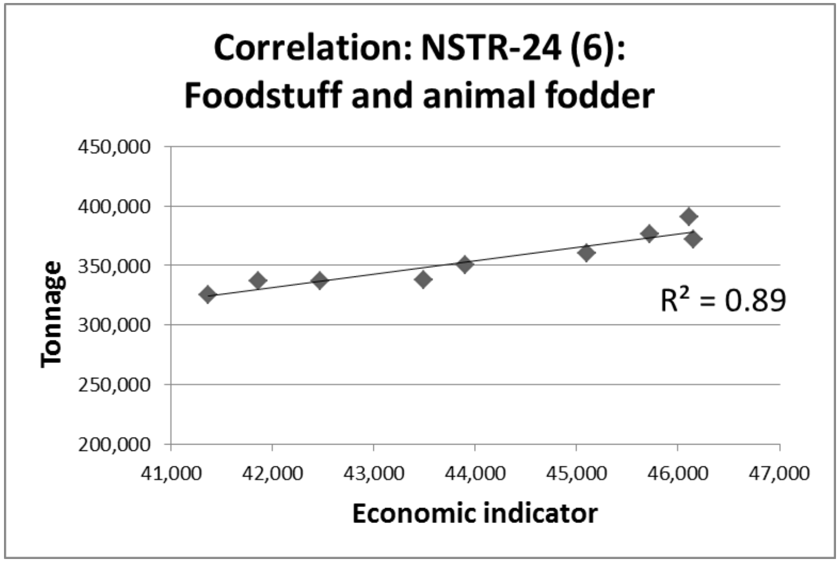
y: year

Finally: perform a lin. regression analysis

- All data available from 1999-2007 [Eurostat]
    - Example NSTR-24 (6): Foodstuff and animal fodder







Results I: Tonnage [t]

- 15 of 24 commodities have a significance of > 90 %
- These 15 commodities represent ca. 90 % of goods transported

	R^2 supply	R^2 use	Tonnage in 2007 [%]
Cereals	0.000	0.310	1.03%
Potatoes, other fresh or frozen fruits and vegetables	0.067	0.011	0.94%
Live animals, sugar beet	0.231	0.344	0.59%
Wood and cork	0.072	0.252	2.56%
Textiles, textile articles, etc	0.152	0.152	0.54%
Foodstuff and animal fodder	0.142	**0.911**	10.23%
Oil seeds and oleaginous fruits and fats	**0.700**	**0.651**	0.70%
Solid minerals fuels	**0.369**	0.096	2.72%
Crude petroleum	0.311	0.106	0.03%
Petroleum products	0.106	**0.568**	4.98%
Iron ore, iron and steel waste	0.002	0.049	2.57%
Non-ferrous ores and waste	0.028	0.134	0.26%
Metal products	**0.817**	**0.828**	4.78%
Cement, lime, manufactured building materials	**0.843**	**0.890**	5.09%
Crude and manufactured minerals	**0.463**	**0.981**	33.40%
Natural and chemical fertilizers	0.282	**0.447**	1.03%
Coal chemicals, tar	**0.462**	**0.529**	0.11%
Chemicals other than coal chemicals and tar	0.184	**0.355**	6.72%
Paper pulp and waste paper	0.022	0.153	0.99%
Transport equipment, machinery, etc	**0.967**	**0.871**	4.01%
Manufactures of metal	**0.784**	**0.831**	1.49%
Glass, glassware, ceramic products	**0.563**	**0.670**	0.55%
Leather, textile, clothing	**0.762**	**0.378**	4.86%
Miscellaneous articles	**0.917**	**0.829**	9.81%
		∑ Correlating tonnage	90.48%

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Results II: Ton kilometres [tkm]

- 16 of 24 commodities have a significance of > 90 %
- These 16 commodities represent ca. 88 % of goods transported

	R^2 supply	R^2 use	Ton kilometres in 2007 [%]
Cereals	**0.716**	0.104	1.57%
Potatoes, other fresh or frozen fruits and	**0.448**	0.202	1.50%
Live animals, sugar beet	**0.591**	**0.628**	0.45%
Wood and cork	0.225	**0.461**	2.94%
Textiles, textile articles, etc	0.092	0.143	0.60%
Foodstuff and animal fodder	0.136	**0.931**	11.80%
Oil seeds and oleaginous fruits and fats	**0.735**	**0.662**	1.13%
Solid minerals fuels	**0.722**	0.020	3.15%
Crude petroleum	0.256	0.021	0.03%
Petroleum products	0.008	0.174	5.42%
Iron ore, iron and steel waste	0.044	0.228	3.06%
Non-ferrous ores and waste	0.048	0.095	0.29%
Metal products	**0.812**	**0.828**	7.45%
Cement, lime, manufactured building	**0.678**	**0.504**	4.46%
Crude and manufactured minerals	**0.710**	**0.443**	10.45%
Natural and chemical fertilizers	0.006	0.003	1.31%
Coal chemicals, tar	**0.880**	**0.870**	0.22%
Chemicals other than coal chemicals and	**0.899**	**0.877**	7.93%
Paper pulp and waste paper	0.324	**0.655**	1.24%
Transport equipment, machinery, etc	**0.980**	**0.929**	6.95%
Manufactures of metal	**0.800**	**0.815**	1.95%
Glass, glassware, ceramic products	0.000	0.011	0.87%
Leather, textile, clothing	**0.678**	**0.498**	8.52%
Miscellaneous articles	**0.915**	**0.806**	16.68%
	∑ Correlating Tkm		88.41%

Other European examples at a glance (first results)

→ currently we elaborate other European countries in the frame of a master‘s thesis

Found significances:

- France: 73.7 % of the tonnage and 79.7 % of the ton kilometres
- Italy: 83.9 % of the tonnage and 37.2 % of the ton kilometres
- Netherlands: 57.8 % of the tonnage and 34.4 % of the ton kilometres

- Other countries and a deep going interpretation is following soon

Discussion of the method

- Disaggregated approaches enable to investigate the coupling/ decoupling

- Just public available data are used (EUROSTAT) → calibration is possible

  - More time series data diserable
  - In future the bridge matrix is not needed (NST2007)

- Correlation is found, however no explaination power

  - Taking into account the handling in the transport of goods

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Application fields

- Coupling/decoupling discussion
    - Indicator observation over long term

- „Fast forecast“
    - Transport implication by economic activity

- Useful in modeling issues:
    - Disagregated goods in freight generation
    - Time-dependent value densities

- Data interpolation
    - E.g. USA where nat. freight data are detected in frequence of 5y
    - Method has to be evaluated first for countries

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Final messages:

1. The information from supply and use tables and the introduced economic indicator are useful to investigate the coupling/decoupling between economy and transport in a new way.

2. A strong coupling between economy and transport, measured in tonnes transported or ton kilometres can be found using the “right” indicators.

3. The correlations indicate that the demand side of the economy drives the transport demand (i.e. a use table based indicator shows better correlation).

Thank you for your attention.

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