

A methodology for estimating the Dutch interfirm trade network

Including a breakdown by commodity

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Economic networks

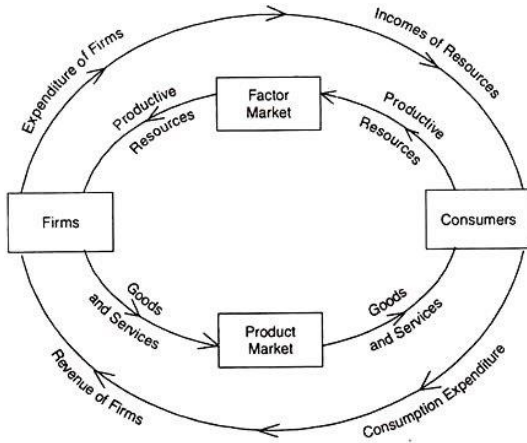


Fig. 10

The economy is basically a network

Usually analyzed at macro level



What if we had network data at a micro level?



Possible applications of micro network data

Describe structures and patterns of the network as such

Detect and describe clusters and supply chains

Regional analysis

Analyze resilience, vulnerability and systemic risks

Basis for Agent Based Models

High frequency payments data to see the network in motion?

Improve existing statistics



Towards network statistics of firms

Statistics Netherlands are developing a method for estimating the interfirm trade network at a micro level, as a basis for statistics and analysis

- ✓ The method can use and combine various kinds of autonomous data on relations as well as auxiliary data
- ✓ Can impute missing links
- ✓ Includes a breakdown by commodities as a by-product
- ✓ Can be applied by other NSI's as well

Still 'laboratory phase'



Basic approach (1)

The network nodes are in the Statistical Business Register, which gives the maximum version for the network

	Firms													
Firms	1	2	3	4	5	6	7	8	9	.	.	.	.	N
1	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9	x	x	x	x	x	x	x	x	x	x	x	x	x	x
.	x	x	x	x	x	x	x	x	x	x	x	x	x	x
.	x	x	x	x	x	x	x	x	x	x	x	x	x	x
.	x	x	x	x	x	x	x	x	x	x	x	x	x	x
.	x	x	x	x	x	x	x	x	x	x	x	x	x	x
N	x	x	x	x	x	x	x	x	x	x	x	x	x	x



Add information to delete unlikely links between firms in the Statistical Business Register

	Firms													
Firms	1	2	3	4	5	6	7	8	9	.	.	.	.	N
1	x		x	x	x			x		x			x	x
2	x		x		x		x	x	x		x		x	x
3	x	x		x	x	x	x						x	x
4	x		x	x				x	x	x			x	x
5		x	x	x	x		x		x					
6	x	x				x		x						
7			x	x			x			x				
8	x	x						x						
9		x	x	x		x	x							
.					x					x			x	x
.						x	x	x			x	x	x	x
.					x		x				x			x
.					x			x	x	x				x
N					x		x	x			x		x	x



Basic approach (2): narrow down

Supply table

	Commodities																											
Industry	a	b	c	d	e	f	g	h	i	. . . . .	z																	
1	x	x	x		x	x			x	x		x																
2		x	x	x						x			x								x		x			x	x	x
3		x		x		x	x				x			x							x		x			x	x	x

Supply matrix

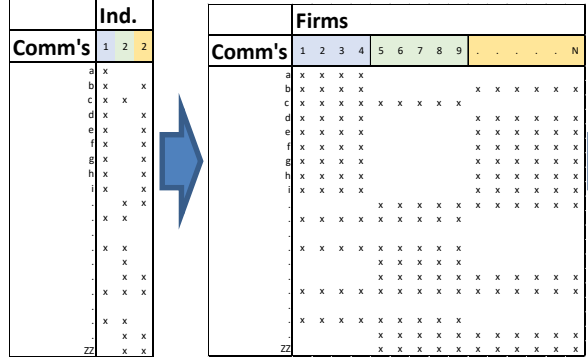
	Commodities																											
Firms	a	b	c	d	e	f	g	h	i	. . . . .	z																	
1	x	x	x		x	x			x		x										x		x			x	x	x
2	x	x	x		x	x			x		x										x		x			x	x	x
3	x	x	x		x	x			x		x										x		x			x	x	x
4	x	x	x		x	x			x		x										x		x			x	x	x
5		x	x	x					x		x										x		x			x	x	x
6		x	x	x					x		x										x		x			x	x	x
7		x	x	x					x		x										x		x			x	x	x
8		x	x	x					x		x										x		x			x	x	x
9		x	x	x					x		x										x		x			x	x	x
N	x	x	x		x	x			x		x										x		x			x	x	x

SBS, Prodcum etc.

Supply matrix, enriched

	Commodities																											
Firms	a	b	c	d	e	f	g	h	i	. . . . .	z																	
1	x	x		x	x				x		x										x		x			x		
2	x	x	x		x				x		x										x		x			x		
3	x	x		x		x			x		x										x		x			x		
4	x	x	x		x	x			x		x										x		x			x		
5		x	x	x					x		x										x		x			x		
6		x	x	x					x		x										x		x			x		
7		x	x	x					x		x										x		x			x		
8		x	x	x					x		x										x		x			x		
9		x	x	x					x		x										x		x			x		
N	x	x		x	x				x		x										x		x			x		

Use table Use matrix



SBS, etc.

Use matrix, enriched

	Firms																											
Comm's	1	2	3	4	5	6	7	8	9	. . . . .	N																	
a	x	x	x	x																								
b	x	x	x	x																	x	x	x	x	x	x	x	x
c	x	x	x	x																	x	x	x	x	x	x	x	x
d	x	x	x	x																	x	x	x	x	x	x	x	x
e	x	x	x	x																	x	x	x	x	x	x	x	x
f	x	x	x	x																	x	x	x	x	x	x	x	x
g	x	x	x	x																	x	x	x	x	x	x	x	x
h	x	x	x	x																	x	x	x	x	x	x	x	x
i	x	x	x	x																	x	x	x	x	x	x	x	x
z	x	x	x	x																	x	x	x	x	x	x	x	x



Basic approach (3): add observed links

Comm's	Firms										
	1	2	3	4	5	6	7	8	9	...	N
a	x	x	x	x							
b	x	x	x						x	x	x
c	x	x	x	x	x	x	x				
d	x	x	x						x	x	x
e	x	x	x						x	x	x
f	x	x	x						x	x	x
g	x	x	x						x	x	x
h	x	x	x						x	x	x
i	x	x	x						x	x	x
j	x	x	x						x	x	x
k	x	x	x						x	x	x
l	x	x	x						x	x	x
m	x	x	x						x	x	x
n	x	x	x						x	x	x
o	x	x	x						x	x	x
p	x	x	x						x	x	x
q	x	x	x						x	x	x
r	x	x	x						x	x	x
s	x	x	x						x	x	x
t	x	x	x						x	x	x
u	x	x	x						x	x	x
v	x	x	x						x	x	x
w	x	x	x						x	x	x
x	x	x	x						x	x	x
y	x	x	x						x	x	x
z	x	x	x						x	x	x

E.g. VAT data,
Bank transactions,
debtors and creditors lists

Observed links

		Firms			
Firms		1	3	8	12
1		x		x	
3					x
8		x	x		x
12			x		x

Breakdown by commodities

Comm X	Firms			
Firms	1	3	8	12
1	x		x	
3				x
8	x	x		x
12		x		x

Firms	Commodities																				
	a	b	c	d	e	f	g	h	i	...	...	...	...	...	...	...	...	...	...	...	Zz
1	x	x		x	x		x		x												
2	x	x	x		x		x		x												
3	x	x		x		x		x													
4	x	x	x		x		x		x												
5		x	x		x		x		x												
6		x	x		x		x		x												
7		x	x		x		x		x												
8		x	x		x		x		x												
9		x	x		x		x		x												
10		x	x		x		x		x												
11		x	x		x		x		x												
12		x	x		x		x		x												
13		x	x		x		x		x												
14		x	x		x		x		x												
15		x	x		x		x		x												
16		x	x		x		x		x												
17		x	x		x		x		x												
18		x	x		x		x		x												
19		x	x		x		x		x												
20		x	x		x		x		x												
21		x	x		x		x		x												
22		x	x		x		x		x												

Use matrix, enriched and adjusted

Comm's	Firms										
	1	2	3	4	5	6	7	8	9	...	N
a	x										
b	x	x	x						x	x	x
c	x	x	x	x	x	x	x				
d	x	x	x						x	x	x
e	x	x	x						x	x	x
f	x	x	x						x	x	x
g	x	x	x						x	x	x
h	x	x	x						x	x	x
i	x	x	x						x	x	x
j	x	x	x						x	x	x
k	x	x	x						x	x	x
l	x	x	x						x	x	x
m	x	x	x						x	x	x
n	x	x	x						x	x	x
o	x	x	x						x	x	x
p	x	x	x						x	x	x
q	x	x	x						x	x	x
r	x	x	x						x	x	x
s	x	x	x						x	x	x
t	x	x	x						x	x	x
u	x	x	x						x	x	x
v	x	x	x						x	x	x
w	x	x	x						x	x	x
x	x	x	x						x	x	x
y	x	x	x						x	x	x
z	x	x	x						x	x	x

Supply matrix, enriched and adjusted

Firms	Commodities																				
	a	b	c	d	e	f	g	h	i	...	...	...	...	...	...	...	...	...	...	...	Zz
1	x				x	x		x		x											x
2	x	x	x		x		x		x						x						x
3	x	x		x		x		x		x											x
4	x	x	x		x		x		x						x						x
5		x	x		x		x		x						x						x
6		x	x		x		x		x						x						x
7		x	x		x		x		x						x						x
8		x	x		x		x		x						x						x
9		x	x		x		x		x						x						x
10		x	x		x		x		x						x						x
11		x	x		x		x		x						x						x
12		x	x		x		x		x						x						x
13		x	x		x		x		x						x						x
14		x	x		x		x		x						x						x
15		x	x		x		x		x						x						x
16		x	x		x		x		x						x						x
17		x	x		x		x		x						x						x
18		x	x		x		x		x						x						x
19		x	x		x		x		x						x						x
20		x	x		x		x		x						x						x
21		x	x		x		x		x						x						x
22		x	x		x		x		x						x						x

(Remove to avoid double counting)

(Remove to avoid double counting)



Basic approach (4): match and combine

Input/Output table

	Ind.
Industry	1 2 3
1	x x x
2	x x
3	x x

Auxiliary data and assumptions

Use matrix, enriched and adjusted

	Firms										
Comm's	1	2	3	4	5	6	7	8	9	...	N
a	x			x							
b	x	x	x					x	x	x	x
c	x	x	x								
d	x	x	x					x	x	x	x
e	x	x	x								
f	x	x	x					x	x	x	x
g	x	x	x								
h	x	x	x					x	x	x	x
i	x	x	x								
j	x	x	x								
k	x	x	x								
l	x	x	x								
m	x	x	x								
n	x	x	x								
o	x	x	x								
p	x	x	x								
q	x	x	x								
r	x	x	x								
s	x	x	x								
t	x	x	x								
u	x	x	x								
v	x	x	x								
w	x	x	x								
x	x	x	x								
y	x	x	x								
z	x	x	x								

Comm X	Firms			
Firms	1	3	8	12
1	x		x	
3				x
8	x	x		x
12			x	x

Supply matrix, enriched and adjusted

	Commodities																			
Firms	a	b	c	d	e	f	g	h	i	...	...	...	...	...	...	...	...	...	...	ZZ
1	x				x	x														x
2	x	x	x		x		x	x												x
3	x	x	x		x	x														x
4	x	x	x		x	x														x
5		x	x		x	x														x
6		x	x		x	x														x
7		x	x		x	x														x
8		x	x		x	x														x
9		x	x		x	x														x
...																				
N																				

Comm X	Firms										
Firms	1	2	3	4	5	6	7	8	9	...	N
1	x	x	x	x				x			x
2	x	x	x	x				x			x
3	x	x	x	x				x			x
4	x	x	x	x				x			x
5					x	x					x
6					x	x					x
7					x	x					x
8					x	x					x
9					x	x					x
...											
N											

Match suppliers and users per commodity

Comm X	Firms										
Firms	1	2	3	4	5	6	7	8	9	...	N
1	x	x	x	x				x			x
2	x	x	x	x				x			x
3	x	x	x	x				x			x
4	x	x	x	x				x			x
5					x	x					x
6					x	x					x
7					x	x					x
8					x	x					x
9					x	x					x
...											
N											

Add



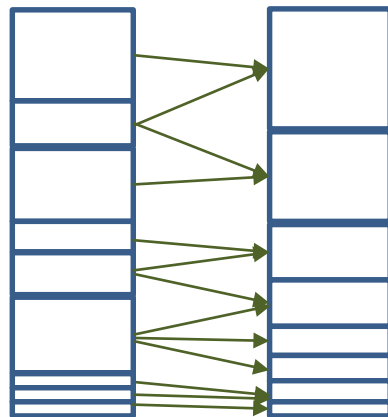
Matching procedure for 'missing links' (1)

Inspired by Agent Based Models with market clearing mechanisms

Supply per firm

Use per firm

Ranked
by
score



Ranked
by
size

Connections removed from remaining indegree and outdegree per firm

Matching procedure for 'missing links' (2)

Estimation of number of in- and outgoing connections by firm (adjusted for directly observed links). Theoretical minimum is the sum of commodity x firm combinations in the Supply Table

Suppliers with 'spare outward connections' ranked and matched according to a score that represents the likelihood of supplying commodity X to user A

Parameters and assumptions e.g.

- Large users prefer large suppliers (assortativity)
- Power law distributions of in- and outdegrees; related to size
- Geographical distance plays a role



Additional process steps

- Distribute the weights from the Supply and Use tables to arrive at weighted relations
- Aggregate to a firm x firm network
- Publish in such a way that confidentiality is guaranteed

Further research

- Get access to more data:
 - Negotiations with the major banks
 - Develop methods to aggregate data of one person firms and include these in our approach
- Regionalization of firms with several local establishments
- Establish and improve quality of the imputation procedure:
 - Sensitivity analysis (different parameter settings)
 - Validation and calibration
 - Compare imputed data with real data



