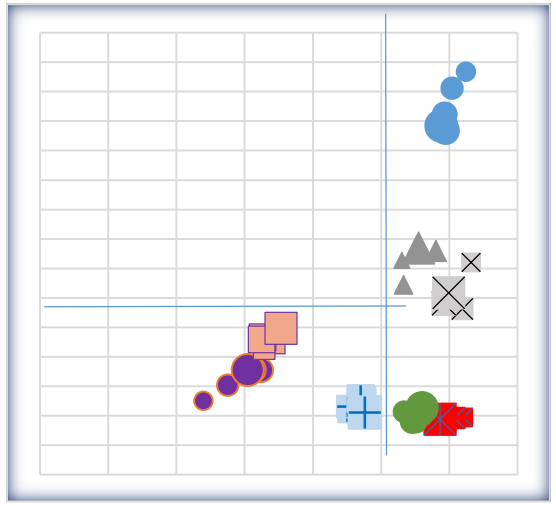

Financial input-output multipliers

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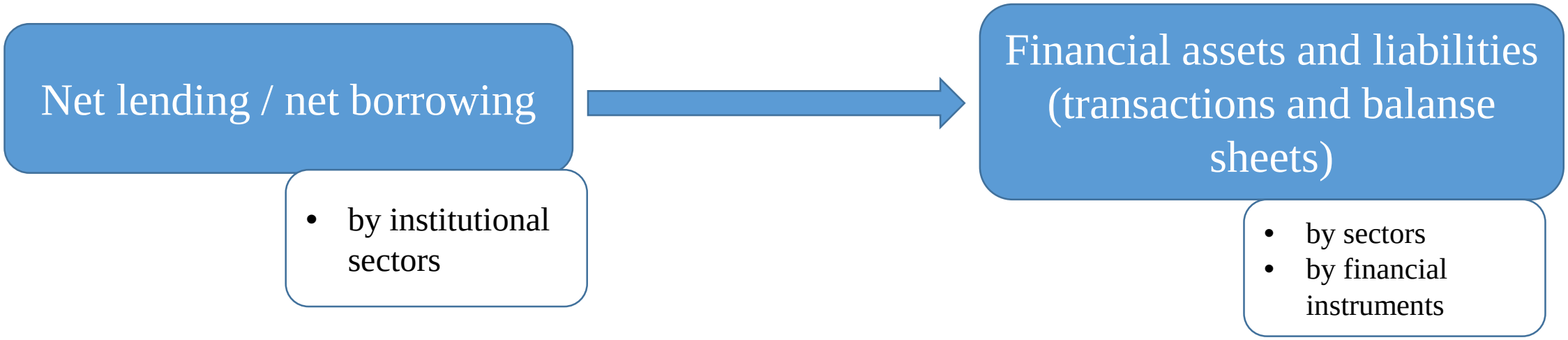
Aims

- Construction of financial input-output tables basing on liability and asset oriented systems of financial flows in SNA.
- Calculation of investment financing and money supply multipliers for selected years – tendencies and comparisons the Polish multipliers with the other EU countries' ones.
- Some possibilities of financial system's analysis using financial i/o multipliers (power of dispersion indices, sensitivity of dispersion and total dispersion indices).

Statistical data – SNA



Construction of the financial input-output tables - brief literature overview

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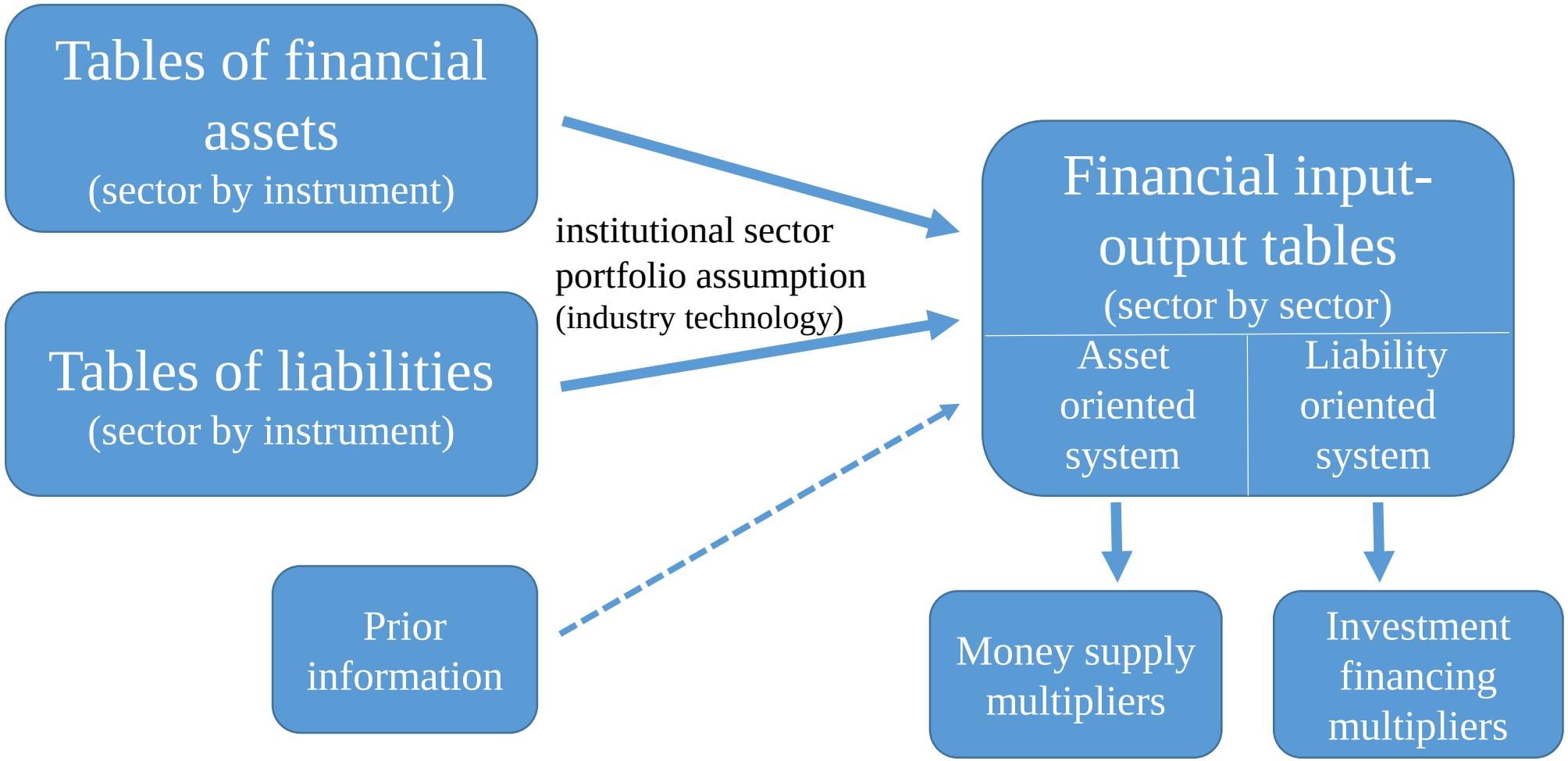
•Trębska J,. 2017, *Household savings in the financial intersectoral linkages*, Equillibrium (paper in press).

Intersectoral financial flows - construction of tables



Financial input-output table
(liability-oriented system)

sector / sector	j	$\sum e_{ij}$	ε_i	z_i
i	I $\mathbf{Y} = [y_{ij}]$ flows of funds from i-th to j-th sector	$\mathbf{e}^T$ i-th sector's lending	II $\boldsymbol{\varepsilon}^T$ the excess of liabilities over assets of i-th sector (if exists; 0 otherwise)	$\mathbf{z}^T$
$\sum_i r_{ij}$	$\mathbf{r}$ j-th sector's borrowing			
ρ_j	III $\boldsymbol{\rho}$ 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			

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	$\mathbf{r}^{\mathrm{T}}$ i-th sector's borrowing	$\boldsymbol{\rho}^{\mathrm{T}}$ the excess of assets over liabilities of i-th sector (if exists; 0 otherwise)	$\mathbf{z}^{\mathrm{T}}$
$\sum e_{ij}$	$\mathbf{e}$ 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			

Financial input-output table – balance equations
(liability-oriented system)

sector / sector	j	$\sum e_{ij}$	ε_i	z_i
i	$\mathbf{Y} = [y_{ij}]$ flows of funds from i-th to j-th sector	$\mathbf{e}^T$ i-th sector's lending	$\boldsymbol{\varepsilon}^T$ the excess of liabilities over assets of i-th sector (if exists; 0 otherwise)	$\mathbf{z}^T$
$\sum_i r_{ij}$	$\mathbf{r}$ j-th sector's borrowing			
ρ_j	$\boldsymbol{\rho}$ the excess of assets over liabilities of j-th sector (if exists; 0 otherwise)			
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$$\mathbf{C}\cdot\mathbf{z}+\boldsymbol{\varepsilon}=\mathbf{z} \quad , \quad \mathbf{C}=[c_{ij}] \quad , \quad c_{ij}=\frac{y_{ij}}{z_j}$$

0,21	0,16	0,13	0,17	0,10	0,13	0,02	0,09
0,17	0,15	0,31	0,03	0,01	0,33	0,21	0,17
0,02	0,01	0,02	0,02	0,00	0,02	0,01	0,01
0,03	0,02	0,03	0,05	0,01	0,05	0,00	0,03
0,05	0,02	0,04	0,08	0,03	0,03	0,00	0,03
0,09	0,05	0,07	0,11	0,03	0,08	0,01	0,04
0,13	0,42	0,09	0,21	0,75	0,03	0,00	0,08
0,30	0,15	0,32	0,34	0,07	0,33	0,12	0,00

Financial input-output table – balance equations
(liability-oriented system)

sector / sector	j	$\sum e_{ij}$	ε_i	z_i
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0,17	0,15	0,31	0,03	0,01	0,33	0,21	0,17
0,02	0,01	0,02	0,02	0,00	0,02	0,01	0,01
0,03	0,02	0,03	0,05	0,01	0,05	0,00	0,03
0,05	0,02	0,04	0,08	0,03	0,03	0,00	0,03
0,09	0,05	0,07	0,11	0,03	0,08	0,01	0,04
0,13	0,42	0,09	0,21	0,75	0,03	0,00	0,08
0,30	0,15	0,32	0,34	0,07	0,33	0,12	0,00

Financial input-output table – balance equations and multipliers
(liability-oriented system)

sector / sector	j	$\sum e_{ij}$	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)	$\mathbf{z}^{\mathrm{T}}$
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$$\mathbf{C}\cdot\mathbf{z}+\boldsymbol{\varepsilon}=\mathbf{z}$$

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

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

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

Financial input-output table - balance equations and multipliers
(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			

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

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

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

γ_{ij}^* - supply of funds directed to sector i induced by the unit increment in the j-th sector's supply

Investment financing i/o multipliers for Poland

$\Gamma=[\gamma_{ij}]$, $\Gamma=(\mathbf{I}-\mathbf{C})^{-1}$ γ_{ij} - demand for funds of sector *i* induced by the unit increment in the *j*-th sector's money demand for investment financing

2015

$\Gamma=$

1,670	0,534	0,582	0,586	0,389	0,608	0,206	0,324	Non-financial corporations
0,847	1,750	0,979	0,668	0,547	1,017	0,471	0,500	Monetary financial institutions
0,074	0,057	1,072	0,063	0,041	0,069	0,029	0,036	Other financial intermediaries
0,131	0,097	0,122	1,138	0,065	0,145	0,039	0,078	Investment funds
0,155	0,108	0,141	0,179	1,091	0,144	0,041	0,085	Insurance corp.and pension funds
0,293	0,209	0,265	0,296	0,149	1,279	0,089	0,142	General government
0,796	0,965	0,790	0,809	1,161	0,763	1,298	0,439	Households; NPISH
0,892	0,661	0,893	0,886	0,491	0,923	0,340	1,313	Rest of the world
4,858	4,381	4,844	4,625	3,935	4,948	2,514	2,917	

$\sum_i \gamma_{ij}$

Non-financial corporations
Monetary financial institutions
Other financial intermediaries
Investment funds
Insurance corp.and pension funds
General government
Households; NPISH
Rest of the world

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4,858	4,381	4,844	4,625	3,935	4,948	2,514	2,917	$\sum_i \gamma_{ij}$

Non-financial corporations | Monetary financial institutio | Other financial intermediarie | Investment funds | Insurance corp.and pensio | General government | Households; NPISH | Rest of the world

2010	4,972	4,652	4,912	4,576	3,976	4,962	2,716	2,739
2003	4,153	3,542	4,125	3,674	2,999	4,200	1,593	2,299

Investment financing i/o multipliers for selected EU countries (2015)

	Germany								
	1,966	0,671	0,816	0,966	0,458	0,798	0,241	0,835	Non-financial corporations
	1,860	2,744	2,285	1,715	1,022	2,134	0,713	2,011	Monetary financial institutions
	0,171	0,150	1,191	0,174	0,089	0,172	0,059	0,172	Other financial intermediaries
	0,349	0,290	0,341	1,388	0,166	0,419	0,094	0,384	Investment funds
$\Gamma =$	0,537	0,452	0,533	0,585	1,294	0,549	0,157	0,543	Insurance corp.and pension funds
	0,244	0,209	0,242	0,248	0,119	1,249	0,072	0,239	General government
	1,141	1,151	1,180	1,218	1,309	1,194	1,349	1,201	Households; NPISH
	1,432	1,340	1,565	1,465	0,751	1,776	0,453	2,218	Rest of the world
$\sum_i \gamma_{ij}$	7,698	7,007	8,153	7,759	5,208	8,290	3,138	7,602	
Poland	4,858	4,381	4,844	4,625	3,935	4,948	2,514	2,917	
Latvia	5,375	5,110	5,407	5,120	3,520	5,494	2,209	4,106	
Italy	4,496	4,144	3,207	4,119	3,115	4,697	1,869	3,636	

Money supply i/o multipliers for Poland

$\Gamma^* = [\gamma^*_{ij}], \quad \Gamma^* = (\mathbf{I} - \mathbf{C}^*)^{-1}$ γ_{ij}^* - supply of funds directed to sector *i* induced by the unit increment in the *j*-th sector's supply

2015

$\Gamma^* =$

1,670	1,233	1,152	1,273	1,276	0,636	1,323	1,301	Non-financial corporations
0,367	1,750	0,612	0,652	0,611	0,311	1,101	0,662	Monetary financial institutions
0,037	0,092	1,072	0,076	0,075	0,037	0,084	0,084	Other financial intermediaries
0,060	0,100	0,101	1,138	0,151	0,066	0,138	0,133	Investment funds
0,047	0,097	0,077	0,077	1,091	0,039	0,234	0,087	Insurance corp.and pension funds
0,280	0,683	0,492	0,650	0,548	1,279	0,584	0,620	General government
0,124	0,413	0,274	0,231	0,204	0,116	1,298	0,298	Households; NPISH
0,222	0,499	0,382	0,523	0,480	0,212	0,500	1,313	Rest of the world
2,808	4,865	4,161	4,620	4,436	2,697	5,263	4,497	

$\sum_i \gamma_{ij}^*$

Non-financial corporations
Monetary financial institutions
Other financial intermediaries
Investment funds
Insurance corp.and pension funds
General government
Households; NPISH
Rest of the world

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$\sum_i \gamma_{ij}^*$

Non-financial corporations
Monetary financial institutions
Other financial intermediaries
Investment funds
Insurance corp.and pension funds
General government
Households; NPISH
Rest of the world

Power of dispersion indices (w_p) and total dispersion indices (w) for Poland

w_p – the strength/power of particular sectors' impact on the financial system through their demand for funds

w – average of total multipliers for all sectors

2015

	Non-financial corporations	Monetary financial institutions	Other financial intermediaries	Investment funds	Insurance corp.and pension funds	General government	Households; NPISH	Rest of the world
$\sum_i \gamma_{ij}$	4,858	4,381	4,844	4,625	3,935	4,948	2,514	2,917
$w_p = \frac{\sum_i \gamma_{ij}}{w}$	1,177	1,061	1,174	1,120	0,953	1,199	0,609	0,707

$$w = \frac{1}{m}\sum_i \sum_j \gamma_{ij} = 4{,}128$$

2010	1,187	1,111	1,173	1,092	0,949	1,185	0,649	0,654
2003	1,250	1,066	1,241	1,105	0,902	1,264	0,479	0,692

Power of dispersion indices (w_p) and total dispersion indices (w) for selected EU countries (2015)

$$w_p = \frac{\sum_i \gamma_{ij}}{w}$$

$$w = \frac{1}{m}\sum_i \sum_j \gamma_{ij}$$

	Non-financial corporations	Monetary financial institutions	Other financial intermediaries	Investment funds	Insurance corp.and pension funds	General government	Households; NPISH	Rest of the world	
Poland	1,177	1,061	1,174	1,120	0,953	1,199	0,609	0,707	4,128
Germany	1,123	1,022	1,189	1,132	0,760	1,209	0,458	1,109	6,857
Latvia	1,183	1,125	1,190	1,127	0,775	1,209	0,486	0,904	4,542
Italy	1,228	1,132	0,876	1,125	0,851	1,283	0,511	0,993	3,660

Sensitivity of dispersion indices (w_s) for Poland in 2015

$$\sum_j \gamma_{ij} \qquad w_s = \frac{\sum_j \gamma_{ij}}{w}$$

w_s – particular sectors' reaction to the unit increment in the demand for funds of all sectors

4,899	1,187	Non-financial corporations
6,779	1,642	Monetary financial institutions
1,441	0,349	Other financial intermediaries
1,815	0,440	Investment funds
1,944	0,471	Insurance corp.and pension funds
2,723	0,660	General government
7,021	1,701	Households; NPISH
6,399	1,550	Rest of the world

$$w = \frac{1}{m}\sum_i \sum_j \gamma_{ij} \qquad 4{,}128$$

Sensitivity of dispersion indices (w_s) for selected EU countries in 2015

$$w_s = \frac{\sum_j \gamma_{ij}}{w}$$

Germany	Poland	Latvia	Italy	
0,984	1,187	0,924	0,914	Non-financial corporations
2,112	1,642	2,031	1,848	Monetary financial institutions
0,318	0,349	0,428	0,651	Other financial intermediaries
0,500	0,440	0,233	0,374	Investment funds
0,678	0,471	0,374	0,553	Insurance corp.and pension funds
0,383	0,660	0,505	0,394	General government
1,421	1,701	1,467	2,077	Households; NPISH
1,604	1,550	2,039	1,190	Rest of the world

Money supply i/o multipliers for Poland and power of dispersion indices

2015

$\Gamma^* =$

1,670	1,233	1,152	1,273	1,276	0,636	1,323	1,301	Non-financial corporations
0,367	1,750	0,612	0,652	0,611	0,311	1,101	0,662	Monetary financial institutions
0,037	0,092	1,072	0,076	0,075	0,037	0,084	0,084	Other financial intermediaries
0,060	0,100	0,101	1,138	0,151	0,066	0,138	0,133	Investment funds
0,047	0,097	0,077	0,077	1,091	0,039	0,234	0,087	Insurance corp.and pension funds
0,280	0,683	0,492	0,650	0,548	1,279	0,584	0,620	General government
0,124	0,413	0,274	0,231	0,204	0,116	1,298	0,298	Households; NPISH
0,222	0,499	0,382	0,523	0,480	0,212	0,500	1,313	Rest of the world

$\sum \gamma_{ij}^*$	2,808	4,865	4,161	4,620	4,436	2,697	5,263	4,497
w_p^*	0,674	1,167	0,998	1,108	1,064	0,647	1,263	1,079

$w =$ 4,168

Non-financial corporations
Monetary financial institutions
Other financial intermediaries
Investment funds
Insurance corp.and pension funds
General government
Households; NPISH
Rest of the world

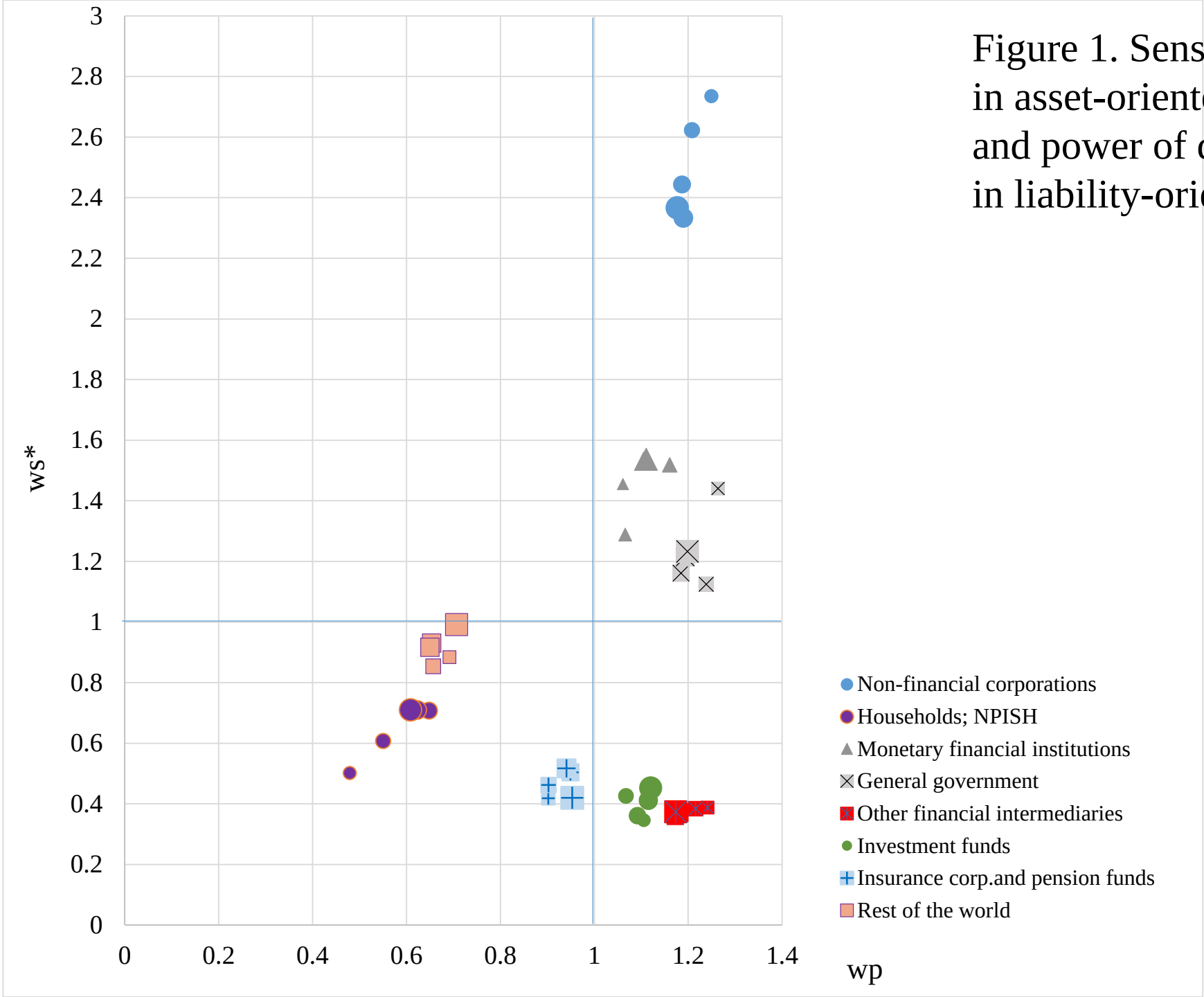

Figure 1. Sensitivity of dispersion index in asset-oriented system (w_s^*) and power of dispersion index in liability-oriented system (w_p)

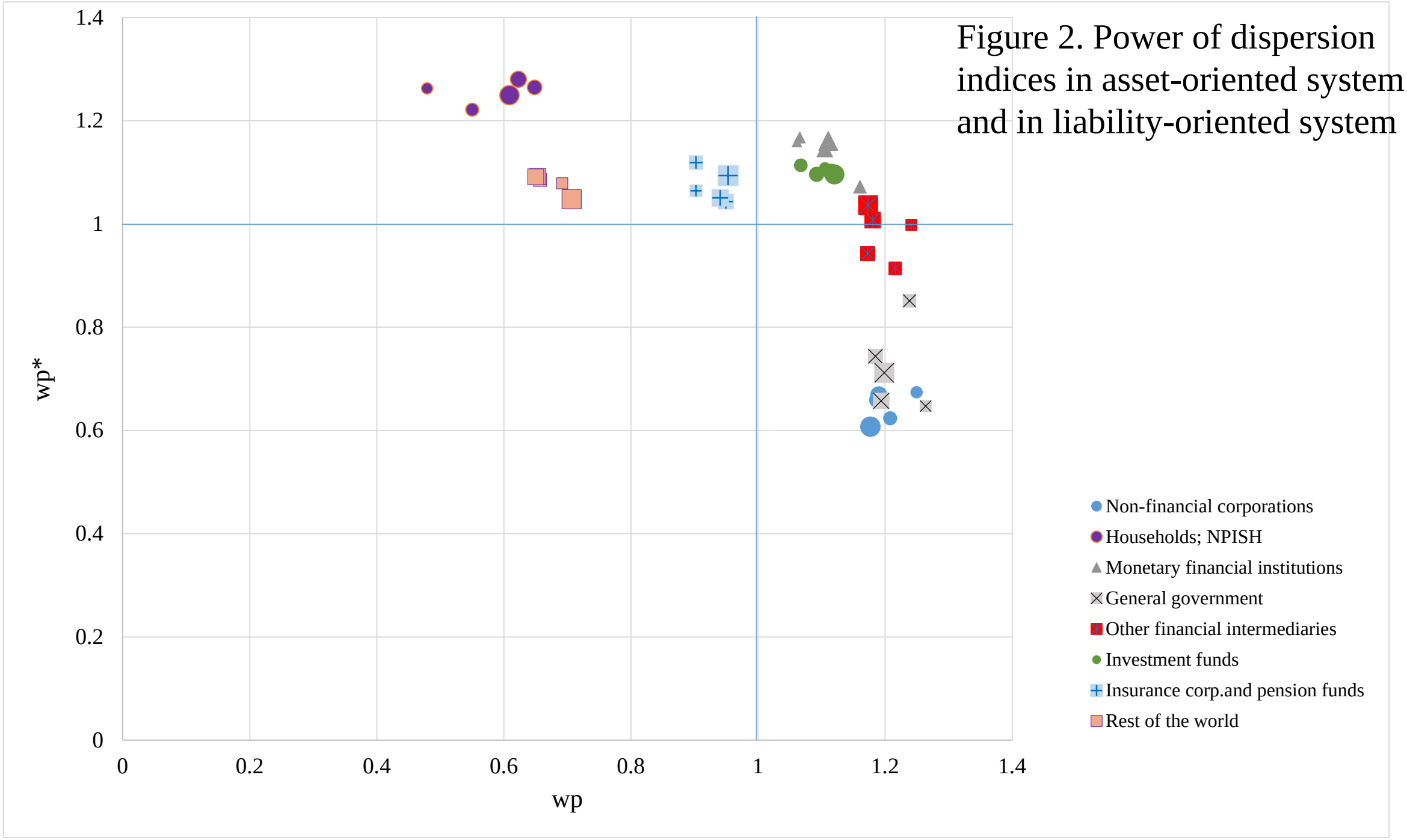

Figure 2. Power of dispersion indices in asset-oriented system (w_p^*) and in liability-oriented system (w_p)

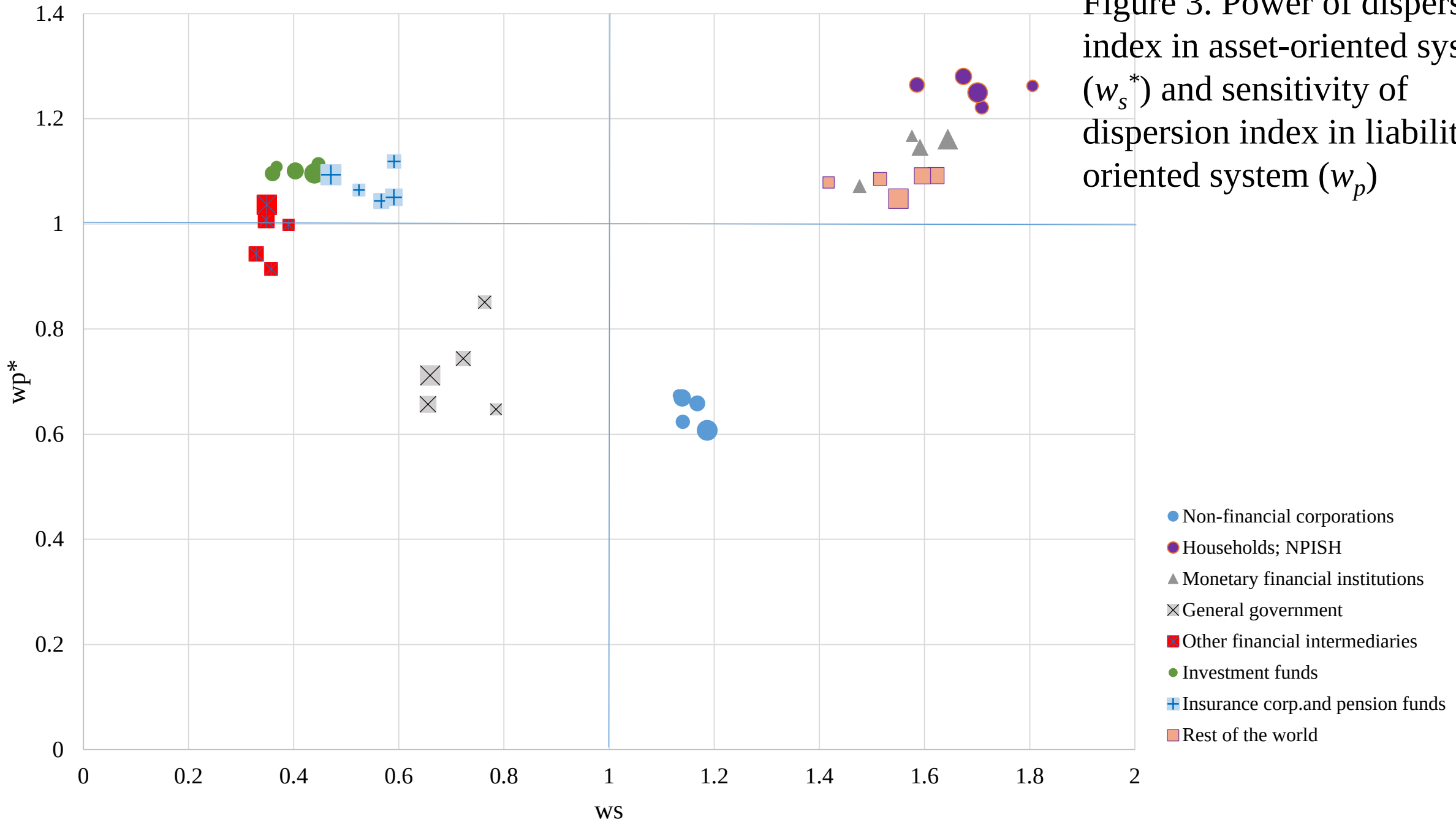

Figure 3. Power of dispersion index in asset-oriented system (w_s^*) and sensitivity of dispersion index in liability-oriented system (w_p)

Summary

I Methodology

- The input-output approach for the transformation of financial assets and liabilities by sectors and instruments into square matrices of flow of funds between institutional sectors was presented.
- Some of the analitical appliences of input-output methodology for identifying financial i/o multipliers on the basis of assets and liability orriented systems were shown.

Summary (cont.)

II Empirical results

- Financial multipliers of input-output models - investment financing (Γ) nad money supply (Γ^*) for Poland and selected UE countries were subjected to an examination.
- The changes of standarized multipliers are relatively small. It means that the changes of proportions in which particular sectors create the demand for money and supply the money are of a little importance. This is significant issue in the case of using financial i/o models for forcasting purposes.
- In general, multipliers for Poland are charecterized by increasing tendency – column sums of Γ and Γ^* matrices (comparing the years 2003, 2010, 2015);
- Multipliers for Poland (as well as for Latvia and Italy) are almost half lower than for Germany, what indicates more complex relationships in the financial system of Germany, resulting in more feedbacks, increasing the multiplier value.