Assessing economic impacts in a megacity: the case of Istanbul

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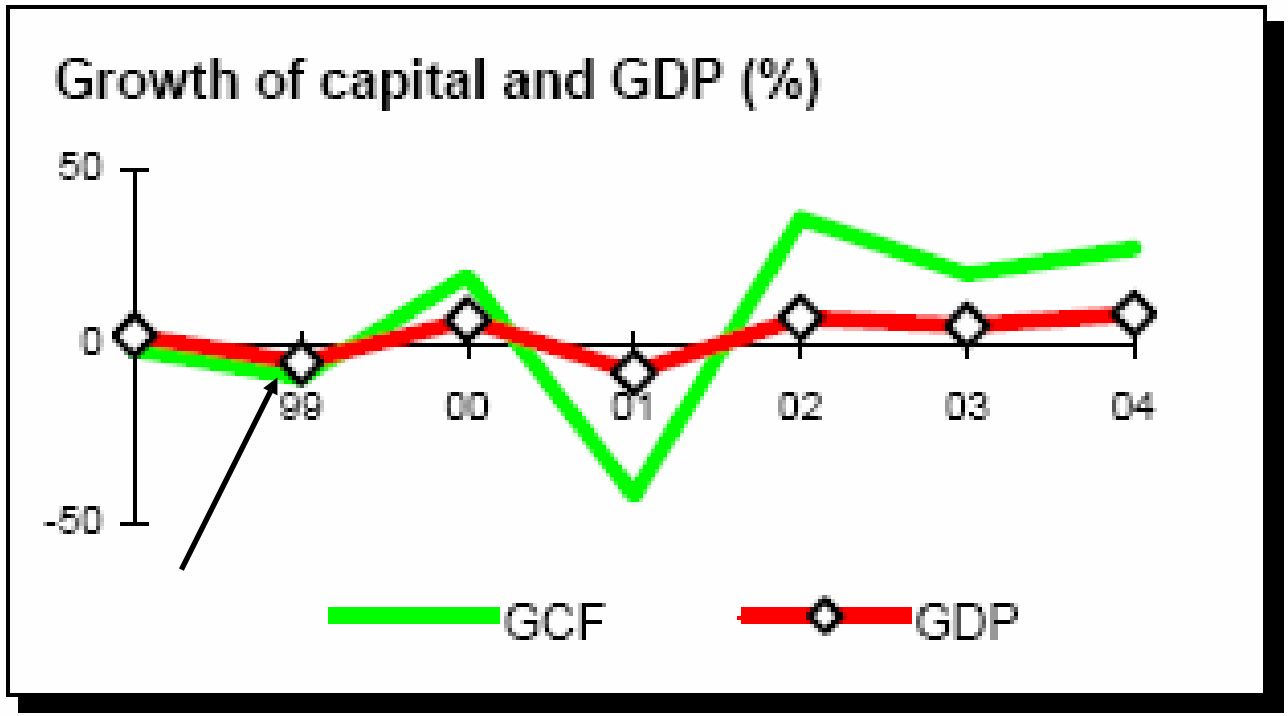
CEDIM-KOERI-IMM project

"Disaster Risk in the Megacity of Istanbul"

Economic effects and disasters

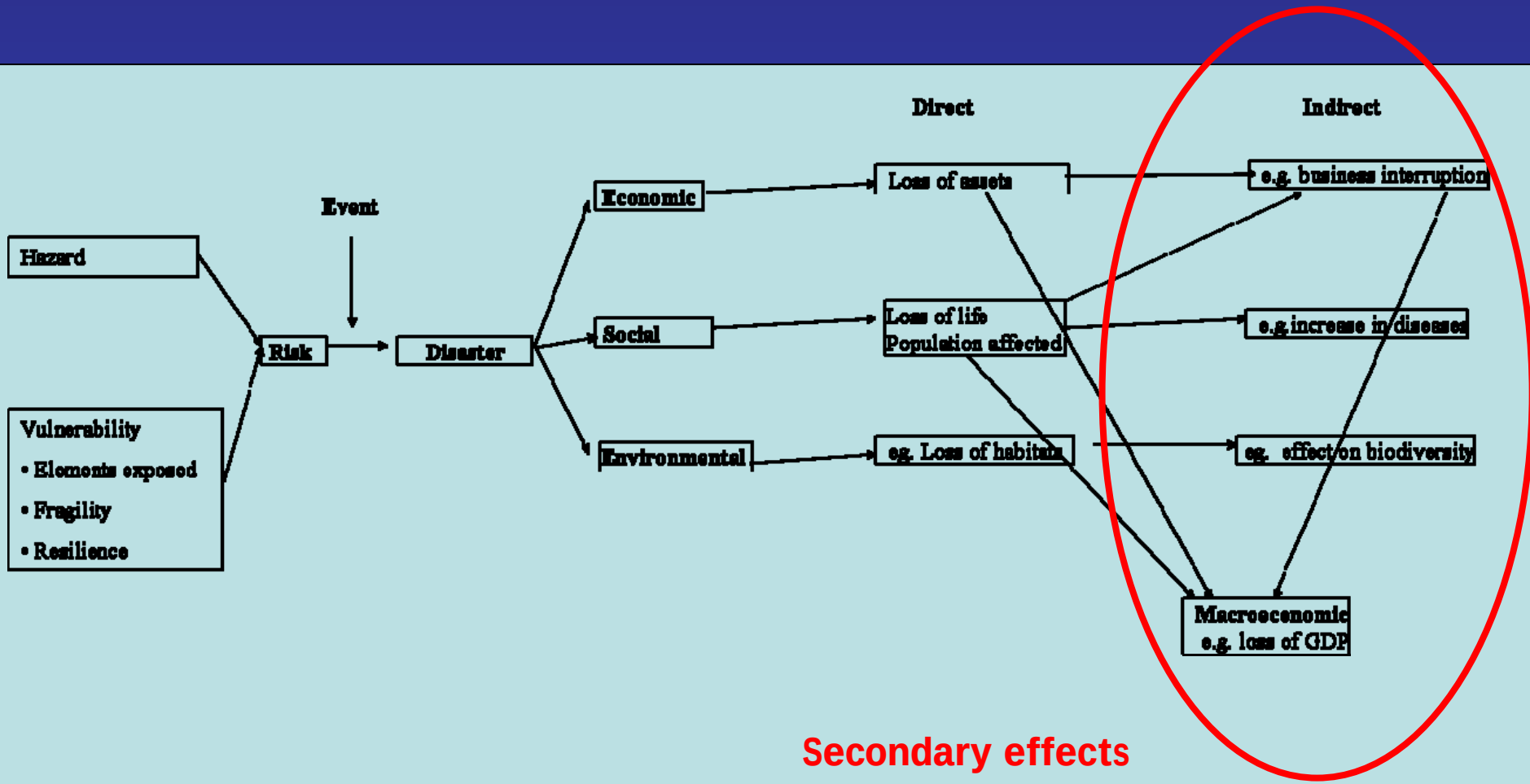
→ **Ceteris paribus analysis: isolate potential impacts**



Marmara EQs

Methodology

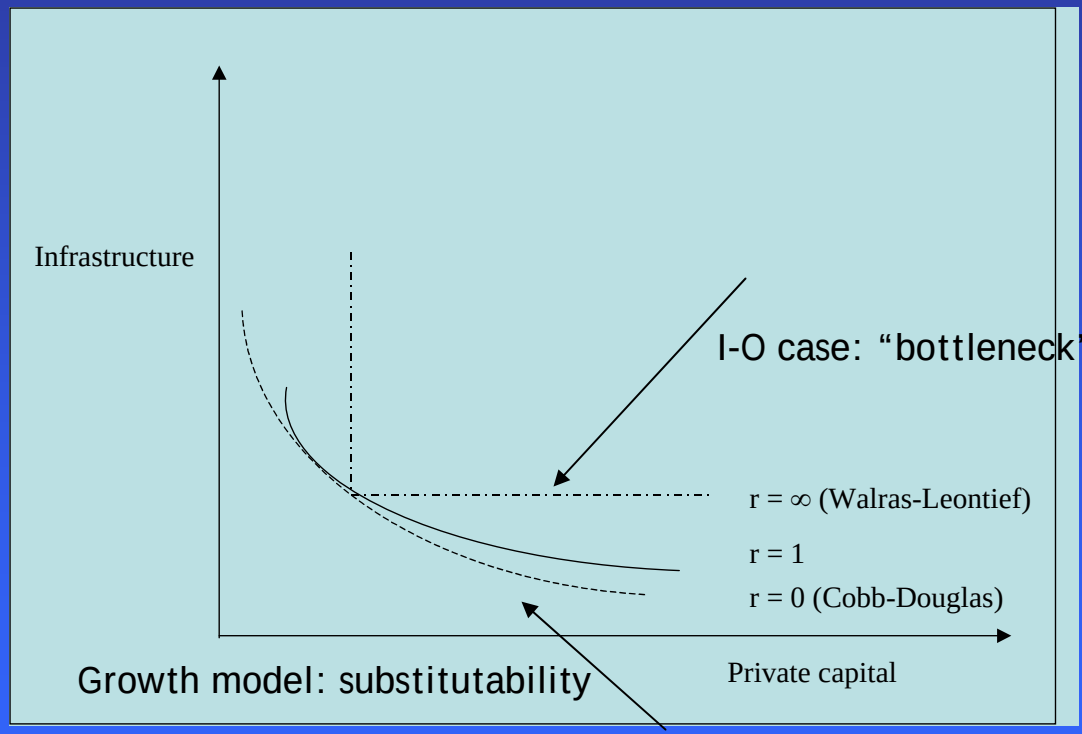
- Objective: to develop a method for assessing the totality of secondary damages due to earthquakes as a function of their timing during the next 30 years
- Combination of micro- and macroeconomic approaches
- Microeconomic approach:
  links up with seismological and engineering analyses of hazard, exposure and vulnerability and leads to impacts on individual units such as households and business.
- Macroeconomic approach:
  potential aggregate socioeconomic impacts to the municipality and province of Istanbul as well as the country


Direct
Indirect
Event
Hazard
Risk
Disaster
Economic
Social
Environmental
Loss of assets
Loss of life
Population affected
eg. Loss of habitats
e.g. business interruption
e.g.increase in diseases
eg. effect on biodiversity
Macroeconomic
e.g. loss of GDP
Vulnerability
• Elements exposed
• Fragility
• Resilience
Secondary effects

Macro analysis

Compare effects

- Growth framework: aggregate
- I-O analysis: sectoral



Hazard
Floods, earthquakes etc.

Elements at risk
Capital stock, population

Physical Vulnerability
Susceptibility to physical damage

Direct Risk
Potential asset losses
STEP 1

Financial Resilience

STEP 2

CATSIM

Financial vulnerability:
Potential financing gap
STEP 3

Risk Management

Development of risk management strategies

STEPS 5+6

Growth model

Macroeconomic risk
STEP 4

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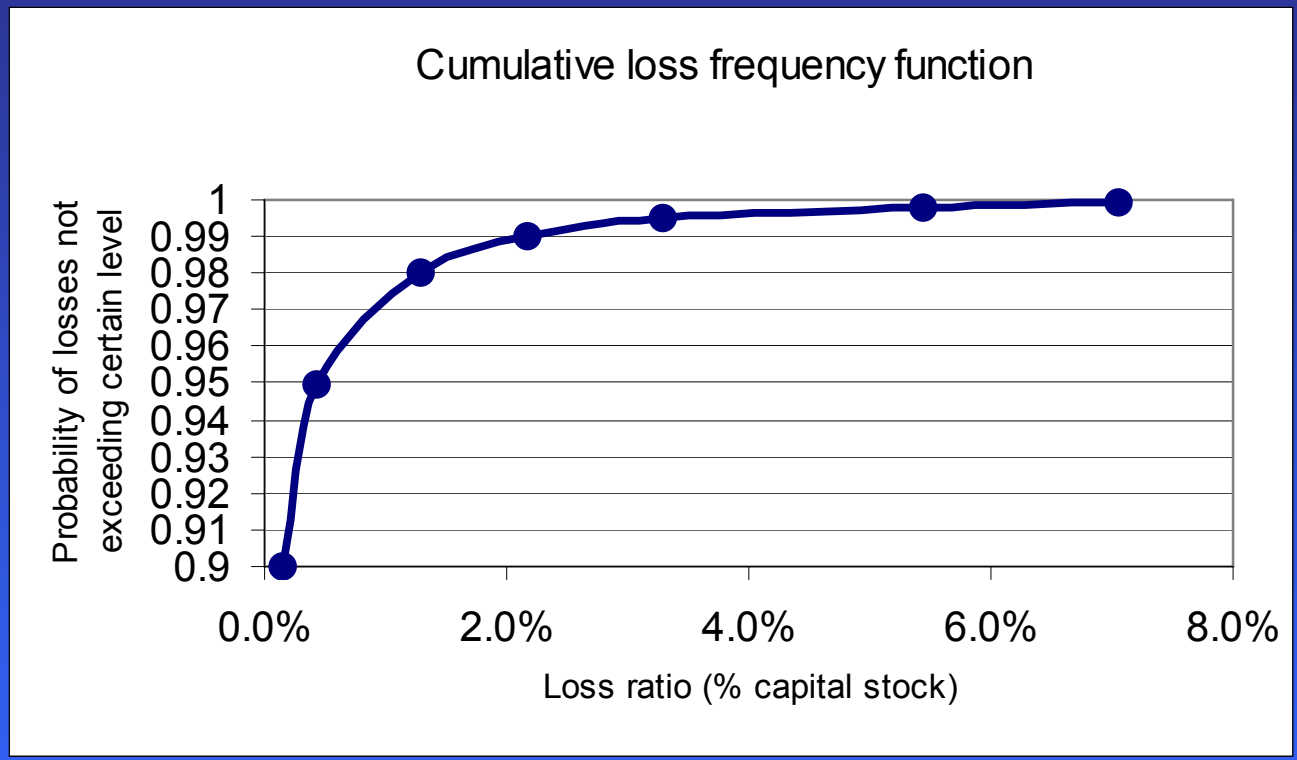
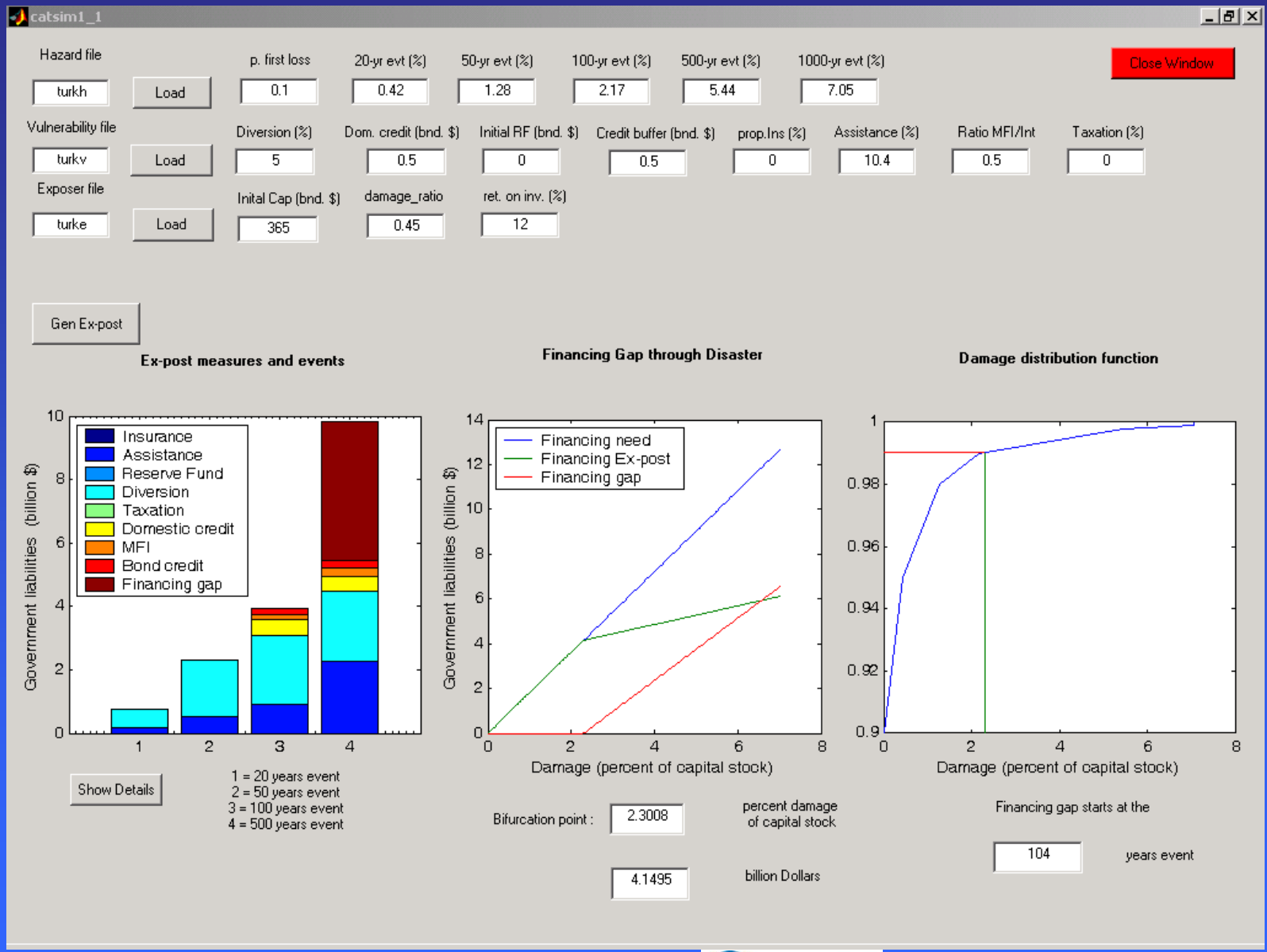
Input: direct risk to capital stock

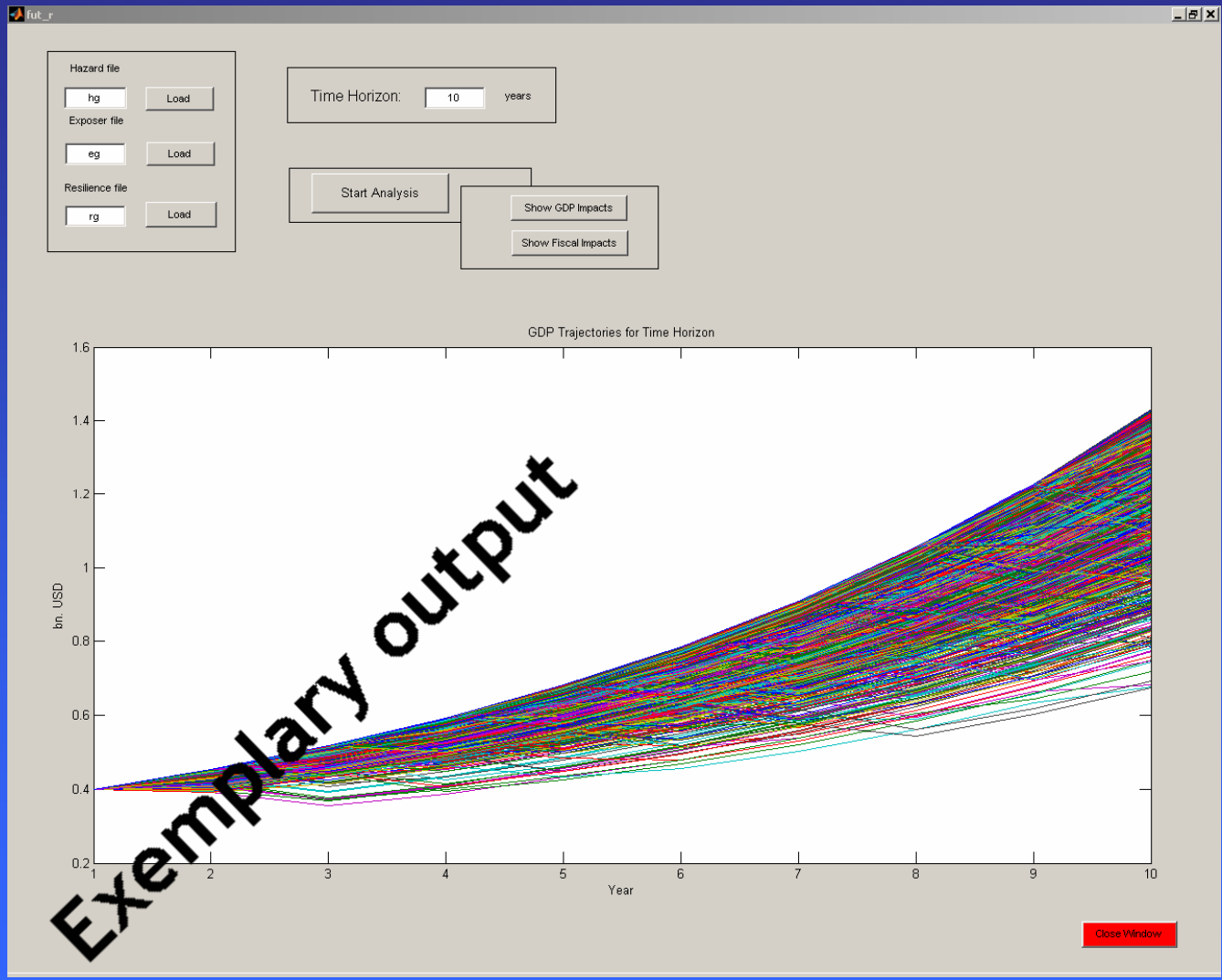


Capital stock: 365 billion USD
Gov. liabilities: 164 billion USD

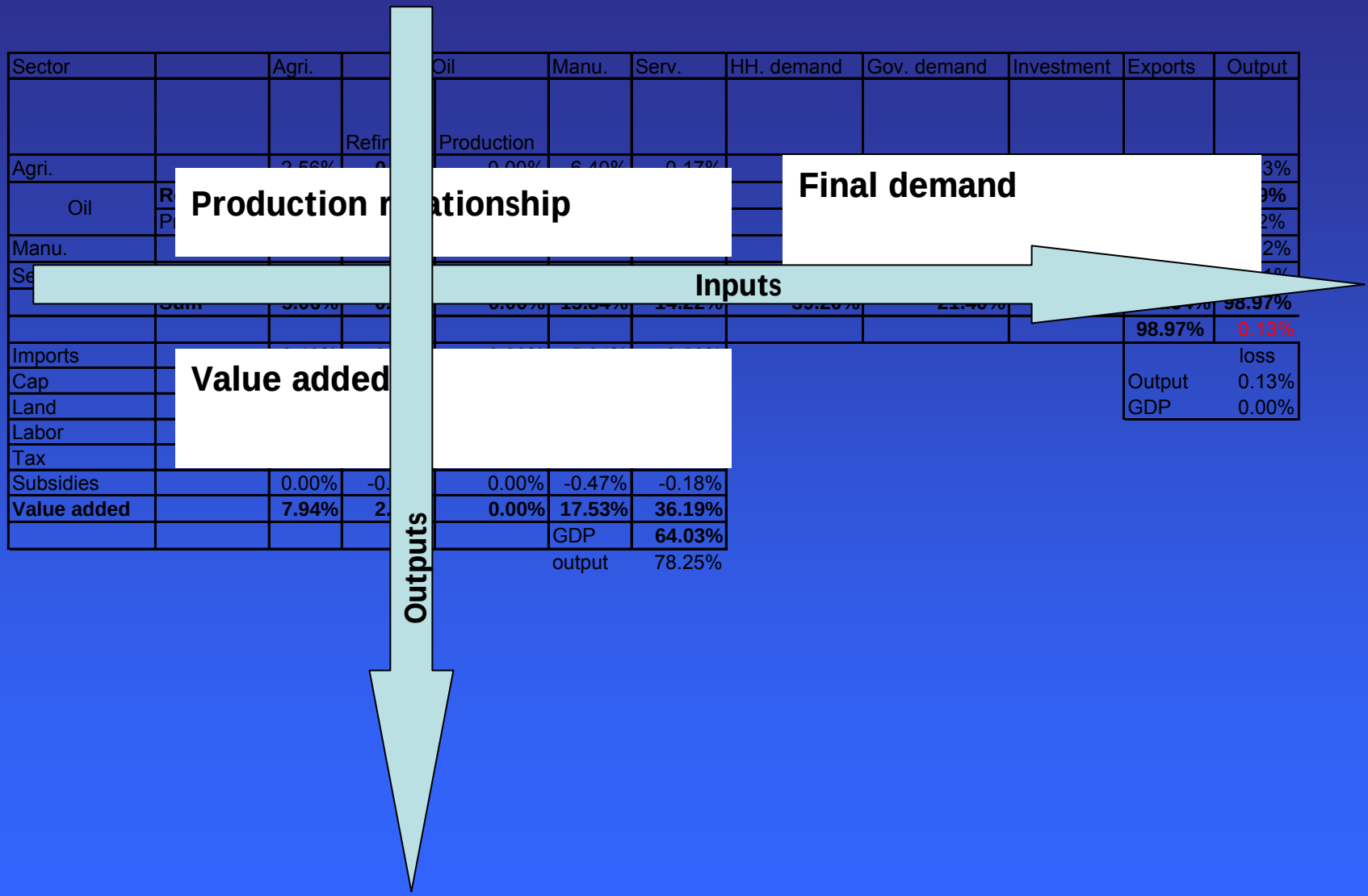
Direct losses and financial vulnerability



Assess macro risk: stochastic GDP impacts



I-O model



Sector		Agri.	Refin	Oil Production	Manu.	Serv.	HH. demand	Gov. demand	Investment	Exports	Output
Agri.											3%
Oil											9%
											2%
Manu.											2%
Se											1%
	Sum										98.97%
										98.97%	0.13%
Imports											loss
Cap										Output	0.13%
Land										GDP	0.00%
Labor											
Tax											
Subsidies		0.00%	-0.	0.00%	-0.47%	-0.18%					
Value added		**7.94%**	**2.**	**0.00%**	**17.53%**	**36.19%**					
					GDP	**64.03%**					
					output	78.25%					

I-O model

Loss of inputs by oil refinery sector…

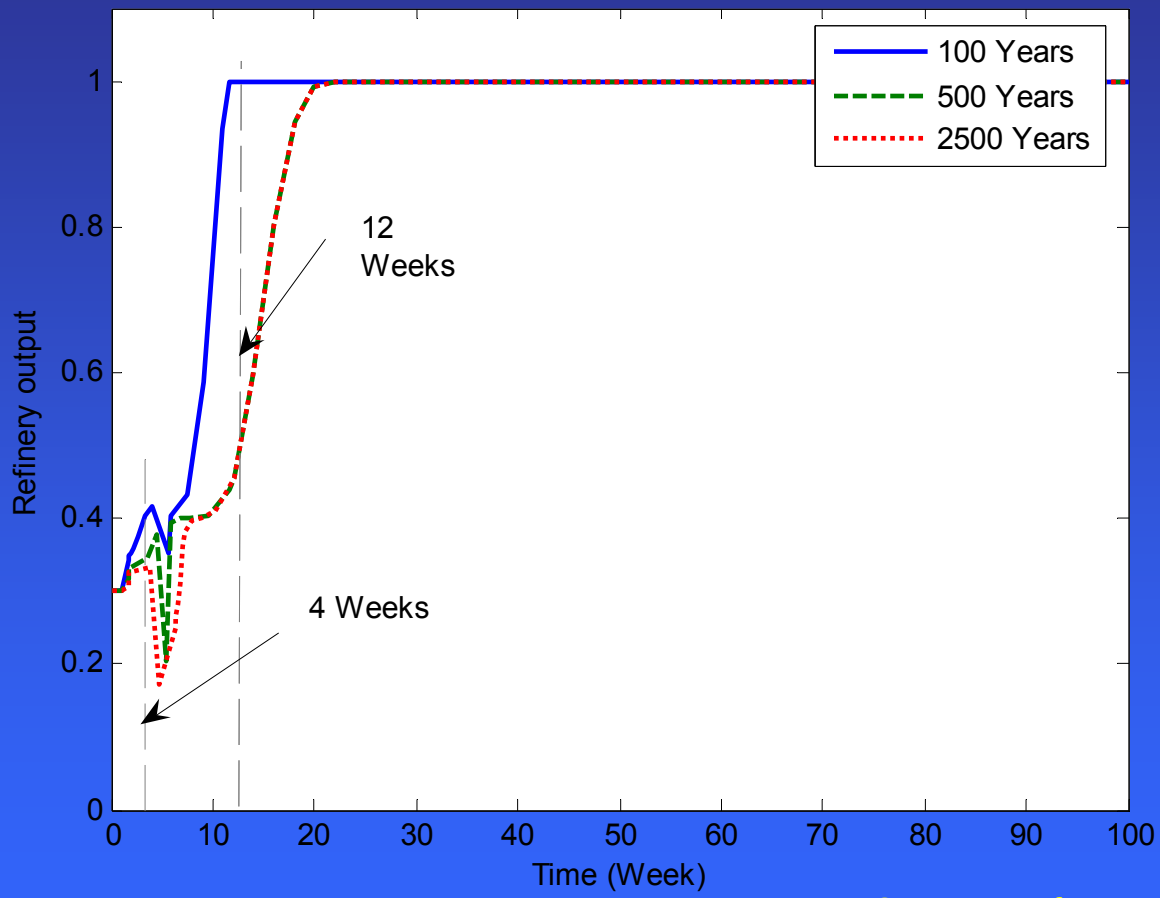
Sector		Agri.	Oil		Manu.	Serv.	HH. demand	Gov. demand	Investment	Exports	Output
			Refinery	Production							
Agri.		2.56%	**0.00%**	0.00%	6.40%	0.17%	3.26%	0.39%	0.00%	0.05%	12.83%
Oil	**Refinery**	**0.02%**	**0.00%**	**0.00%**	**0.37%**	**0.10%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.49%**
	Production	0.00%	**0.49%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.73%	2.22%
Manu.		1.31%	**0.06%**	0.00%	6.52%	8.87%	14.22%	1.58%	0.00%	0.76%	33.32%
Serv.		1.17%	**0.16%**	0.00%	2.55%	5.09%	21.72%	19.42%	0.00%	0.00%	50.11%
	Sum	**5.06%**	**0.72%**	**0.00%**	**15.84%**	**14.22%**	**39.20%**	**21.40%**		**2.54%**	**98.97%**
										98.97%	0.13%
Imports		0.12%	0.01%	0.00%	5.94%	0.00%					loss
Cap		1.05%	0.20%	0.00%	8.00%	24.59%				Output	0.13%
Land		3.34%	0.00%	0.00%	0.00%	0.00%				GDP	0.00%
Labor		3.42%	0.76%	0.00%	3.44%	10.78%					
Tax		0.00%	1.44%	0.00%	0.61%	0.99%					
Subsidies		0.00%	-0.02%	0.00%	-0.47%	-0.18%					
Value added		**7.94%**	**2.38%**	**0.00%**	**17.53%**	**36.19%**					
					GDP	**64.03%**					
					output	78.25%					

I-O model

…leads to changes in input/output relationships

Sector		Agri.	Oil		Manu.	Serv.	HH. demand	Gov. demand	Investment	Exports	Output
			Refinery	Production							
Agri.		2.31%	0.00%	0.00%	5.77%	0.15%	2.94%	0.35%	0.00%	0.04%	11.56%
Oil	**Refinery**	0.02%	0.00%	0.00%	0.37%	0.10%	0.00%	0.00%	0.00%	0.00%	**0.49%**
	Production	0.00%	0.49%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.56%	2.05%
Manu.		1.18%	0.06%	0.00%	5.87%	7.99%	12.81%	1.43%	0.00%	0.69%	30.02%
Serv.		1.05%	0.16%	0.00%	2.30%	4.58%	19.56%	17.50%	0.00%	0.00%	45.16%
	Sum	**4.56%**	**0.72%**	**0.00%**	**14.31%**	**12.82%**	**35.31%**	**19.28%**		**2.29%**	**89.27%**
										89.27%	9.92%
Imports		0.11%	0.01%	0.00%	5.35%	0.00%					loss
Cap		0.94%	0.18%	0.00%	7.20%	22.15%				Output	9.92%
Land		3.01%	0.00%	0.00%	0.00%	0.00%				GDP	9.92%
Labor		3.08%	0.68%	0.00%	3.10%	9.71%					
Tax		0.00%	1.29%	0.00%	0.55%	0.89%					
Subsidies		0.00%	-0.02%	0.00%	-0.42%	-0.16%					
Value added		**7.15%**	**2.14%**	**0.00%**	**15.79%**	**32.60%**					
					GDP	**57.68%**					
					output	70.50%					

Timing of effects



Courtesy of K. Nasserasadi

Potential results

Return period	Months	Direct losses	Indirect losses	indirect/ direct	macroeconomic losses
Unit		$	$	Ratio	$
100 years event	1	0.04	0.4	10.000	0.00
					51.26
	3		0.89	22.250	25.89
	12		0.89	22.250	0.00
	36		0.89	22.250	0.00
500 years event	1	0.11	0.4	3.636	0.00
					53.63
	3		1.16	10.545	40.15
	12		1.37	12.455	0.04
	36		1.37	12.455	0.00
2500 years event	1	0.3	0.4	1.333	0.00
					53.63
	3		1.16	3.867	40.15
	12		1.37	4.567	0.04
	36		1.37	4.567	0.00

Next steps

- Review of data and models calibration: Turkey and Istanbul province
- Probabilistic representation
- Uncertainty
- Link with micro analysis

Bottom-up approach: overview of the working packages of the micro-economic research part on indirect loss

-Defining basic scenarios with respect to the seismic hazard and direct loss thereof

-Analysis of the economic structure of Istanbul (branches and underlying characteristics of industrial production within the metropolitan area) and selection of a pilot sector for investigation

-Analysis of the processes of adding value of businesses as the nodes of a network model with their according attributes

-Development and implementation of the network model for the spreading of indirect losses

-Calculation of the model and evaluation

Basic conclusions drawn from the first two steps:

-seismic hazard, inventory of infrastructure, direct loss: remarkable work done so far (JICA report, Red Cross study, Earthquake Masterplan + follow ups)

-Seismic hazard: most probable scenario magnitude of 7.5

-Direct (economic) loss: casualties, building damage; furthermore works on business interruptions of medium to big size industry

-constant need for updated and more detailed data, to be received from the municipality

-our focus: „neglected“ part of economy – sector with high percentage of small size enterprises, labour-intensive, high socio-economic vulnerability -> textile

Analysis of processes of adding value:

-Output of businesses as a function of production technology used and demand side market:
output = f (employees, raw materials, public infrastructure, production facilities, demand side market)

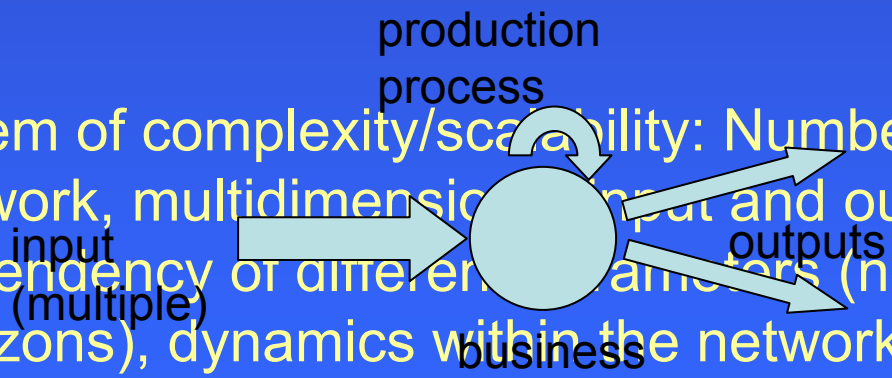
-need for data (primary and secondary) for SME of textile sector (chamber of textile SME): building of a set of production functions to be applied for different classes of businesses of this sector, characteristics of supply and demand side markets

-Disaster effects all parameters of the process of adding value as well as the referring markets – need for assumptions on resilience of each input factor: degree of availability as a function of time after an earthquake!

The development of a model of interlinked micro-economic units is the core of this research project.

-New approach needs for selecting suitable elements from models of different scientific disciplines: macro-economics (input/output, general computable equilibrium (GCE)), economics and social sciences (system dynamics), mathematics (theory of graphs and networks)

-Individual micro-economic units (companies) as nodes of a network, linked by (input and output) streams



-Problem of complexity/scalability: Number of nodes in the network, multidimensional input and output vectors, time-dependency of different parameters (need for certain time horizons), dynamics within the network

Last working package: calculation of the model and evaluation.

-Result: (Reduced) ratio of output of individual business units of the textile sector compared to the pre-disaster level, aggregation for this whole sector

-Consideration for certain points of time (disaster + one day, week, year)

-Comparison with results of macro-economic research team

-Evaluation with respect to losses of 1999 earthquake

-Improvements within the model

Excursion: Why microfinance for relief? Insights in the project of C. Menny

- Microfinance has been proven as an efficient way to give micro- and small enterprises (MSE) access to financial resources.
- Microfinance institutions are known for their strong ties with their clients → These networks might be of great value in chaotic scenarios.
- Expectation: faster economic recovery by using microfinance approaches

Procedure

- Exploring the demand for financial services among micro- and small enterprises
- Exploring the supply of financial services for micro- and small enterprises
- Exploring the potential impact of microfinance measures on micro- and small enterprises after a catastrophe
- Creating different scenarios for different types of earthquakes

Trip to Istanbul, June 19 – June 24

- Meetings with banks, NGOs, academics…
  - Very limited supply of financial products for micro businesses
  - some interest in microfinance
  - Lack of data, even the experts rely on "guessing"

Thank you very much for your attention!