Intersectoral flows of financial assets and liabilities

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Outline

1. Aims:

- analysis of the scope and forms of external financing of the institutional sectors' activities in Poland in the years 2003-2015 compared to the selected European countries,

- estimation of the intersectoral linkages (on a from-whom-to-whom basis) in terms of financial instruments, using the input-output methodology,

- simulation of the demand for funds of individual institutional sectors due to the assumed final demand (the model of financial flows extended by deterministic system of equations resulting from a sequence of non-financial sectoral accounts in the system of national accounts).
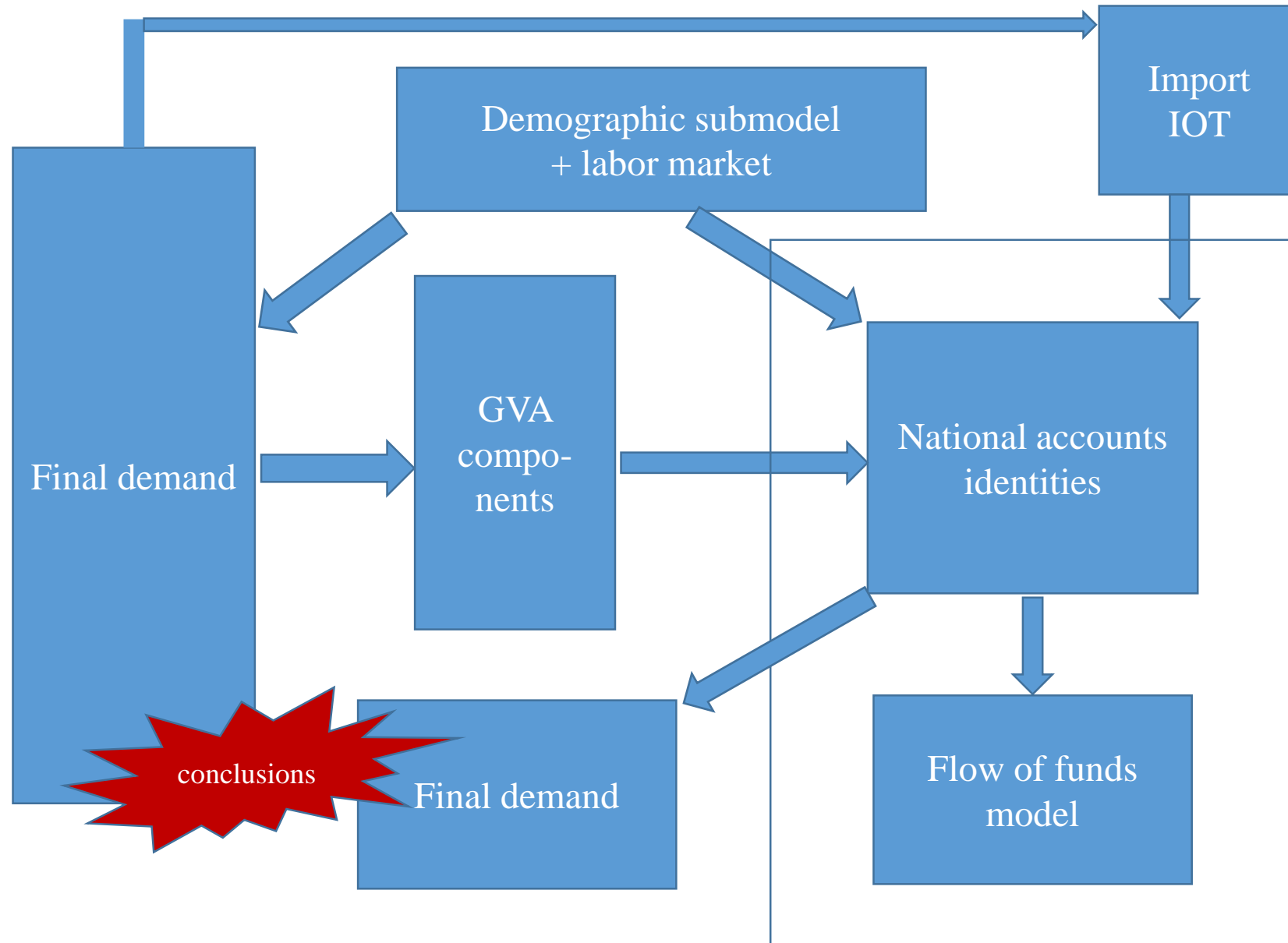
2. Flow of funds model as a part of the research project.

3. Maps of intersectoral linkages in terms of particular financial instruments.

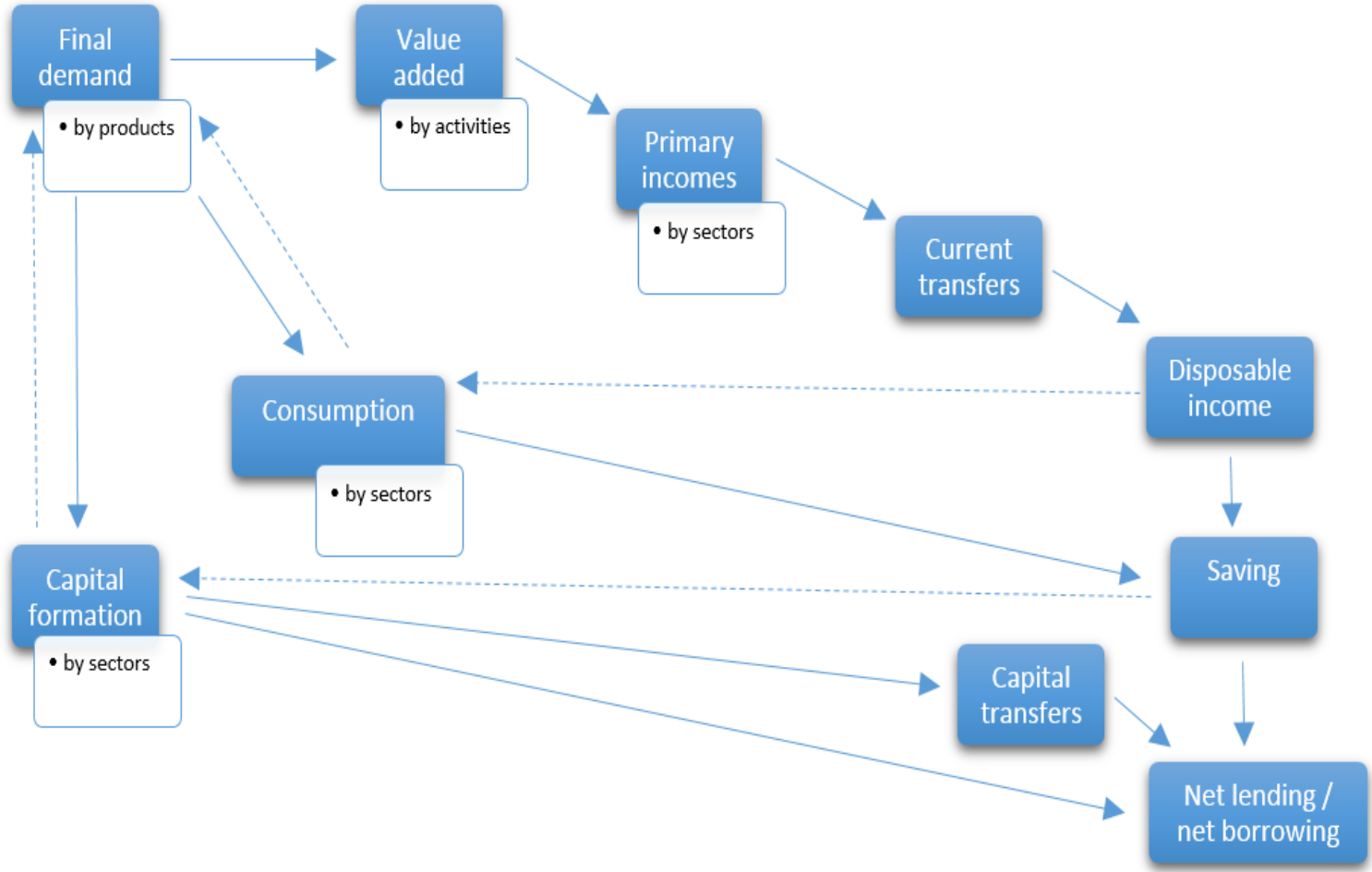4. Financial input-output tables as a simulation tool.

5. Examplary simulations.

Flow of funds model as a part of the research project

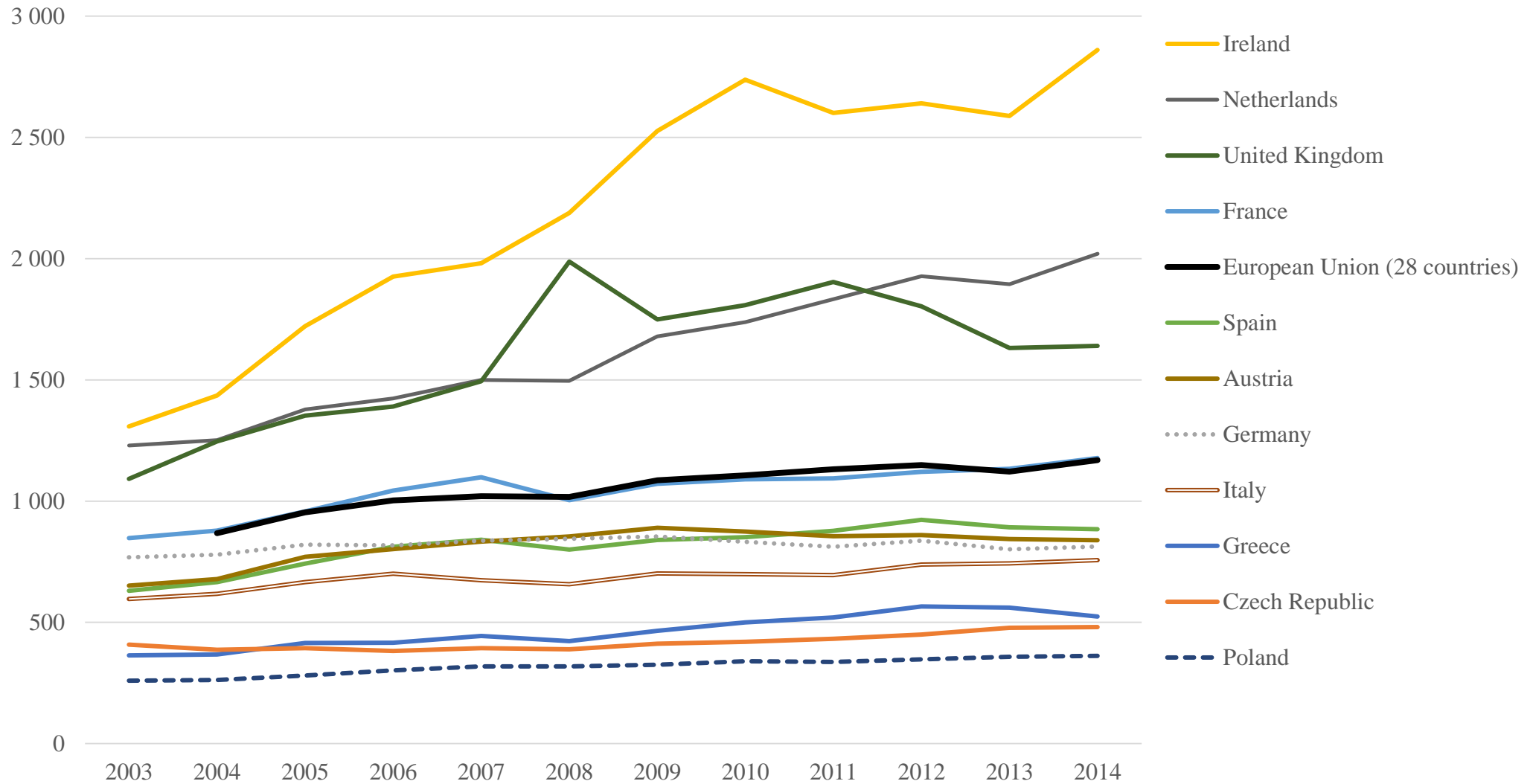Flow of funds model as a part of the research project

National accounts identities

Flow of funds model

DEMAND FOR FUNDS
- by sectors
- by financial instruments

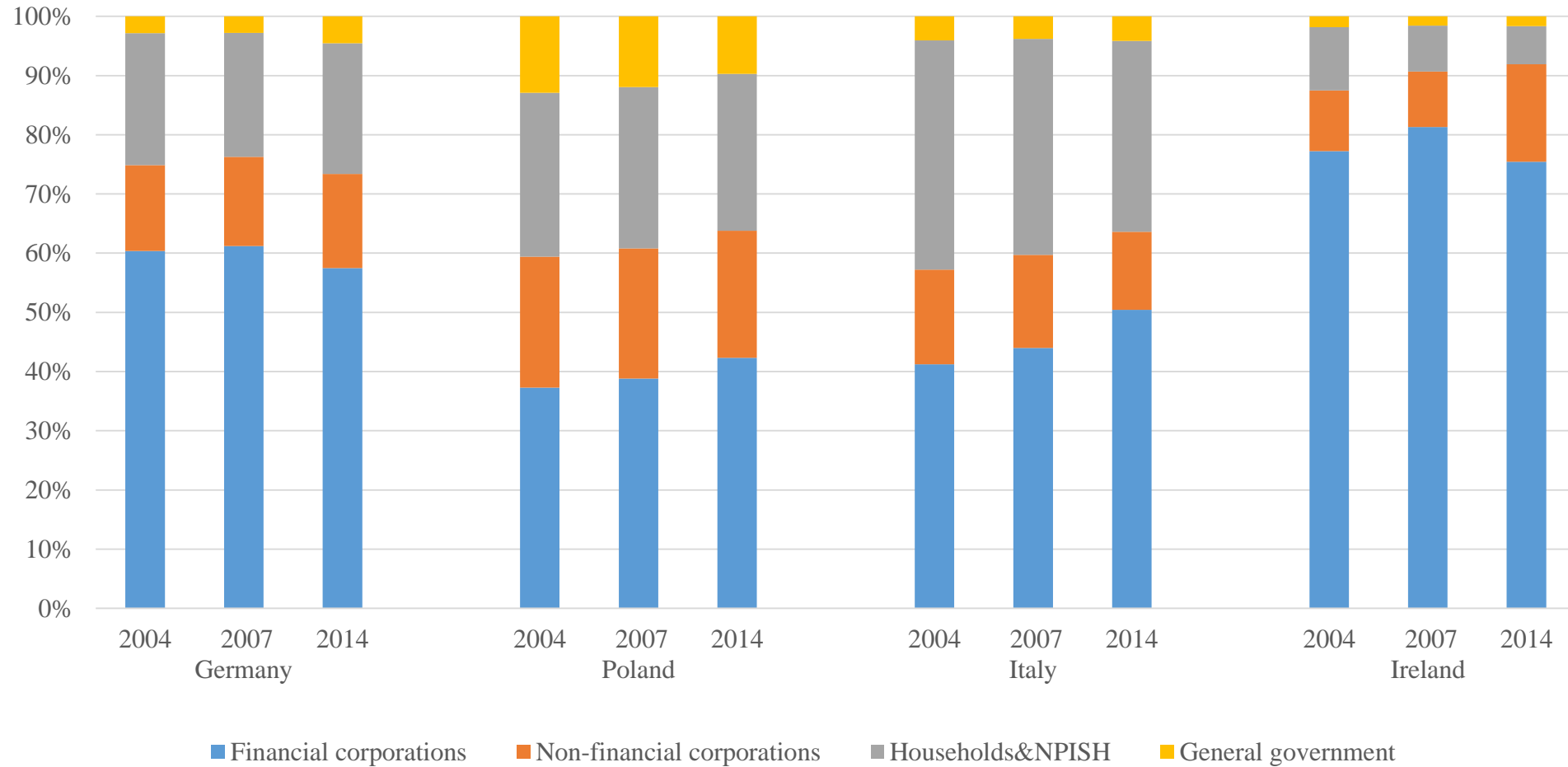The scope of external financing of the economy (financial assets in relation to GDP)

The structure of assets (by financial instruments)

Legend:
- Currency and deposits
- Debt securities
- Loans
- Equity and investment fund shares
- Insurance, pensions and standardised guarantees
- Financial derivatives and employee stock options
- Other accounts receivable / payable
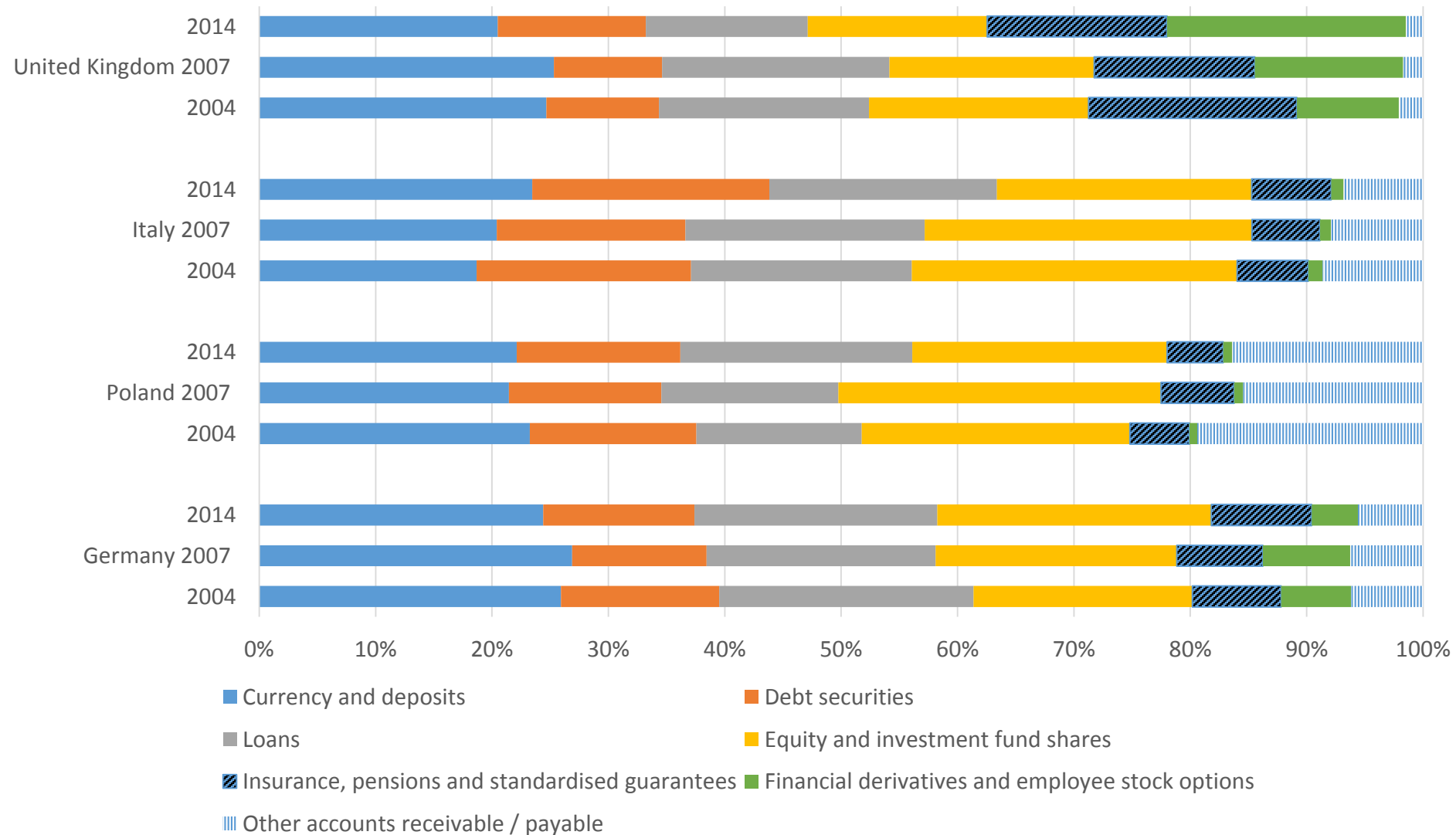
Sectoral structure of financial assets

Compilation of the tables of intersectoral flows

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- *Report on the functioning of the Polish financial market - intersectoral analysis*, 2011, Materials and studies of Financial Supervisory Commission, Warsaw (in Polish).

- Boratyński J. *et al.*, 2016, *Sensitivity of the Polish economy to the changes of inter-industry linkages structure*, 2015, Research project for National Bank of Poland

Compilation of the tables of intersectoral flows based on the tables of liabilities and assets

Matrix of liabilities

sectors / instruments	j	$s_i^R = \sum_j r_{ij}$
i	$\mathbf{R} = [r_{ij}]$ j-th sector's liabilities in the form of i-th instrument	$\mathbf{s^R}$ stock of i-th instrument
$\sum_i r_{ij}$	$\mathbf{r}$ j-th sector's borrowing	
$\rho_j = z_j - \sum_i r_{ij}$	$\boldsymbol{\rho}$ the excess of assets over liabilities of j-th sector (if exists; 0 otherwise)	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$ stock assets or liabilities (whichever is greater) of j-th sector	

Compilation of the tables of intersectoral flows based on the tables of liabilities and assets (cont.)

Matrix of assets

instruments \ sectors	j	$s_i^E = \sum_j e_{ij} = \sum_j r_{ij}$
i	$\mathbf{E} = [e_{ij}]$ j-th sector's assets in the form of i-th instrument	$\mathbf{s^E}$ stock of i-th instrument
$\sum_i e_{ij}$	$\mathbf{e}$ j-th sector's lending	
$\varepsilon_j = z_j - \sum_i e_{ij}$	$\mathbf{\varepsilon}$ the excess of liabilities over assets of j-th sector (if exists; 0 otherwise)	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$ stock assets or liabilities (whichever is greater) of j-th sector	

Liability-oriented system vs asset-oriented system

sectors / instruments	j	$s_i^R = \sum_j r_{ij}$
i	$\mathbf{R} = [r_{ij}]$	$\mathbf{s^R}$
$\sum_i r_{ij}$	$\mathbf{r}$	
$\rho_j = z_j - \sum_i r_{ij}$	$\boldsymbol{\rho}$	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$	

sectors / instruments	j	$s_i^E = \sum_j e_{ij}$
i	$\mathbf{E} = [e_{ij}]$	$\mathbf{s^E}$
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$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$	

Liability-oriented system

$\mathbf{U} \equiv \mathbf{R}$ – use matrix
$\mathbf{V} \equiv \mathbf{E}^{\mathrm{T}}$ – supply matrix

Asset-oriented system

$\mathbf{U}^* \equiv \mathbf{E}$ – use matrix
$\mathbf{V}^* \equiv \mathbf{R}^{\mathrm{T}}$ – supply matrix

Compilation of the tables of intersectoral flows – liability-oriented system

sectors / instruments	j	$s_i^R = \sum_j r_{ij}$
i	$\mathbf{R} = [r_{ij}]$	$\mathbf{s^R}$
$\sum_i r_{ij}$	$\mathbf{r}$	
$\rho_j = z_j - \sum_i r_{ij}$	$\mathbf{\rho}$	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$	

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$\varepsilon_j = z_j - \sum_i e_{ij}$	$\mathbf{\varepsilon}$	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$	

$$\mathbf{B} = [b_{ij}], \quad b_{ij} = \frac{r_{ij}}{z_j}$$

$$\mathbf{C} = [c_{ij}] \quad \mathbf{C} = \mathbf{D}^T \cdot \mathbf{B}$$

$$\mathbf{D} = [d_{ij}], \quad d_{ij} = \frac{e_{ij}}{s_i^E}$$

$$\mathbf{Y} = [y_{ij}] \quad y_{ij} = c_{ij} \cdot z_j$$

institutional sector portfolio assumption

Compilation of the tables of intersectoral flows – liability-oriented system

sectors / instruments	j	$s_i^R = \sum_j r_{ij}$
i	$\mathbf{R} = [r_{ij}]$	$\mathbf{s^R}$
$\sum_i r_{ij}$	$\mathbf{r}$	
$\rho_j = z_j - \sum_i r_{ij}$	$\boldsymbol{\rho}$	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$	

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$\sum_i e_{ij}$	$\mathbf{e}$	
$\varepsilon_j = z_j - \sum_i e_{ij}$	$\boldsymbol{\varepsilon}$	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$	

$$\mathbf{B} = [b_{ij}], \quad b_{ij} = \frac{r_{ij}}{z_j} \qquad \mathbf{C} = [c_{ij}] \quad \mathbf{C} = \mathbf{D^T} \cdot \mathbf{B} \qquad \mathbf{D} = [d_{ij}], \quad d_{ij} = \frac{e_{ij}}{s_i^E}$$

$$\mathbf{Y} = [y_{ij}] \qquad y_{ij} = c_{ij} \cdot z_j$$

institutional sector portfolio assumption

A modification using the prior knowledge: $\tilde{\mathbf{Y}} = [\tilde{y}_{ij}] \longrightarrow \tilde{c}_{ij} = \frac{\tilde{y}_{ij}}{z_j}$

Financial input-output table
(liability-oriented system)

sector \ sector	j	$\sum_{j} e_{ij}$	ε_i	z_i
i	$\mathbf{Y} = [y_{ij}]$ flows of funds from i-th to j-th sector	$\mathbf{e}^{\mathrm{T}}$ i-th sector's lending	$\boldsymbol{\varepsilon}^{\mathrm{T}}$ the excess of liabilities over assets of i-th sector (if exists; 0 otherwise)	$\mathbf{z}^{\mathrm{T}}$
$\sum_{i} r_{ij}$	$\mathbf{r}$ j-th sector's borrowing			
ρ_j	$\boldsymbol{\rho}$ the excess of assets over liabilities of j-th sector (if exists; 0 otherwise)			
z_j	$\mathbf{z}$ stock assets or liabilities (whichever is greater) of j-th sector			

$$\mathbf{C} \cdot \mathbf{z} + \boldsymbol{\varepsilon} = \mathbf{z}$$

Financial input-output table
(liability-oriented system)

sector \ sector	j	$\sum_{j} e_{ij}$	ε_i	z_i
i	$\mathbf{Y} = [y_{ij}]$ flows of funds from i-th to j-th sector	$\mathbf{e}^{\mathrm{T}}$ i-th sector's lending	$\mathbf{\varepsilon}^{\mathrm{T}}$ the excess of liabilities over assets of i-th sector (if exists; 0 otherwise)	$\mathbf{z}^{\mathrm{T}}$
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z_j	$\mathbf{z}$ stock assets or liabilities (whichever is greater) of j-th sector			

$\mathbf{C} \cdot \mathbf{z} + \mathbf{\varepsilon} = \mathbf{z}$

$\mathbf{z} = (\mathbf{I} - \mathbf{C})^{-1} \mathbf{\varepsilon}$

$\mathbf{\Gamma} = [\gamma_{ij}], \quad \mathbf{\Gamma} = (\mathbf{I} - \mathbf{C})^{-1}$

γ_{ij} - demand for funds in i-th sector induced by the unit increment in demand for funds by j-th sector.

Compilation of the tables of intersectoral flows – asset-oriented system

sectors instruments	j	$s_i^E = \sum_j e_{ij}$
i	$\mathbf{E} = [e_{ij}]$	$\mathbf{s^E}$
$\sum_i e_{ij}$	e	
$\varepsilon_j = z_j - \sum_i e_{ij}$	ε	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	z	

sectors instruments	j	$s_i^R = \sum_j r_{ij}$
i	$\mathbf{R} = [r_{ij}]$	$\mathbf{s^R}$
$\sum_i r_{ij}$	r	
$\rho_j = z_j - \sum_i r_{ij}$	ρ	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	z	

$$\mathbf{B}^* = [b_{ij}^*], \quad b_{ij}^* = \frac{e_{ij}}{z_j}$$

$$\mathbf{C}^* = [c_{ij}^*] \quad \mathbf{C}^* = \mathbf{D}^{*\mathrm{T}} \cdot \mathbf{B}^*$$

$$\mathbf{D}^* = [d_{ij}^*], \quad d_{ij}^* = \frac{r_{ij}}{s_i^R}$$

$$\mathbf{Y}^* = [y_{ij}^*] \quad y_{ij}^* = c_{ij}^* \cdot z_j$$

Compilation of the tables of intersectoral flows – asset-oriented system

instruments \ sectors	j	$s_i^E = \sum_j e_{ij}$
i	$\mathbf{E} = [e_{ij}]$	$\mathbf{s^E}$
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$\varepsilon_j = z_j - \sum_i e_{ij}$	$\boldsymbol{\varepsilon}$	
$z_j = \max(\sum_i e_{ij}, \sum_i r_{ij})$	$\mathbf{z}$	

instruments \ sectors	j	$s_i^R = \sum_j r_{ij}$
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$$\mathbf{Y}^* = [y_{ij}^*] \quad y_{ij}^* = c_{ij}^* \cdot z_j$$

$$\mathbf{Y}^* = \mathbf{Y}^T$$

Financial input-output table
(asset-oriented system)

sector \ sector	j	$\sum_j r_{ij}$	ρ_i	z_i
i	$\mathbf{Y}^* = [y^*_{ij}] = \mathbf{Y}^T$ flows of funds from i-th to j-th sector	$\mathbf{r}^T$ i-th sector's borrowing	$\boldsymbol{\rho}^T$ the excess of assets over liabilities of i-th sector (if exists; 0 otherwise)	$\mathbf{z}^T$
$\sum e_{ij}$	$\mathbf{e}$ j-th sector's lending			
ε_j	$\boldsymbol{\varepsilon}$ the excess of liabilities over assets of j-th sector (if exists; 0 otherwise)			
z_j	$\mathbf{z}$ stock assets or liabilities (whichever is greater) of j-th sector			

$$\mathbf{C}^* \cdot \mathbf{z} + \boldsymbol{\rho} = \mathbf{z}$$

Financial input-output table
(asset-oriented system)

sector \\ sector	j	$\sum_j r_{ij}$	ρ_i	z_i
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$$\mathbf{C}^* \cdot \mathbf{z} + \boldsymbol{\rho} = \mathbf{z}$$

$$\mathbf{z} = (\mathbf{I} - \mathbf{C}^*)^{-1} \boldsymbol{\rho}$$

$$\boldsymbol{\Gamma}^* = [\gamma^*_{ij}], \quad \boldsymbol{\Gamma}^* = (\mathbf{I} - \mathbf{C}^*)^{-1}$$

γ^*_{ij} - supply of funds in i-th sector induced by the unit increment in supply of funds by j-th sector.

Financial input-output table for Poland in 2014 (million euro)
(liability-oriented system)

	S11 nonfinancial corporations	S12 financial corporations	S13 general government	S14 households	S15 non-profit institutions	S2 rest of the world	$\sum e_{ij}$ i-th sector's lending	ε_i the excess of liabilities over assets	z_i stock assets or liabilities
S11	131 785	89 497	41 783	8 673	3	41 047	312 788	329 711	642 500
S12	166 322	132 472	138 291	81 044	24	95 194	613 347	18 904	632 251
S13	59 260	44 810	14 355	5 266	2	17 917	141 609	153 854	295 463
S14	84 424	246 094	13 926	1 590	1	35 831	381 866	0	381 866
S15	38	3 807	84	1	0	399	4 330	0	4 330
S2	200 672	115 570	87 025	49 880	16	0	453 162	0	453 162
$\sum r_{ij}$	642 500	632 250	295 463	146 455	46	190 388	j-th sector's borrowing		
ρ_j	0	0	0	235 411	4 284	262 774	the excess of assets over liabilities		
z_j	642 500	632 251	295 463	381 866	4 330	453 162	stock assets or liabilities		

Gross exposures between sectors
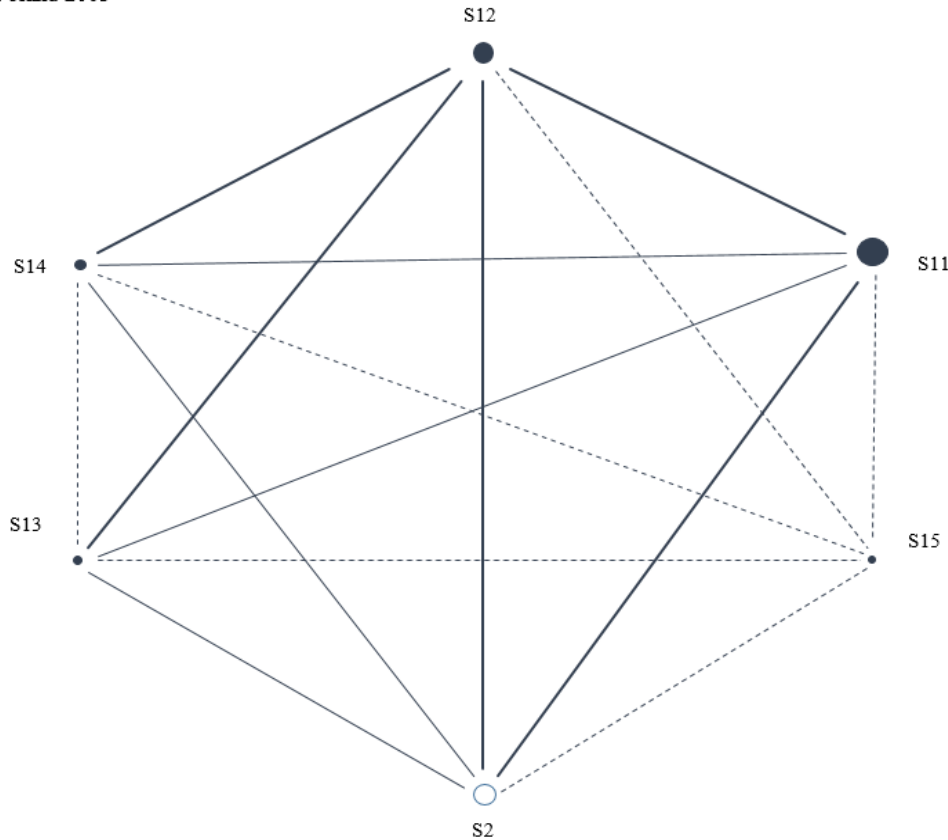
$$\mathbf{G} = \lfloor g_{ij} \rfloor, \qquad g_{ij} = \begin{cases} y_{ij}, & \text{if } i = j \\ y_{ij} + y_{ji}, & \text{if } i < j \\ 0, & \text{if } i > j \end{cases}$$

Gross exposures between sectors

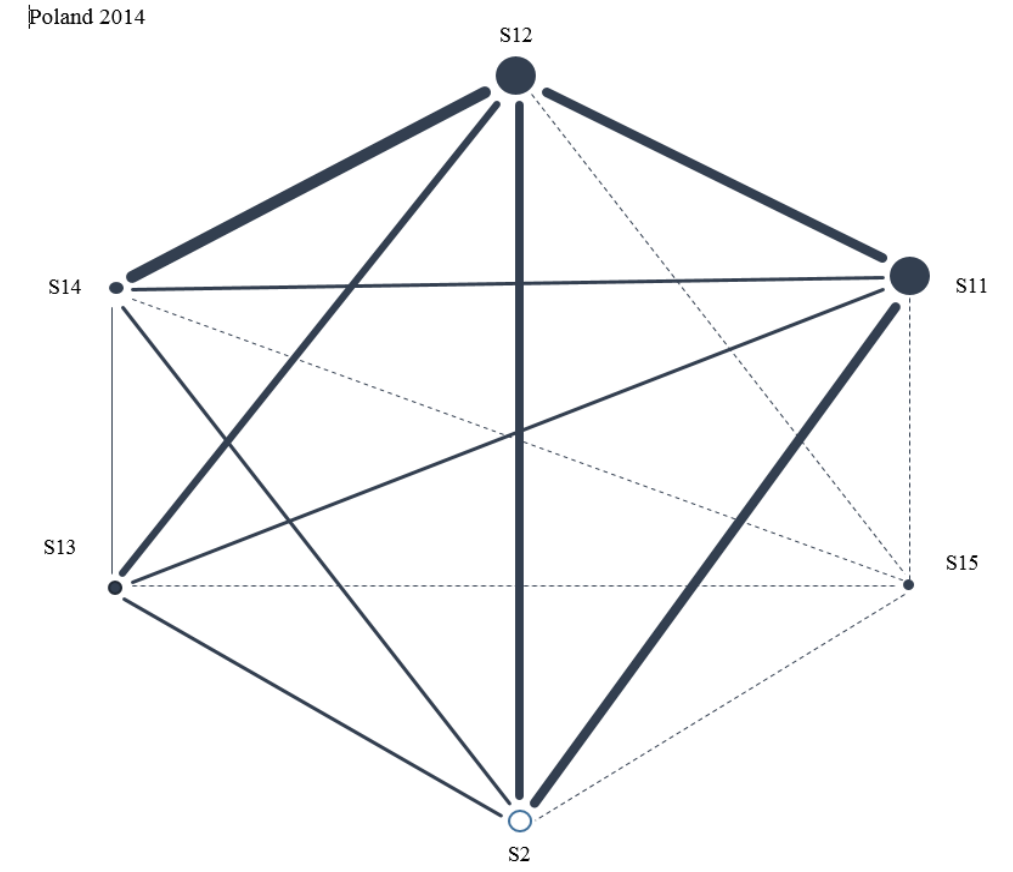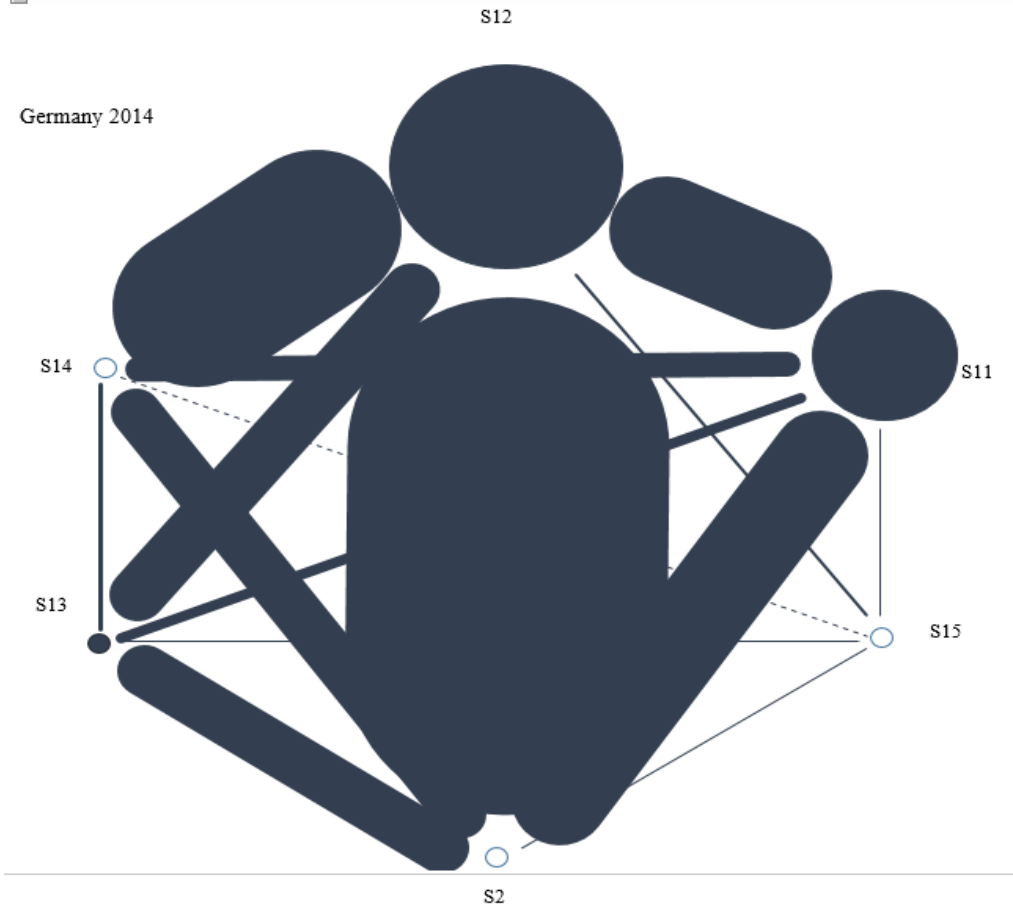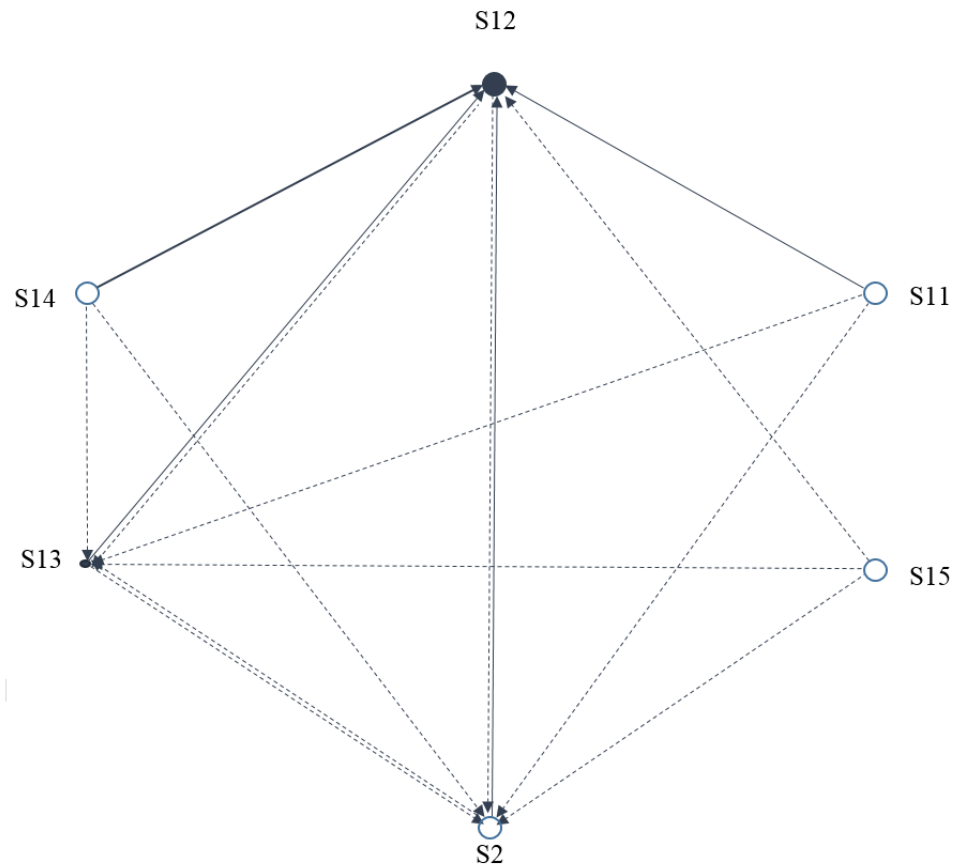|	S11 nonfinancial corporations	S12 financial corporations	S13 general government	S14 households	S15 non-profit institutions	S2 rest of the world
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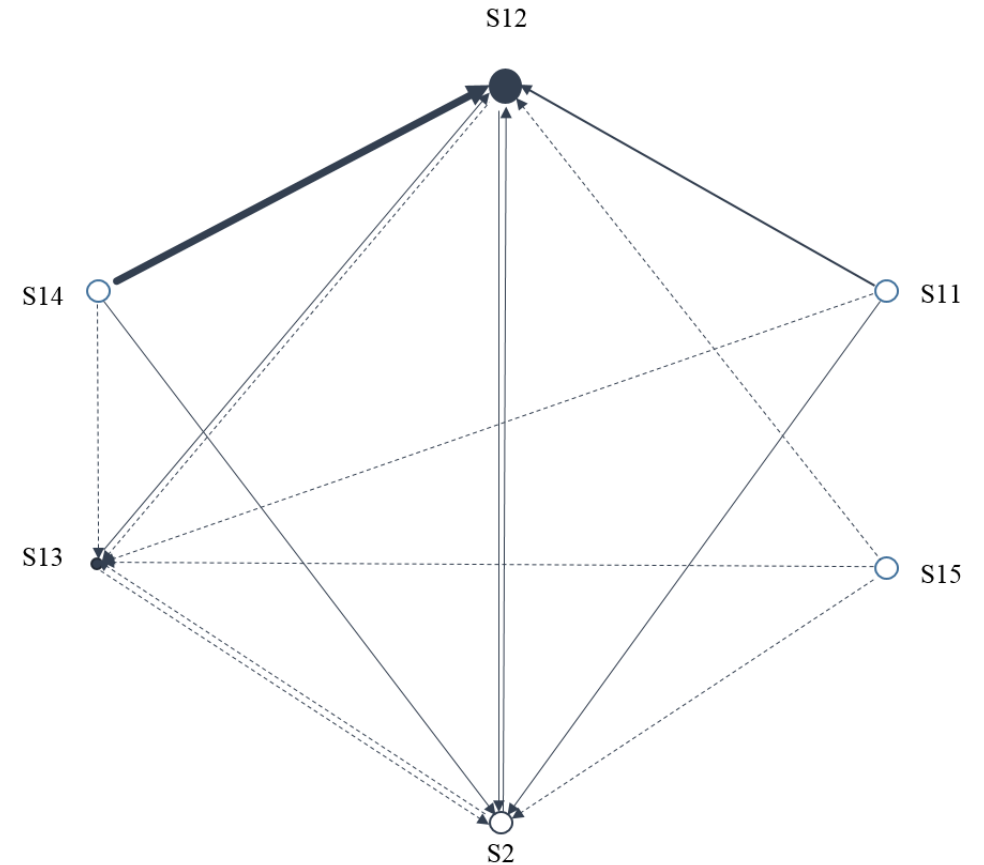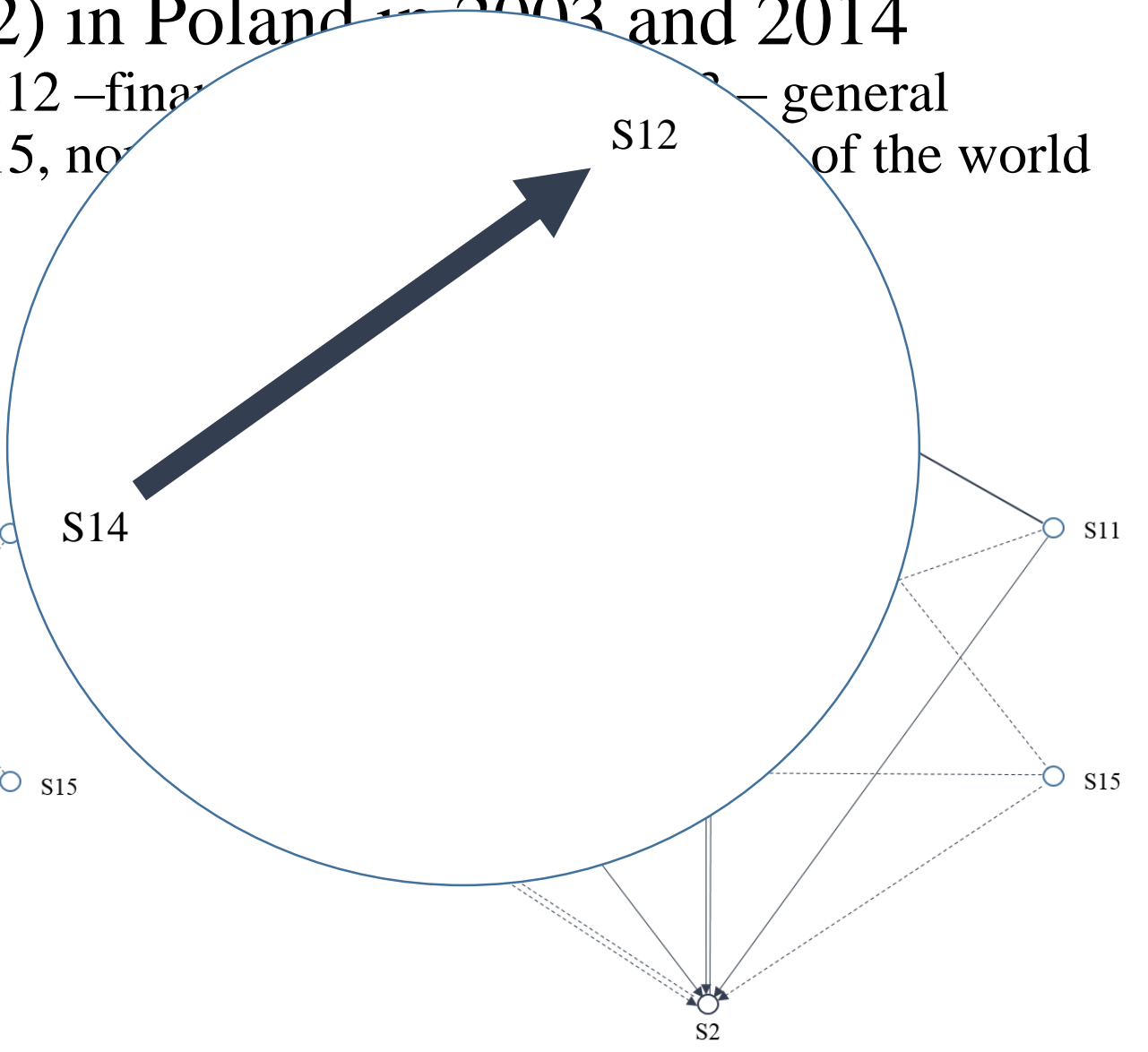|	S11 nonfinancial corporations	S12 financial corporations	S13 general government	S14 households	S15 non-profit institutions	S2 rest of the world
S11	131 785	255 819	101 042	93 098	41	241 719
S12	0	132 472	183 101	327 138	3 832	210 764
S13	0	0	14 355	19 191	86	104 941
S14	0	0	0	1 590	2	85 711
S15	0	0	0	0	0	415
S2	0	0	0	0	0	0

Gross exposures between sectors in Poland in 2014

$$\mathbf{G} = \lfloor g_{ij} \rfloor, \qquad g_{ij} = \begin{cases} y_{ij}, & \text{if } i = j \\ y_{ij} + y_{ji}, & \text{if } i < j \\ 0, & \text{if } i > j \end{cases}$$

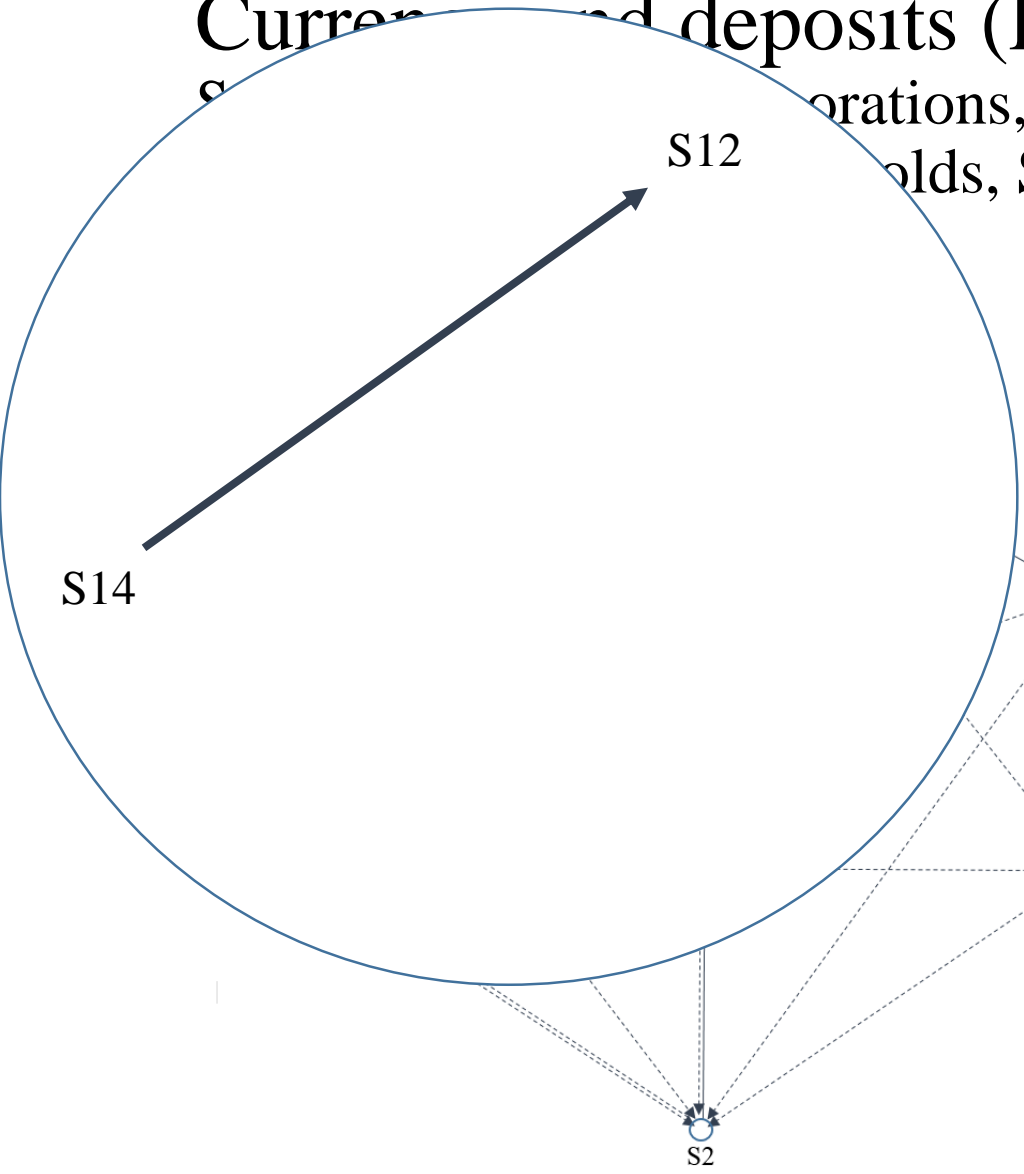|	S11 nonfinancial corporations	S12 financial corporations	S13 general government	S14 households	S15 non-profit institutions	S2 rest of the world
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S14	0	0	0	1 590	2	85 711
S15	0	0	0	0	0	415
S2	0	0	0	0	0	0

Maps of intersectoral linkages (gross exposure)

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world

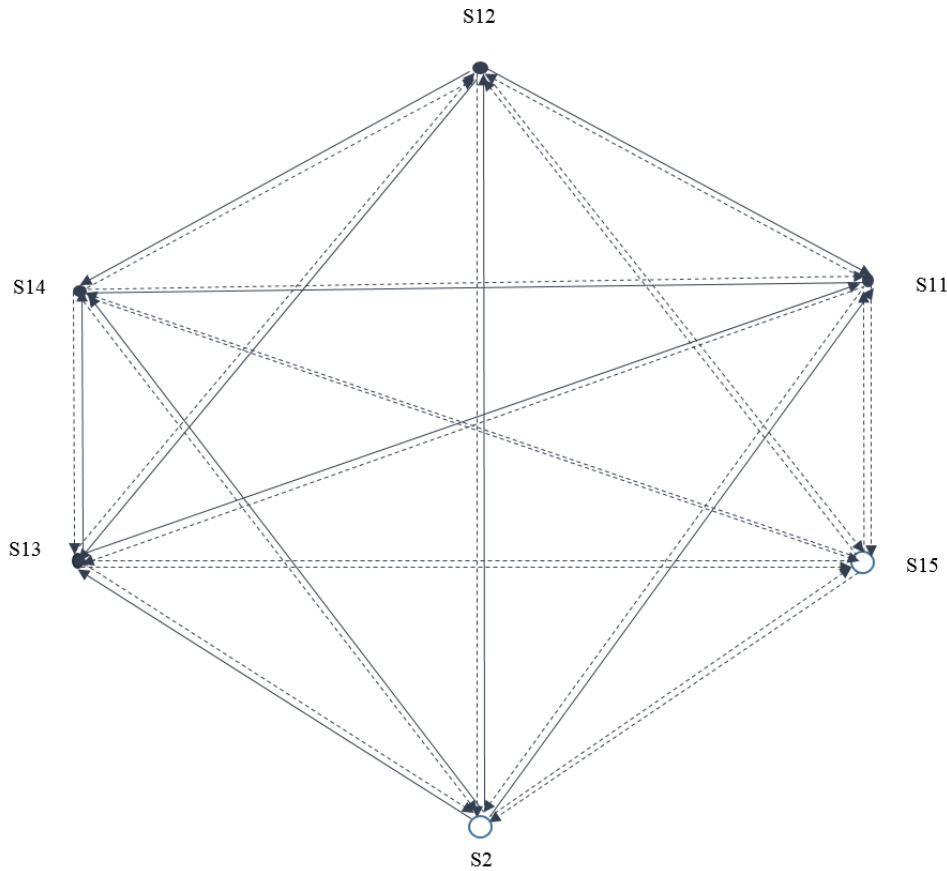# Maps of intersectoral linkages (gross exposure)

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world
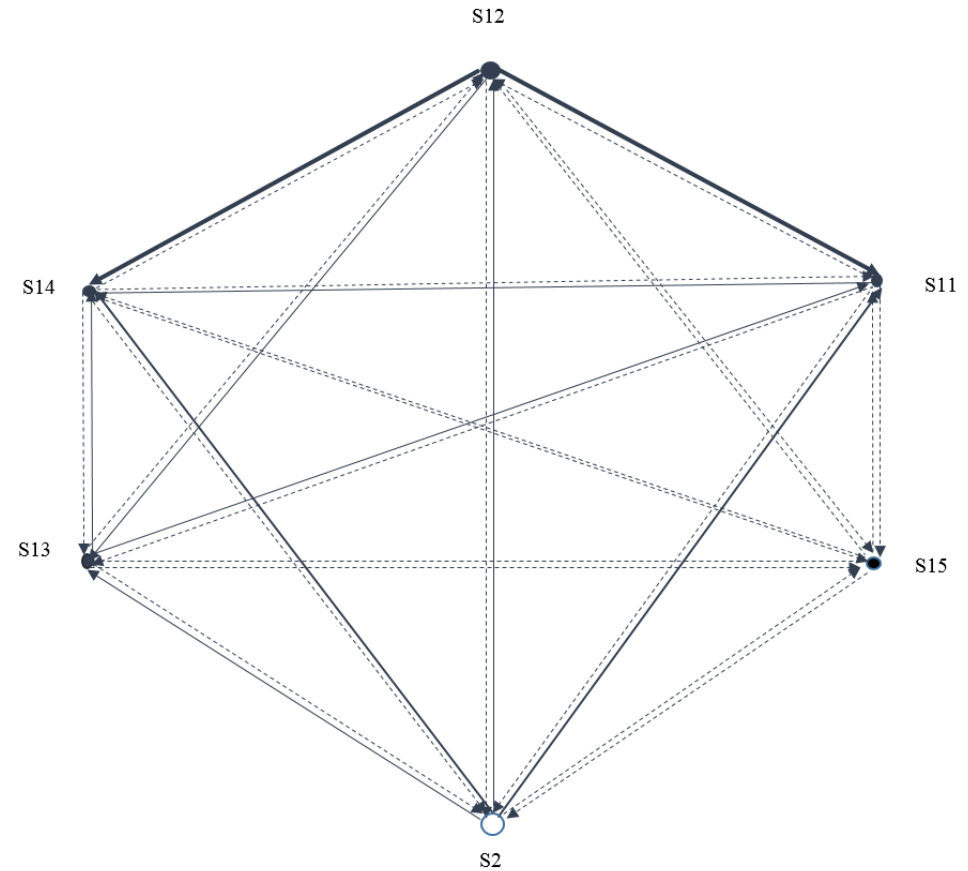
Currency and deposits (F2) in Poland in 2003 and 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world

# Current and deposits (F2) in Poland in 2003 and 2014

S... ...orations, S12 –fina... ...olds, S15, no... – general ...of the world

Currency and deposits (F2) in Poland and Germany in 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world
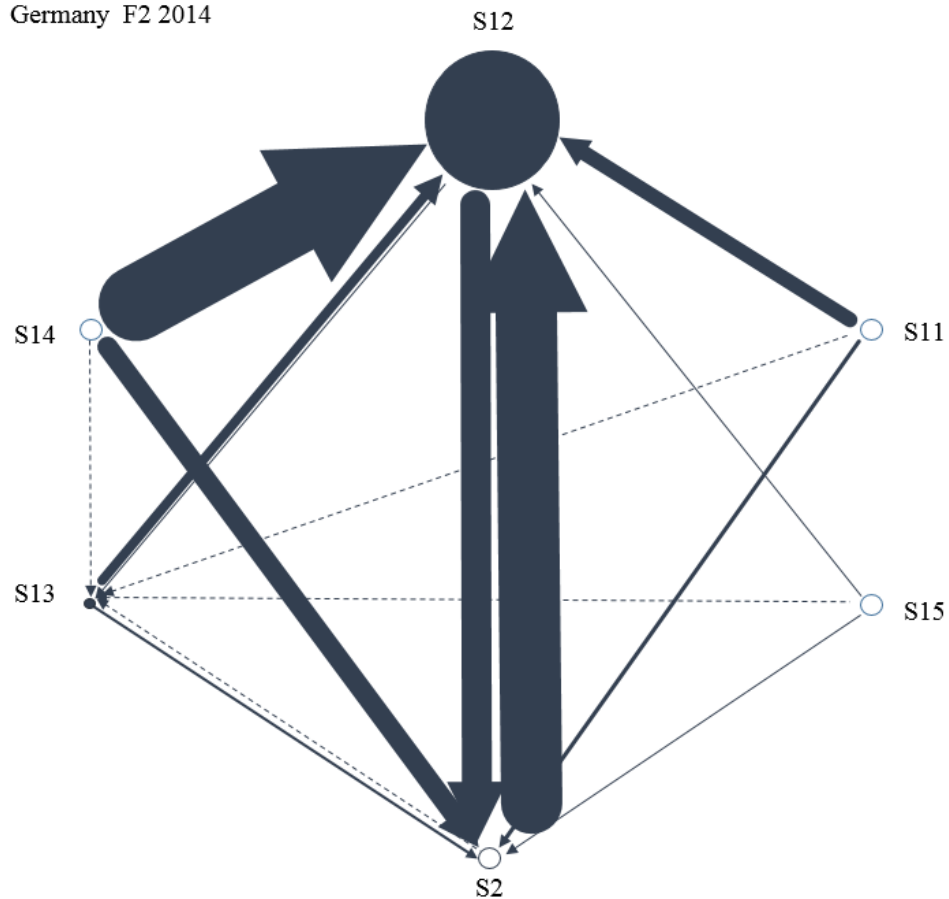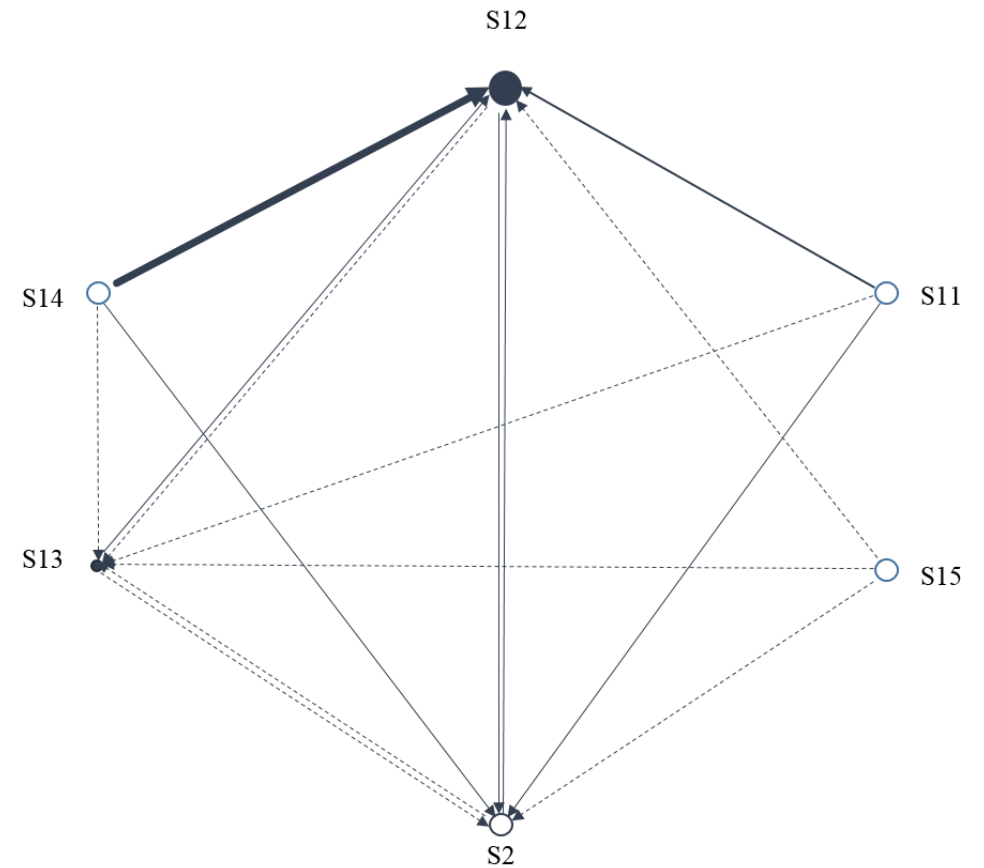
Loans(F4) in Poland in 2003 and 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world
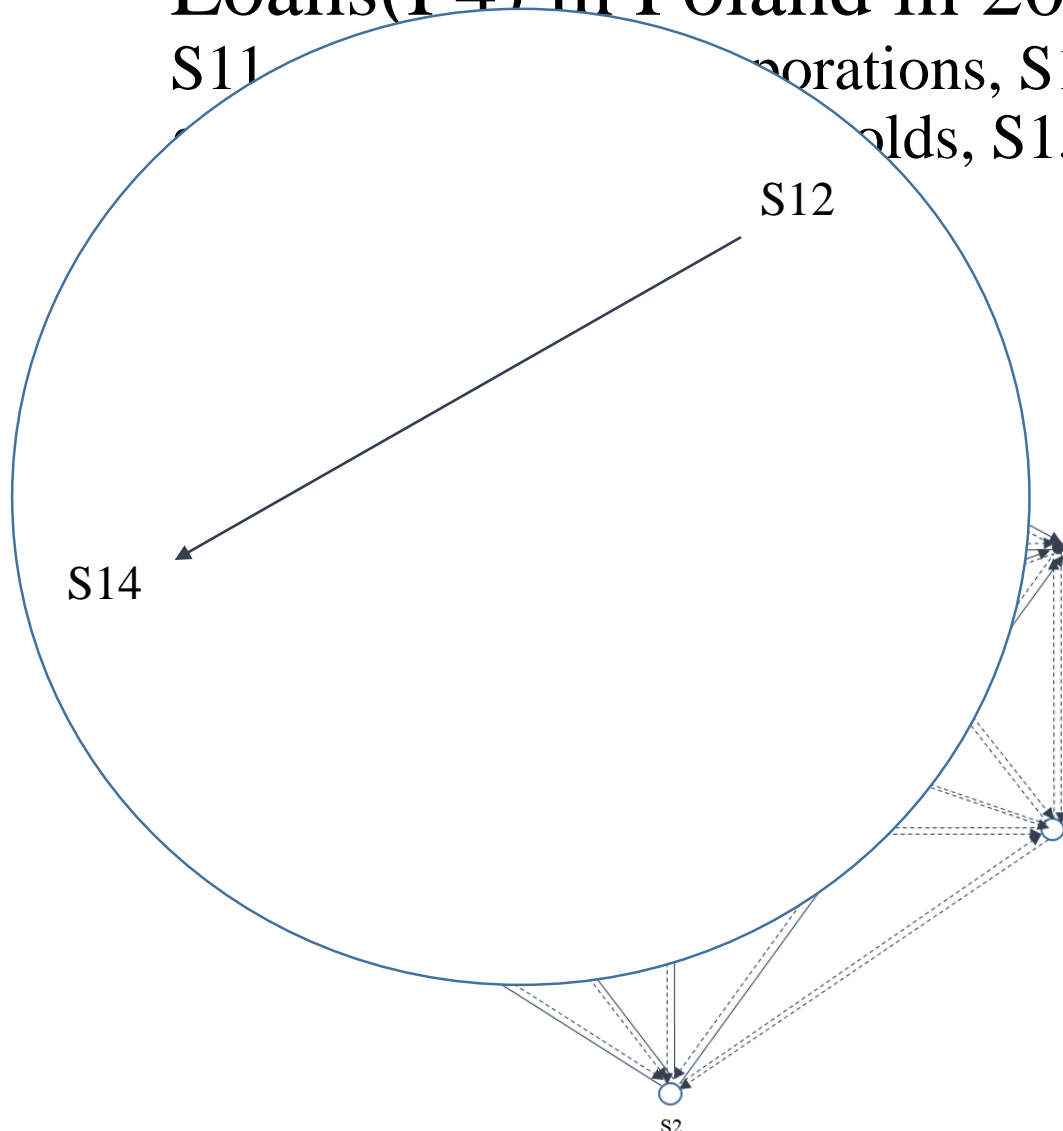

Poland F4 2003

Poland F4 2014

Loans(F4) in Poland in 2003 and 2014

S11 — corporations, S12 –financial — general — general
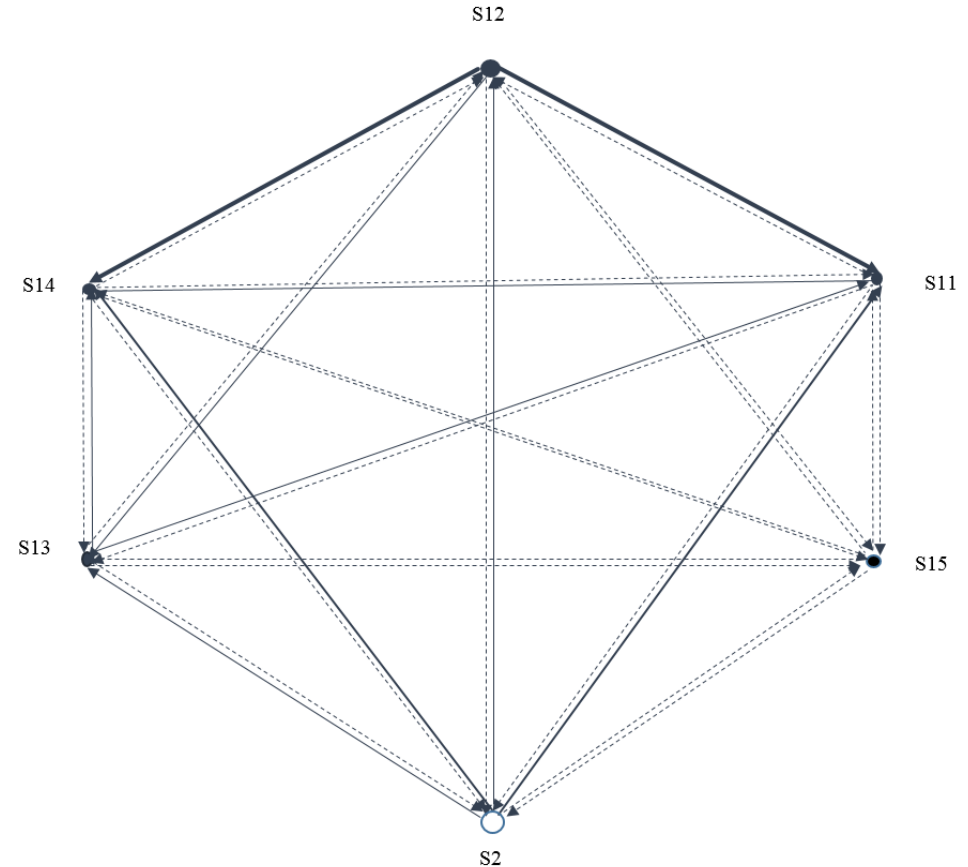— olds, S15, non-pro — f the world
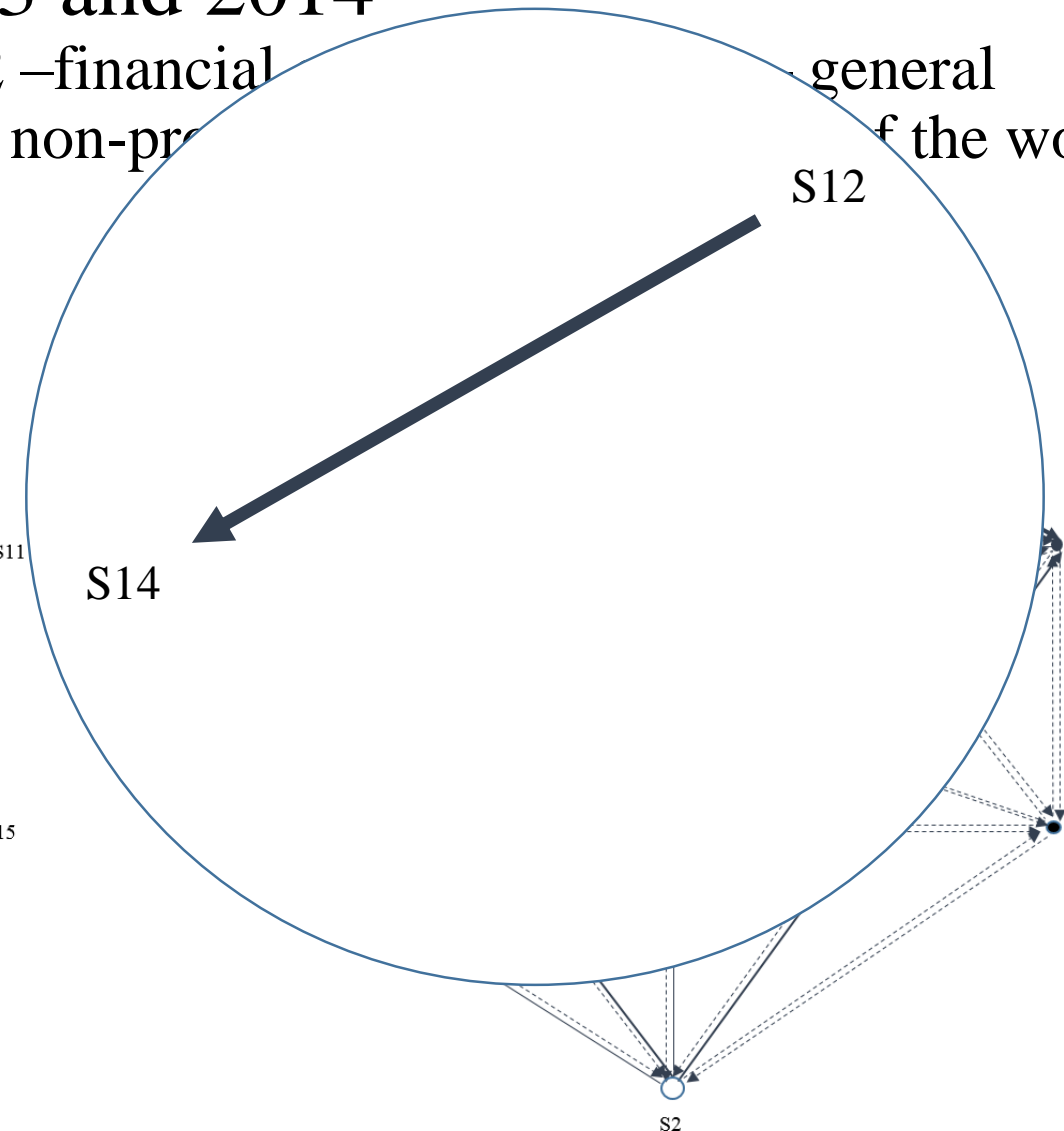
Loans(F4) in Germany and Poland in 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world
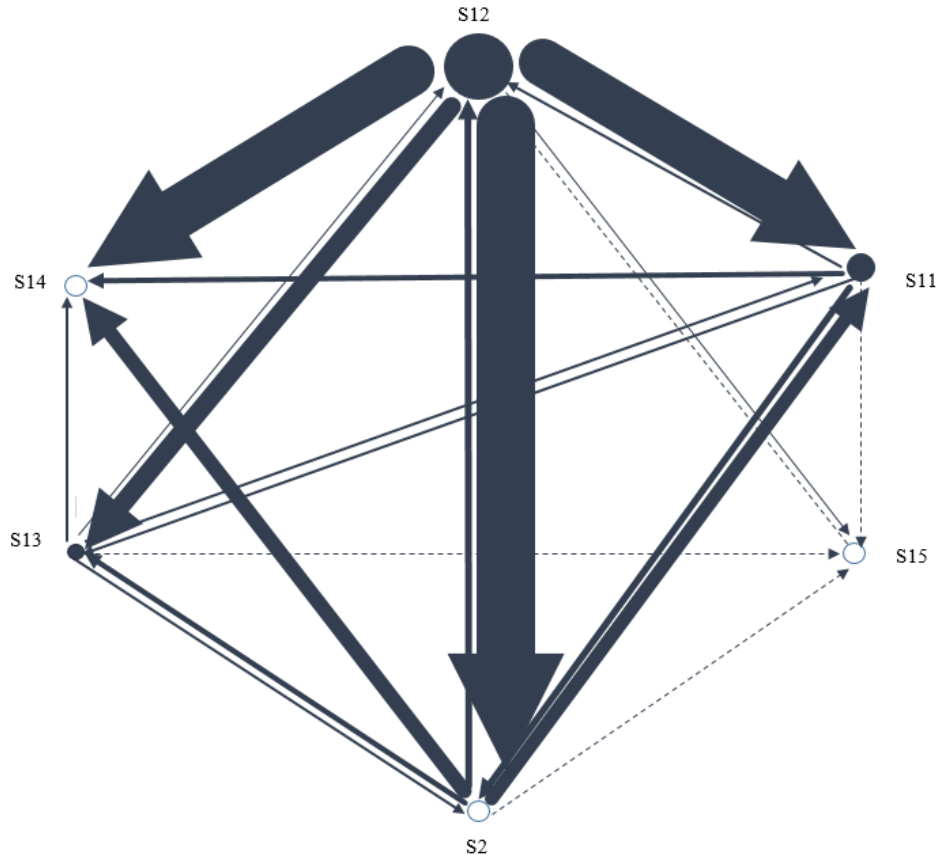
Germany F4 2014

Poland F4 2014

Loans(F4) in Germany and Netherlands in 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world
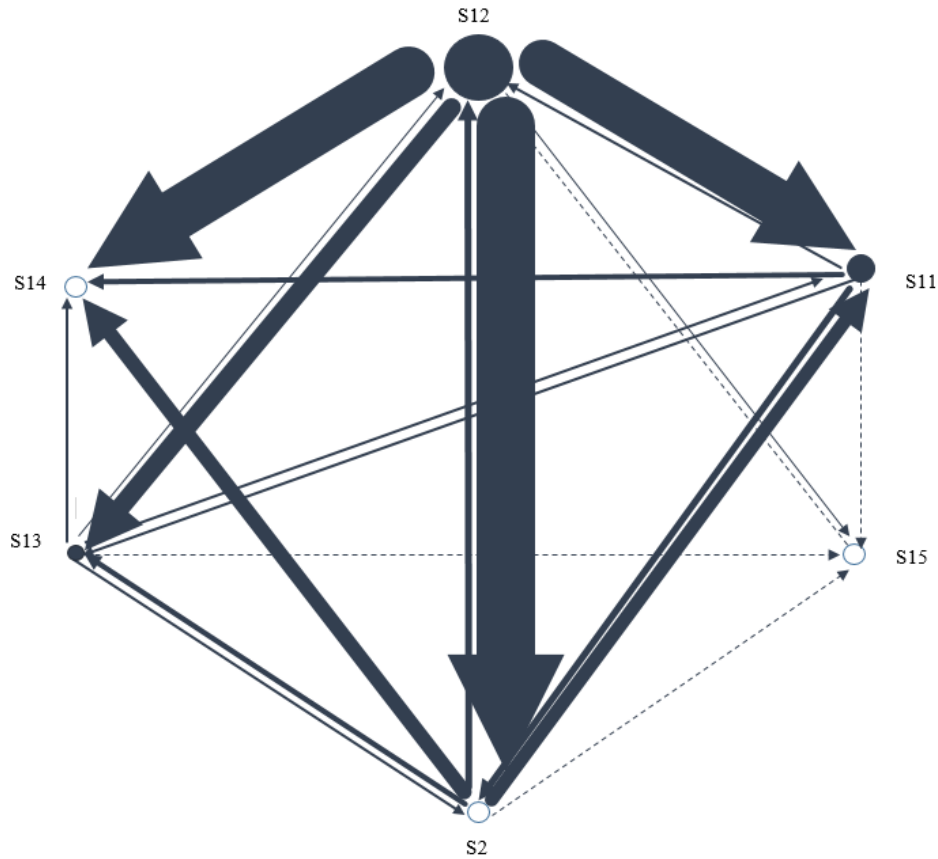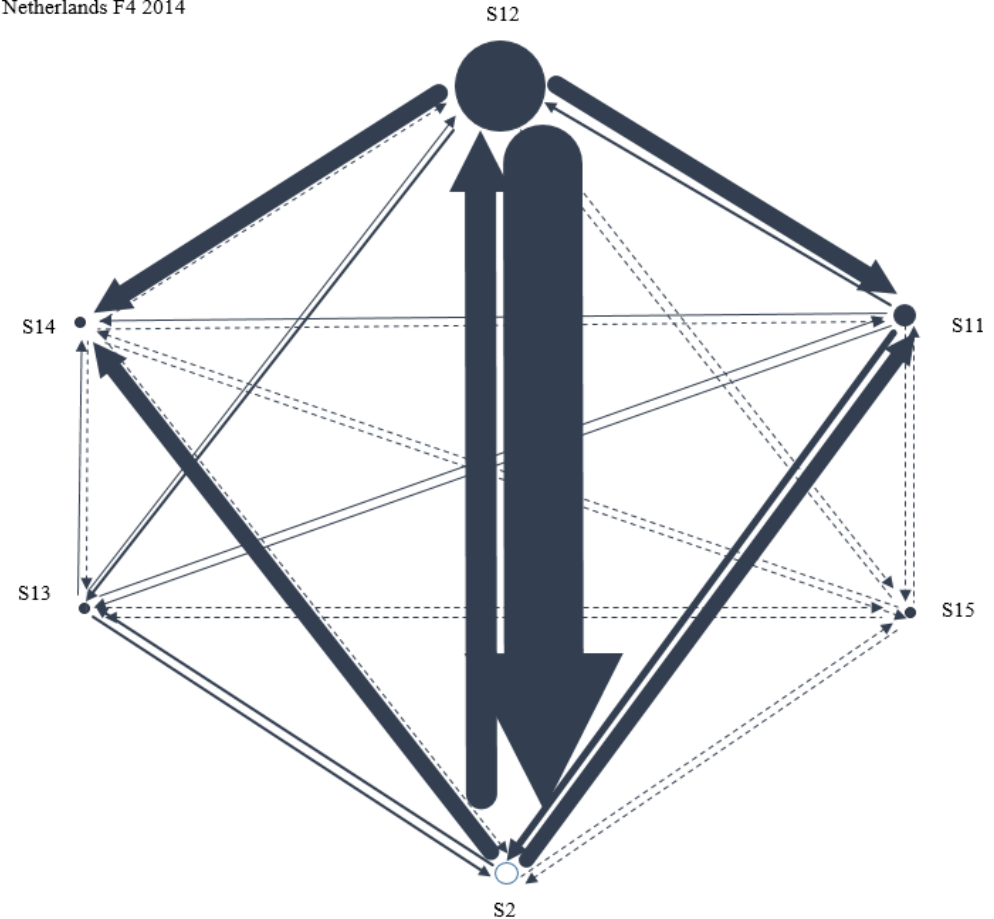

Germany F4 2014

Netherlands F4 2014

Insurance, pensions and standardized guarantees (F6) in Poland in 2003 and 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world

Poland F6 2003

Poland F6 2014

Insurance, pensions and standardized guarantees (F6) in Germany and Poland in 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world
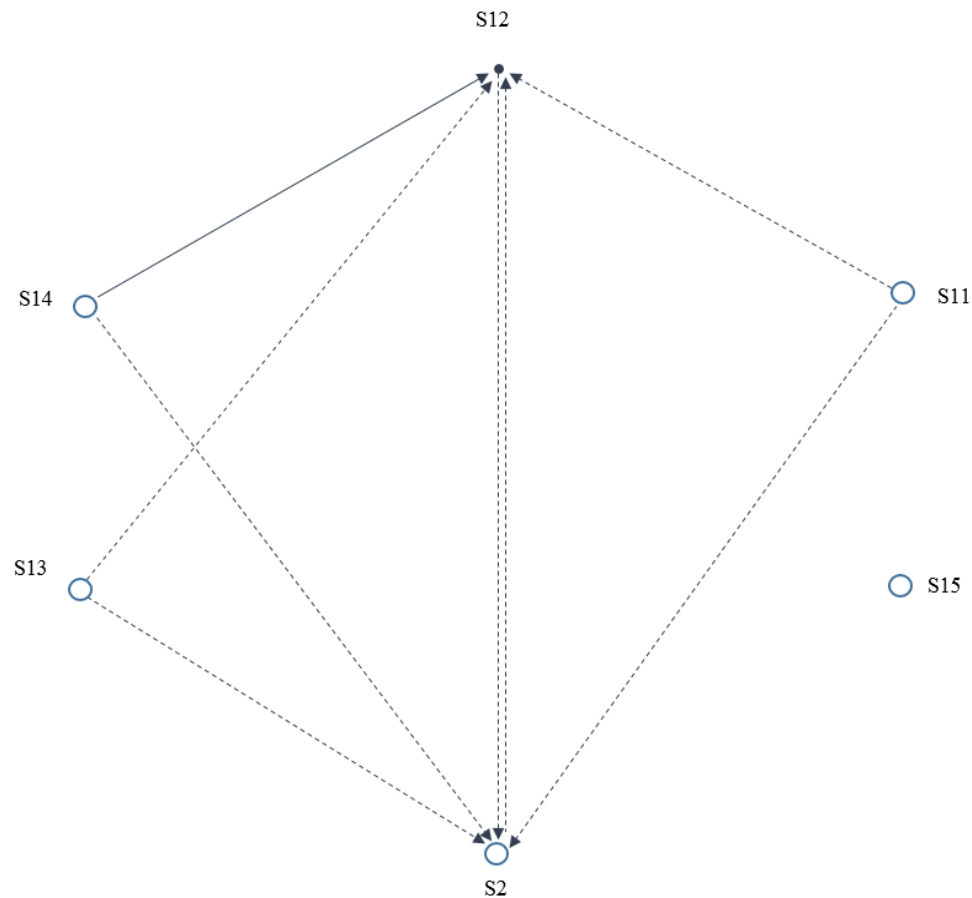

Germany F6 2014

Poland F6 2014

Insurance, pensions and standardized guarantees (F6) in Germany and Italy in 2014

S11 – nonfinancial corporations, S12 –financial corporations, S13 – general government, S14 – households, S15, non-profit institutions, S2 – rest of the world
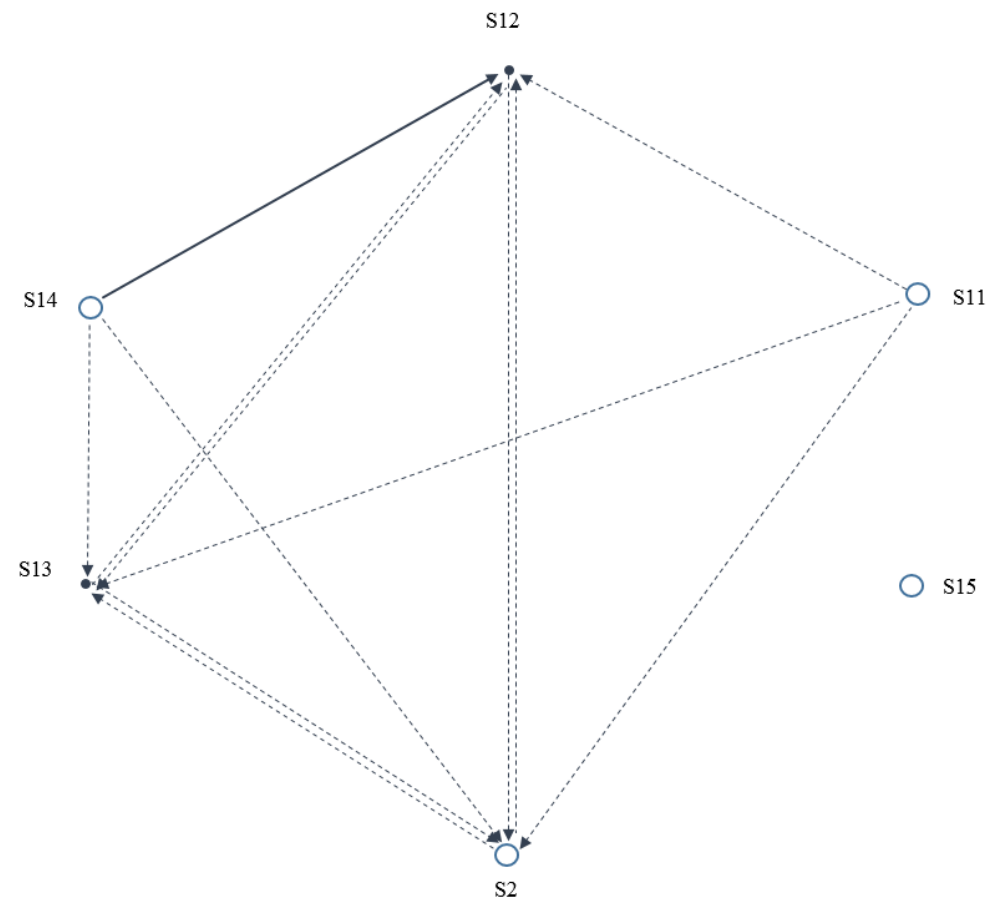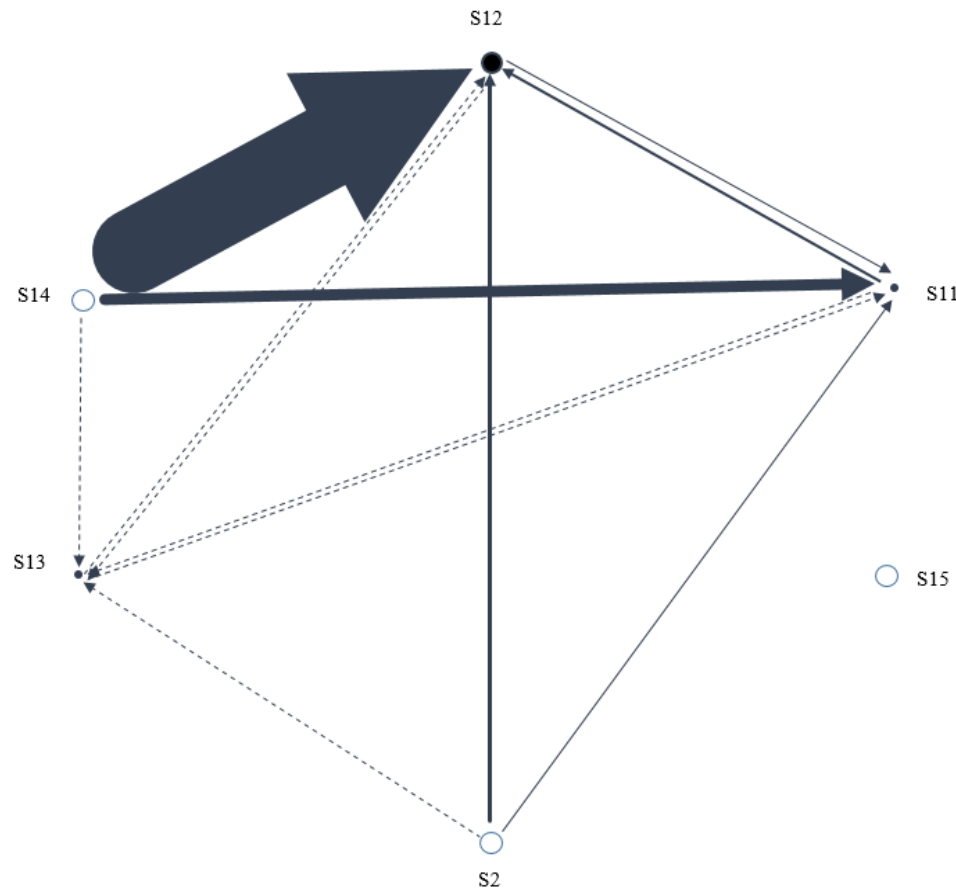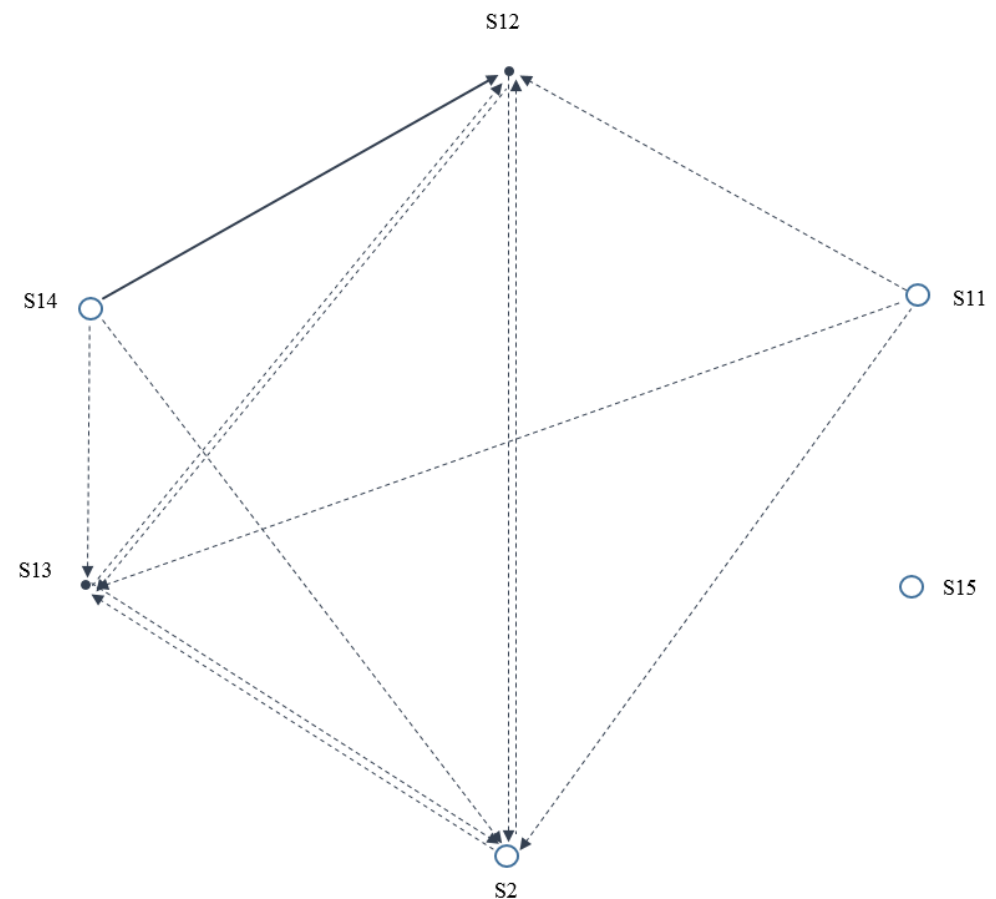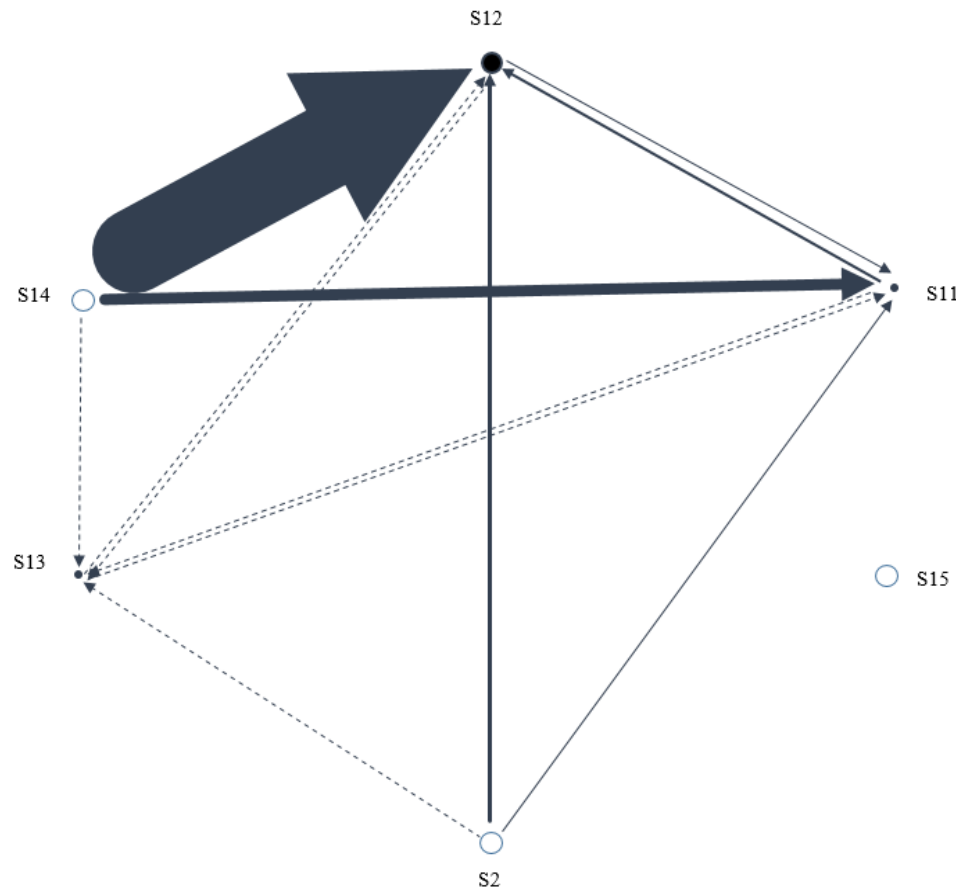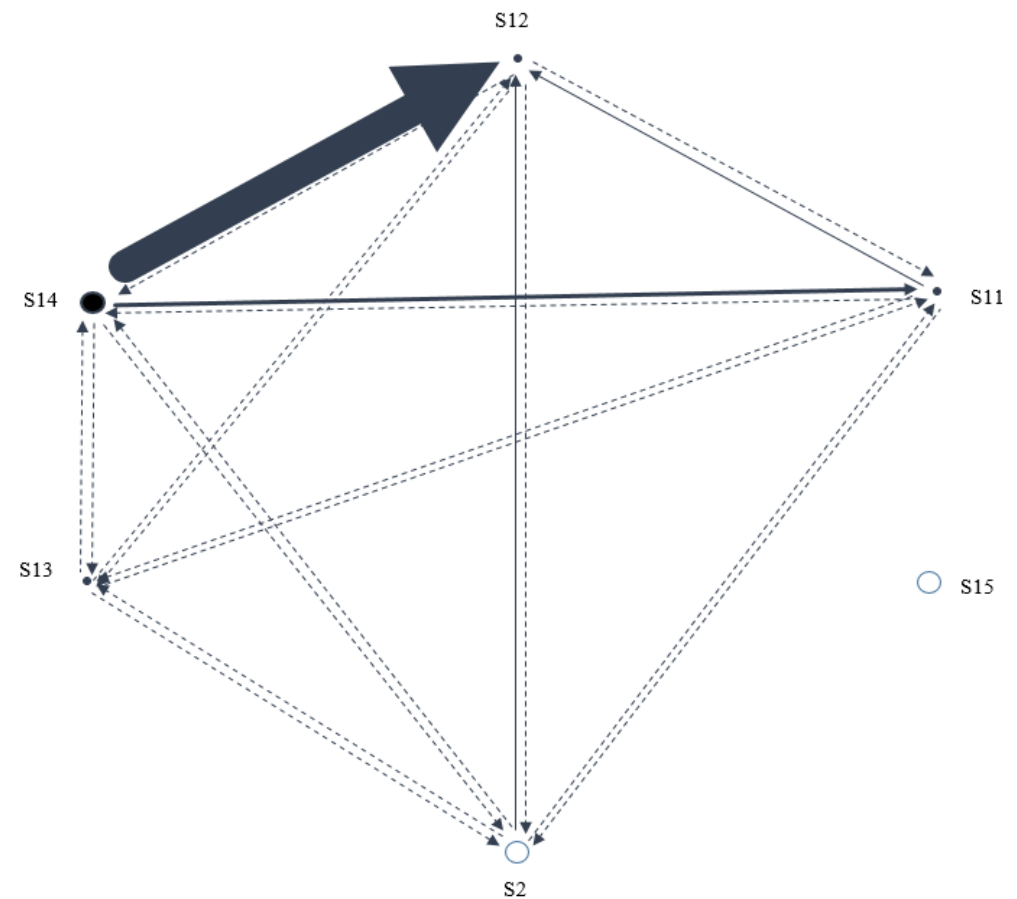

Germany F6 2014

Italy F6 2014

Simulation exercise
step 1 – based on national accounts identities

Assumptions:

- no changes in the level and structure of final demand,

- changes in the structure of value added by institutional sectors, ie. a decrease in the share of the household sector and an increase in the share of non-financial corporations (as observed in trends for certain activities, eg. Trade)

- no changes in the coefficients of identities for secondary distribution of income.

Main effects:

- decrease in operating surplus (and mixed income) of households, increase in operating surplus of non-financial corporations, changes in the primary and disposable incomes of these sectors,

- change in disposable income of general government,

- decrease in savings and net lending of households (or increase in net borrowing), inversely for non-financial corporations,

- changes in savings and net borrowing of general government.

Simulation exercise
step 1 – results of national accounts identities

Transaction \ Sector	Households	Non-financial corporations	General government	Financial corporations	Rest of the world
Value added structure	-1,5 % point	+1,5 % point			
Value added	- 4,8%	+ 2,9%	0%	0%	
Operating surplus	- 4,8%	+ 3,1%	0%	0%	
Labour income	+ 1,3%				
Primary income	- 1,1%	+ 3,1%	0%	0%	
Disposable income	- 0,8%	+ 3,1%	- 0,9%	- 0,6%	
Savings	- 21,0%	+ 3,1%	<0	- 1,3%	
Net lending net borrowing	+ 27,1%	+ 7,3%	+ 4,2%	- 1,8%	- 20,5%

Simulation exercise
step 1 – results of national accounts identities

Transaction / Sector	Households	Non-financial corporations	General government	Financial corporations	Rest of the world
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Savings	- 21,0%	+ 3,1%	<0	- 1,3%	
Net lending net borrowing	+ 27,1%	+ 7,3%	+ 4,2%	- 1,8%	- 20,5%

Simulation exercise

step 2 – based on flow of funds model

$$\Delta z = (I - C)^{-1} \Delta \varepsilon$$

$\Delta \varepsilon$ - increases in net borrowing and decreases in net lending of particular sectors

$$\Delta y_{ij} = c_{ij} \cdot \Delta z_j$$

$$\sum_j \Delta y_{ij} = \Delta \sum_j e_{ij}$$ - increase in assets of i-th sector

$$\sum_i \Delta y_{ij} = \Delta \sum_i r_{ij}$$ - increase in liabilities of j-th sector

$$\Delta r_{ij} = b_{ij} \cdot \Delta z_j$$

$$\sum_j \Delta r_{ij} = \Delta s_i^R = \Delta s_i^E$$ - increase in liabilities/assets in the form of i-th financial instrument

Simulation exercise
step 2 – results of flow of funds model (cont.)

| Sector	Change in net borrowing	Change in assets		Change in liabilities	
	milion PLN	milion PLN	%	milion PLN	%
Non-financial corporations	-7965	-2721	-3,5%	-10686	-6,7%
Financial corporations	249	-2580	-1,7%	-2331	-1,5%
General government	2799	-1236	-3,5%	1563	2,1%
Households	8444	-2695	-2,8%	2205	6,0%
Non-profit institutions	0	-20	-1,8%	0	-1,8%
Rest of the world	-3526	-2553	-2,3%	-2554	-5,4%
Sum	0	-11804	-2,5%	-11804	-2,5%

Simulation exercise
step 2 – results of flow of funds model (cont.)

Changes in gross exposures:
insreses,
decreses
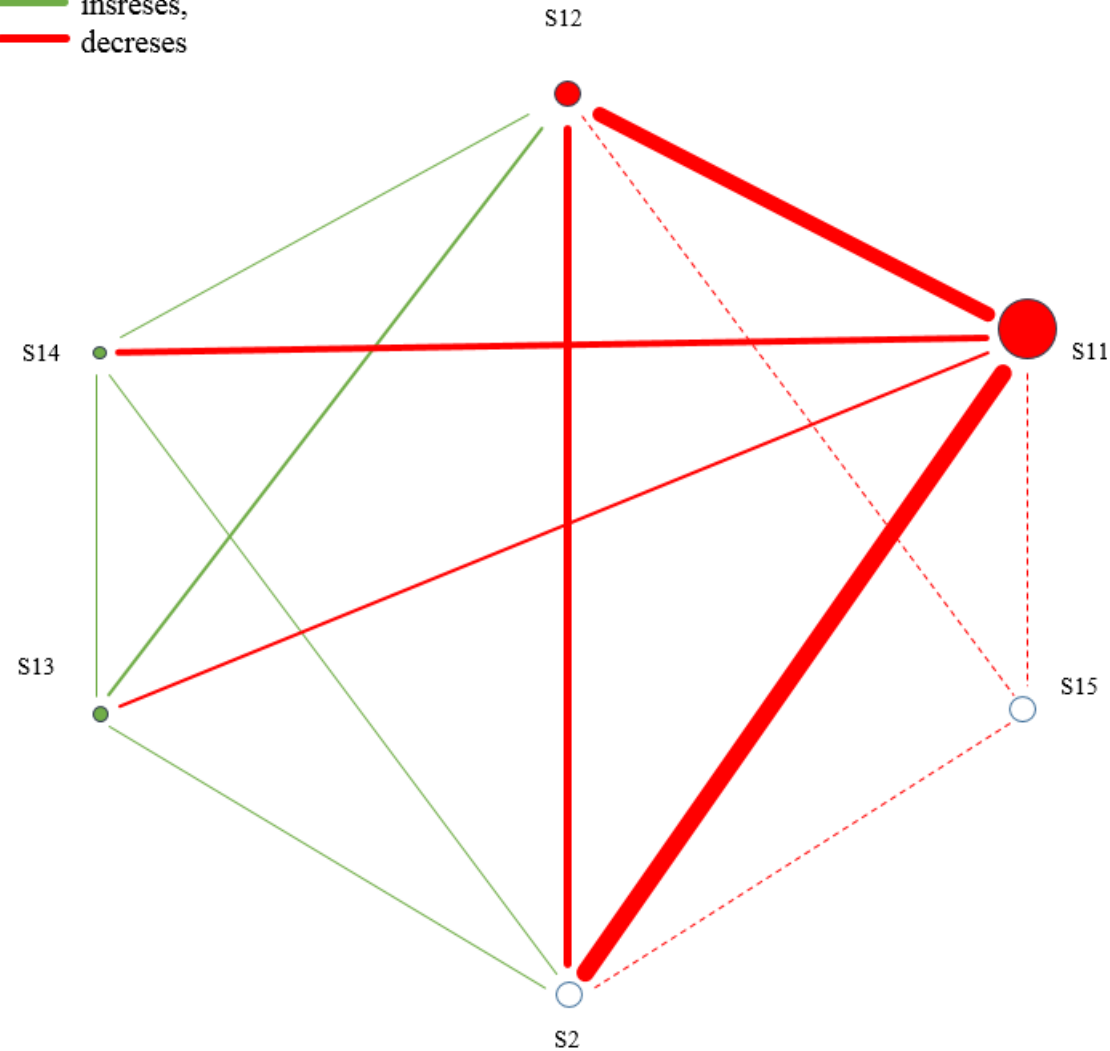
Simulation exercise
step 2 – results of flow of funds model

$$\Delta \mathbf{z} = (\mathbf{I} - \mathbf{C})^{-1} \Delta \boldsymbol{\varepsilon}, \quad (\mathbf{I} - \mathbf{C})^{-1} = \boldsymbol{\Gamma}$$

$$\boldsymbol{\Gamma} = \begin{vmatrix} 1{,}6413 & 0{,}5107 & 0{,}5960 & 0{,}1932 & 0{,}0053 & 0{,}2948 \\ 1{,}1557 & 2{,}0158 & 1{,}3851 & 0{,}5574 & 0{,}0152 & 0{,}6270 \\ 0{,}2939 & 0{,}2430 & 1{,}2607 & 0{,}0936 & 0{,}0026 & 0{,}1349 \\ 0{,}7544 & 0{,}9240 & 0{,}7519 & 1{,}2803 & 0{,}0078 & 0{,}3934 \\ 0{,}0079 & 0{,}0129 & 0{,}0095 & 0{,}0037 & 1{,}0001 & 0{,}0050 \\ 0{,}9090 & 0{,}7203 & 0{,}9089 & 0{,}3571 & 0{,}0099 & 1{,}2978 \end{vmatrix}$$

				Description
1,6413	0,5107	0,5960	0,1932	0,0053	0,2948	Non-financial corporations
1,1557	2,0158	1,3851	0,5574	0,0152	0,6270	Financial corporations
0,2939	0,2430	1,2607	0,0936	0,0026	0,1349	General government
0,7544	0,9240	0,7519	1,2803	0,0078	0,3934	Households
0,0079	0,0129	0,0095	0,0037	1,0001	0,0050	Non-profit institutions
0,9090	0,7203	0,9089	0,3571	0,0099	1,2978	Rest of the world

$$\sum_i \gamma_{ij} \qquad 4{,}7622 \quad 4{,}4265 \quad 4{,}9122 \quad 2{,}4853 \quad 1{,}0408 \quad 2{,}7529$$

Simulation exercise
step 2 – results of flow of funds model (cont.)

Financial instrument	Percentage change of assets/liabilities
Currency and deposits	-1,7%
Debt securities	-0,8%
Loans	-0,5%
Equity and investment fund shares	-5,0%
Insurance, pensions and standardised guarantees	-1,6%
Financial derivatives and employee stock options	-3,4%
Other accounts receivable / payable	-3,9%
Sum	-2,5%