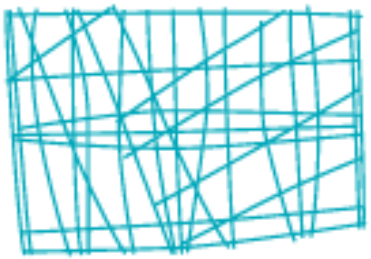


NEREUS

Núcleo de Economia Regional e Urbana
da Universidade de São Paulo

Regional Economic Impacts of Bombing on Lebanon

International Workshop on the Economic Impacts of Extreme Events

Sao Paulo, March 23, 2012

Eduardo Haddad

Outline

- ✓ Motivation
- The 2006 War
- Methodology
- Simulations
- Final remarks

Methodological experimentation with alternative approaches to assess the economic impacts of extreme events

Disasters impact analysis as an "inexact science" (Hewings and Mahidhara, 1996)

How does each model generally behave with the same damage data?

The more sophisticated regional impact models, the more precise numerical data are required (West and Lenze, 1994)

Challenge: *Rede CLIMA* and *INCT of Climate Change* seek appropriate responses for the economic impacts of extreme events

Why assessing the impacts of bombing on Lebanon?

Characteristics of the 2006 War: destruction of capital stocks (vital economic infrastructure as main targets)

Access to estimates of damage at the regional level (Council for Development and Reconstruction)

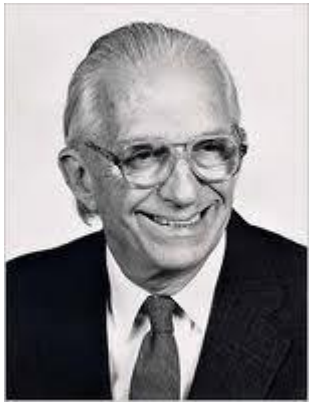
Small territory with localized bombing provides an opportunity to better understand resilience at the spatial level

Parallel project to develop the first fully operational interregional CGE model for Lebanon ("The ARZ Project")

Up to recently, the economic impacts of conflicts received relatively little attention from research communities

Interface of Regional Science and Peace Science

Interface of Regional Science and Peace Science: A Tribute to Walter Isard (1919-2010)



In 1963 Walter Isard assembled a group of scholars in Malmö, Sweden, for the purpose of establishing the Peace Research Society. In 1973, this group became the **Peace Science** Society. Like regional science, peace science was viewed as an interdisciplinary and international effort to develop a special set of concepts, techniques and data. In 1977 Isard stepped down as chair of the department of regional science at Penn in order to devote more time to peace science, and moved to Cornell University in 1979.

Source: http://en.wikipedia.org/wiki/Walter_Isard

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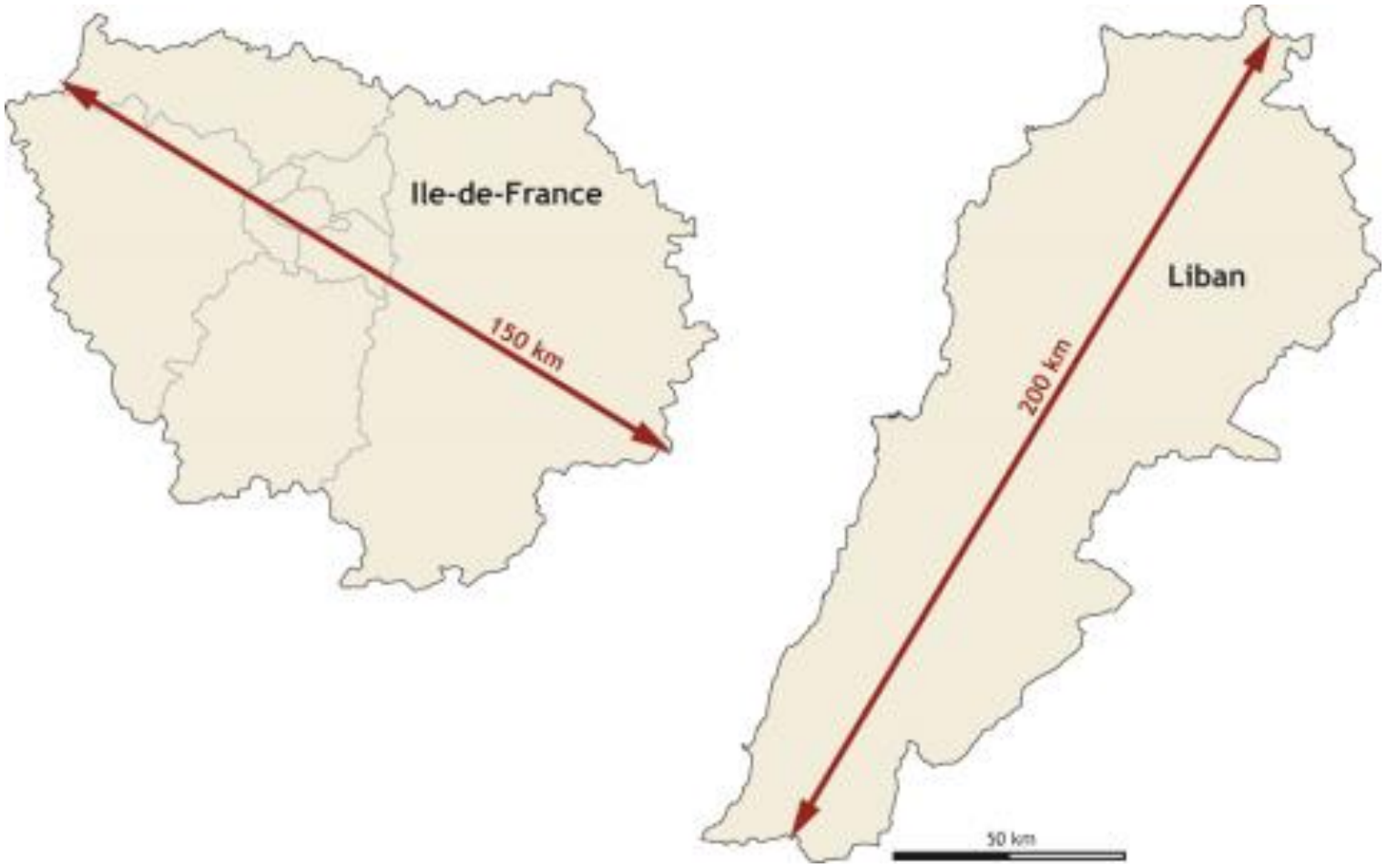
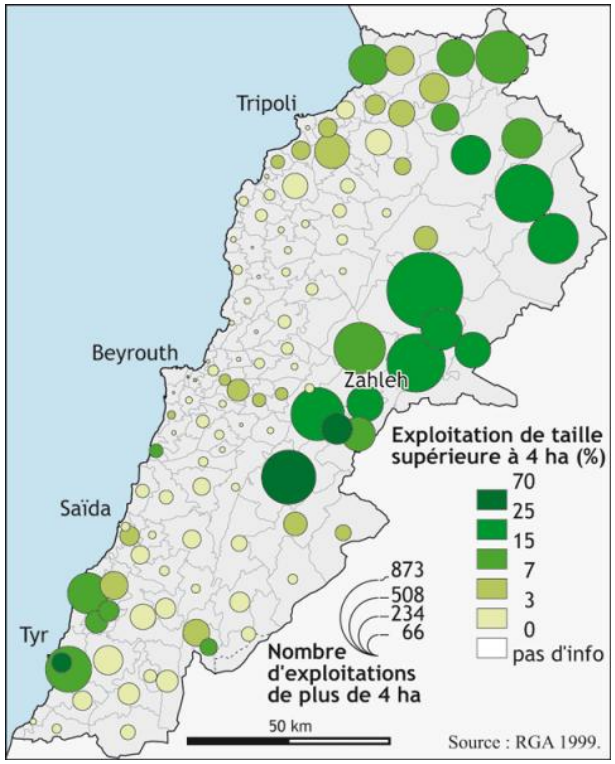
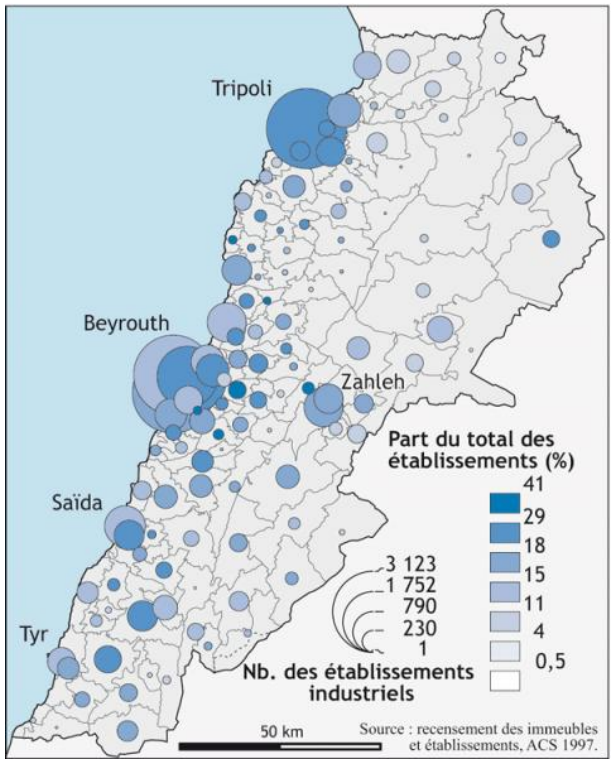
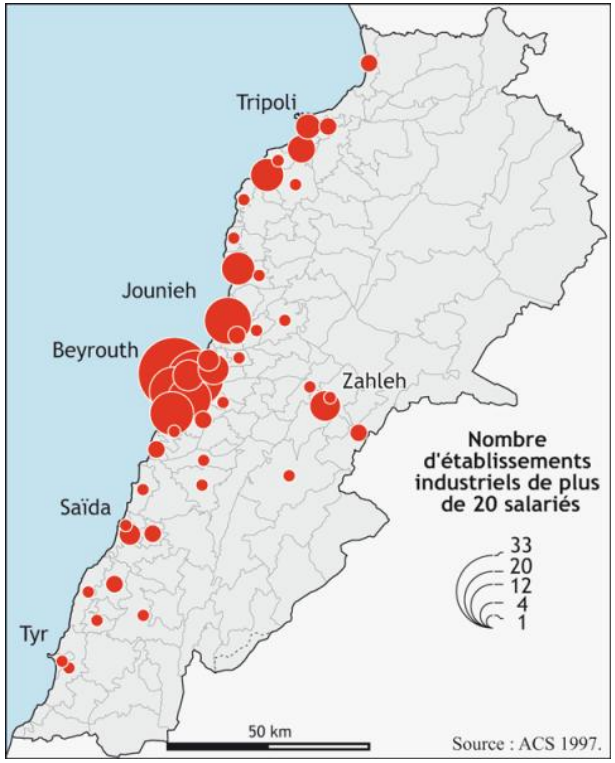
A small country…



Location patterns

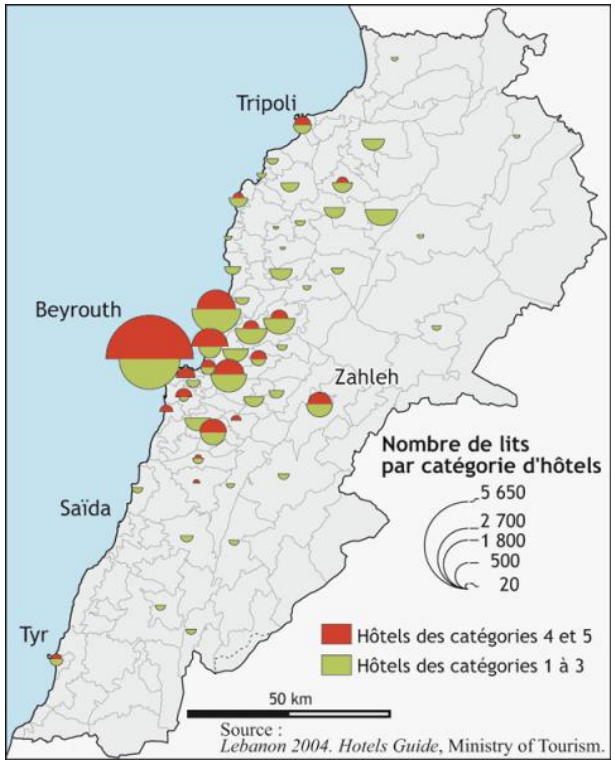


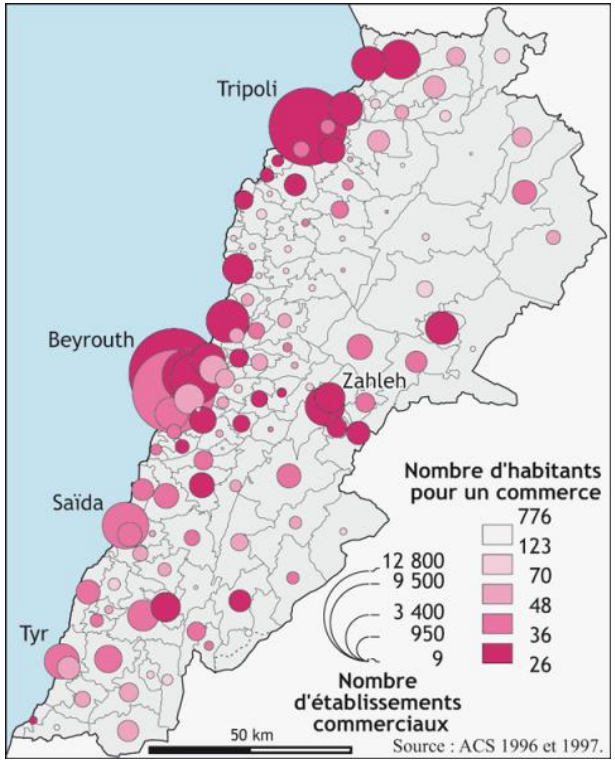


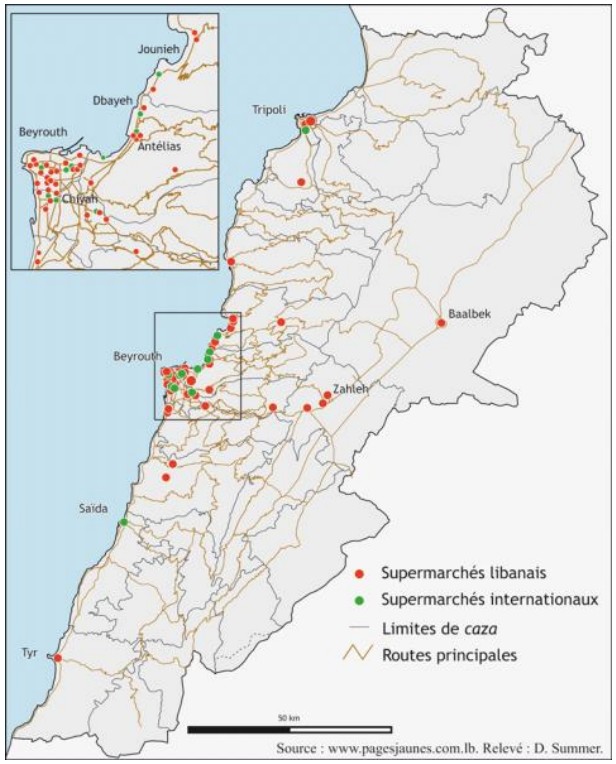


Atlas du Liban, *par Éric Verdeil, Ghaleb Faour et Sébastien Velut*

Location patterns







Atlas du Liban, *par Éric Verdeil, Ghaleb Faour et Sébastien Velut*

Regional setting and sectors in the ARZ model

SECTORS:

1. Agriculture and livestock
2. Energy and water
3. Manufacturing
4. Construction
5. Transport and communication
6. Other services
7. Trade
8. Administration

The 2006 War

The latest conflict between Israel and Lebanon, known in Lebanon as the July War, started on 12 July 2006 and continued until a UN-brokered cease-fire came into effect in 14 August 2006

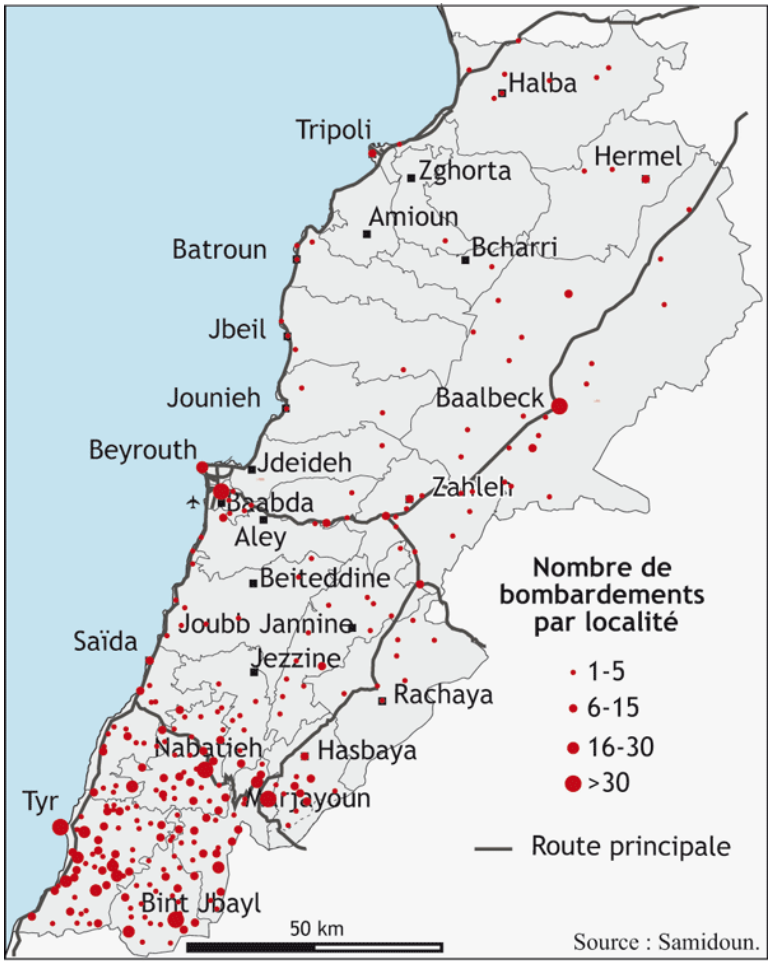
It caused an estimated USD 1.1 billion of **direct damage** to infrastructure

However, it generated also significant higher-order impacts not yet properly estimated

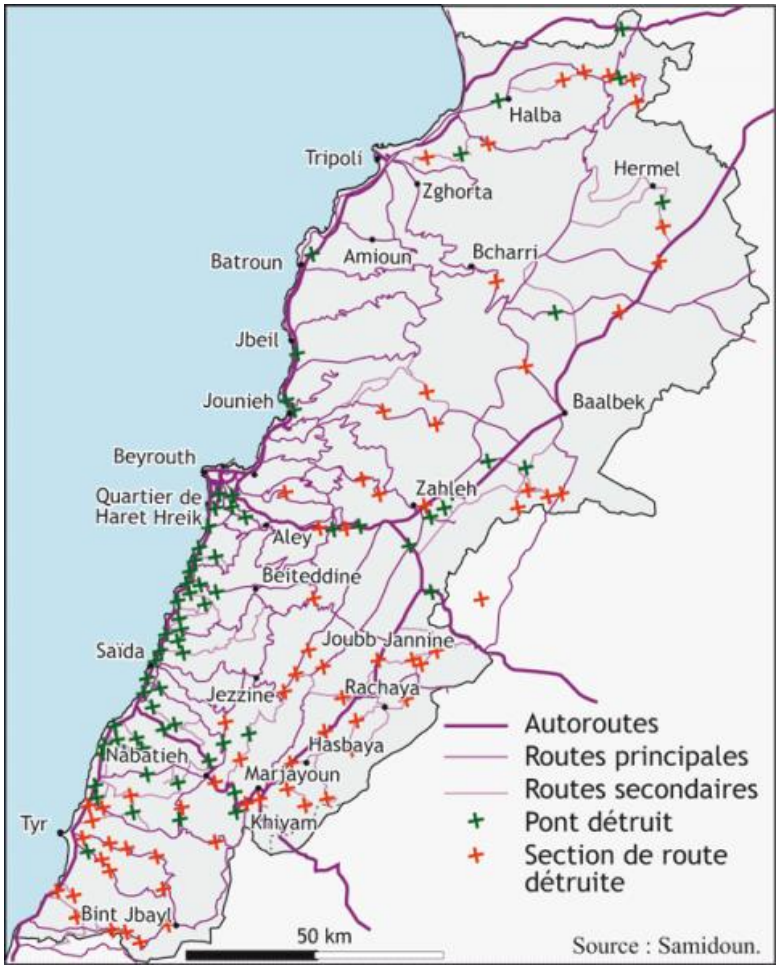
Not only direct economic damage took place, but also other severe impacts (e.g. human and social)

Our focus is on the higher-order economic impacts associated with direct damage

Locations bombed in July/August 2006



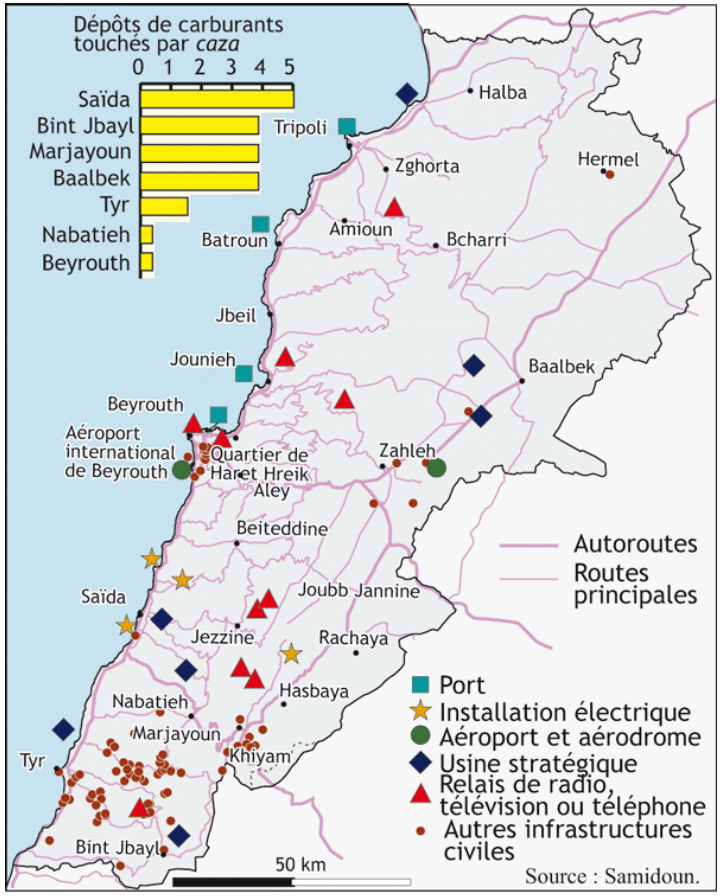
Localized disruption in infrastructure



« Dans le domaine des infrastructures de transport, le bilan des attaques touchant l'aéroport de Beyrouth et les ports peut être considéré comme relativement modéré et, dès que la situation politique l'a permis, le trafic aérien et maritime a repris. Plus sévères ont été les bombardements visant les infrastructures routières. 97 ponts ainsi que 630 km de routes et autoroutes ont été détruits. La circulation vers le Sud du pays (notamment l'autoroute récemment construite) et à travers la montagne a été rendue particulièrement difficile par ces bombardements. Plusieurs points de passage vers la Syrie ont aussi été visés. »

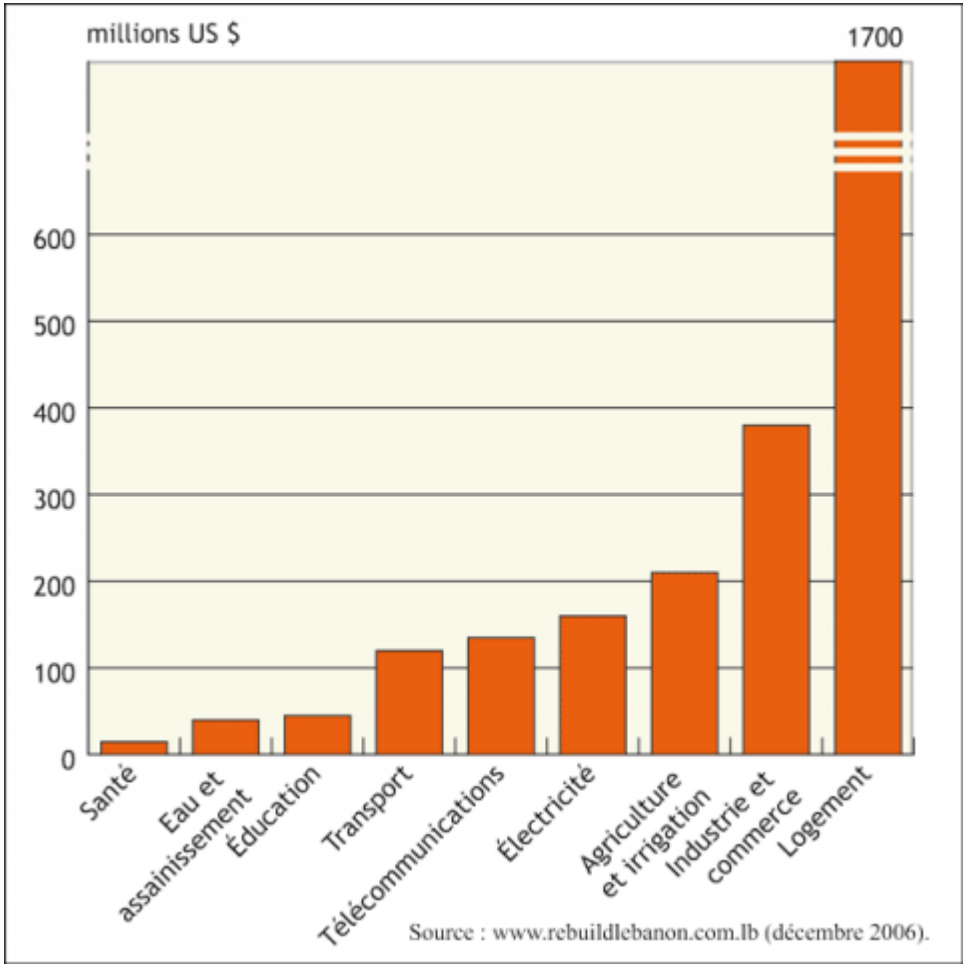
Atlas du Liban, par Éric Verdeil, Ghaleb Faour et Sébastien Velut

Other infrastructure affected during July/August 2006 (other than roads)



Source : d'après maps.samidoun.org, cartes elles-mêmes fondées sur des sources gouvernementales (Comité du Haut Secours, CDR).

Direct economic loss



« Les pertes économiques directes, dues aux destructions, sont évaluées par le gouvernement à 2,8 milliards de dollars, dont 1,7 milliard sont liés aux destructions d'immeubles résidentiels. Les deux autres secteurs qui ont enregistré les pertes directes les plus importantes sont l'industrie et le commerce, ainsi que l'agriculture et l'irrigation. »

Atlas du Liban, par Éric Verdeil, Ghaleb Faour et Sébastien Velut

Source of data: ***Rebuild Lebanon***

http://www.rebuildlebanon.gov.lb/english/f/default.asp

Outline

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The ARZ project

ARZ: the first fully operational interregional computable general equilibrium model for Lebanon designed for policy analysis. It uses a similar approach to Haddad and Hewings (2005) to incorporate recent theoretical developments in the new economic geography. Experimentation with the introduction of scale economies, market imperfections, and trade costs provide ways of dealing explicitly with theoretical issues related to integrated regional systems

Agents' behavior is modeled at the regional level, accommodating variations in the structure of regional economies

The ARZ project

Regarding the regional setting, the main innovation in the ARZ model is the detailed treatment of interregional trade flows in the Lebanese economy, in which the markets of regional flows are fully specified for each origin and destination

The model recognizes the economies of the 6 Lebanese regions (including the capital city, Beirut)

Results are based on a bottom-up approach – i.e. national results are obtained from the aggregation of regional results

The model identifies 8 production/investment sectors in each region producing 8 commodities, one representative household in each region, government demand in each region, and a single foreign area that trades with each domestic region

The ARZ project

The model is structurally calibrated for 2004-2005; a rather complete data set is available for that year for the estimation of the interregional input-output database (**under conditions of limited information**), facilitating the choice of the base year

The ARZ framework includes explicitly some important elements from an interregional system, needed to better understand macro spatial phenomena, namely: (estimated) interregional flows of goods and services, trade costs based on origin-destination pairs, interregional movement of primary factors, regionalization of the transactions of the public sector, regional labor markets segmentation, **estimates of regional-sectoral capital stocks**

The ARZ model was developed at the Regional and Urban Economics Lab at the University of Sao Paulo (NEREUS), Brazil

Limited information

Given the renewed interest by economists on regional issues, there is a need for the development of regional and interregional models for bringing new insights into the process of regional planning in the country

We do recognize that, at this stage, there are still data limitations

But do you wait until the data have improved sufficiently, or do you start with existing data, no matter how imperfect, and improve the database gradually?

In this project, we have opted for the second alternative

National input-output data, in basic prices

Economic Accounts of Lebanon 2009

- Goods and services input-output tables in current prices (territorial concept, no secondary production)
- Purchaser's prices

Working assumptions:

- Same import coefficients across all the users, by product
- Margins rates proportional to basic flows and do not vary across users (only by product)

Input-output table for Lebanon, 2005 (billion LBP)

		Intermediate uses								Final uses					TOTAL
		1	2	3	4	5	6	7	8	Final consumption	GFCF	Exports	Change in inventories	(-) Duty	
BAS DOM	1. Agriculture and livestock	94,0	0,0	710,2	1,1	0,0	1,7	0,0	0,0	1236,4	11,3	191,3	-40,0		2206,0
	2. Energy and water	5,4	337,9	143,5	5,9	268,5	100,6	40,3	20,6	420,0	0,0	2,3	0,0		1345,0
	3. Manufacturing	104,4	47,5	1322,2	677,6	8,2	269,9	114,9	55,4	4519,4	847,1	1347,3	-51,0		9263,0
	4. Construction	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5030,0	0,0	0,0		5030,0
	5. Transport and communication	5,0	9,0	84,0	26,0	697,0	758,0	358,0	23,0	2907,0	0,0	203,0	0,0		5070,0
	6. Other services	58,0	31,0	413,0	371,0	199,0	355,0	697,0	1371,0	9851,0	0,0	441,0	0,0		13787,0
	7. Trade	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	917,0	0,0		917,0
	8. Administration	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5029,0	0,0	0,0	0,0		5029,0
BAS IMP	1. Agriculture and livestock	39,8	0,0	301,0	0,5	0,0	0,7	0,0	0,0	524,1	4,8	81,1	0,0	-101,0	952,0
	2. Energy and water	15,8	989,3	420,2	17,2	786,1	294,5	118,1	60,4	1229,6	0,0	6,9	0,0	-729,0	3938,0
	3. Manufacturing	127,7	58,1	1616,7	828,5	10,1	330,0	140,5	67,7	5526,3	1035,9	1647,4	0,0	-1812,0	11389,0
	4. Construction	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	5. Transport and communication	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	6. Other services	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	7. Trade	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	8. Administration	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
MAR DOM	1. Agriculture and livestock	23,3	0,0	176,1	0,3	0,0	0,4	0,0	0,0	306,6	2,8	47,4	0,0		556,9
	2. Energy and water	0,5	29,0	12,3	0,5	23,0	8,6	3,5	1,8	36,0	0,0	0,2	0,0		115,3
	3. Manufacturing	21,1	9,6	266,8	136,7	1,7	54,5	23,2	11,2	912,1	171,0	271,9	0,0		1879,6
	4. Construction	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	5. Transport and communication	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	6. Other services	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	7. Trade	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	8. Administration	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
MAR IMP	1. Agriculture and livestock	9,9	0,0	74,6	0,1	0,0	0,2	0,0	0,0	130,0	1,2	20,1	0,0		236,1
	2. Energy and water	1,4	84,8	36,0	1,5	67,4	25,3	10,1	5,2	105,4	0,0	0,6	0,0		337,7
	3. Manufacturing	25,8	11,7	326,3	167,2	2,0	66,6	28,4	13,7	1115,2	209,0	332,5	0,0		2298,4
	4. Construction	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	5. Transport and communication	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	6. Other services	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	7. Trade	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
	8. Administration	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0
VA	Value added	1675,0	-263,0	3359,0	2797,0	3007,0	11521,0	7450,0	3399,0						32945,0
GO	Output	2207,0	1345,0	9262,0	5031,0	5070,0	13787,0	8984,0	5029,0	33848,0	7313,0	5510,0	-91,0	-2642,0	97295,0

Regional accounts

Regional aggregates

- Consumption (labor force and mean annual salary, 2004-05)
- Investment (employment in construction, 2004)
- Government (labor force in public sector, 2004)
- Exports (50% national export coefficient + 50% LQ)
- Imports (same as national shares)
- Interregional trade (gravity specification)

Trade matrices

Regional gross output by product

- Employment shares and “Electricité du Liban”

Regional exports

- Regional accounts

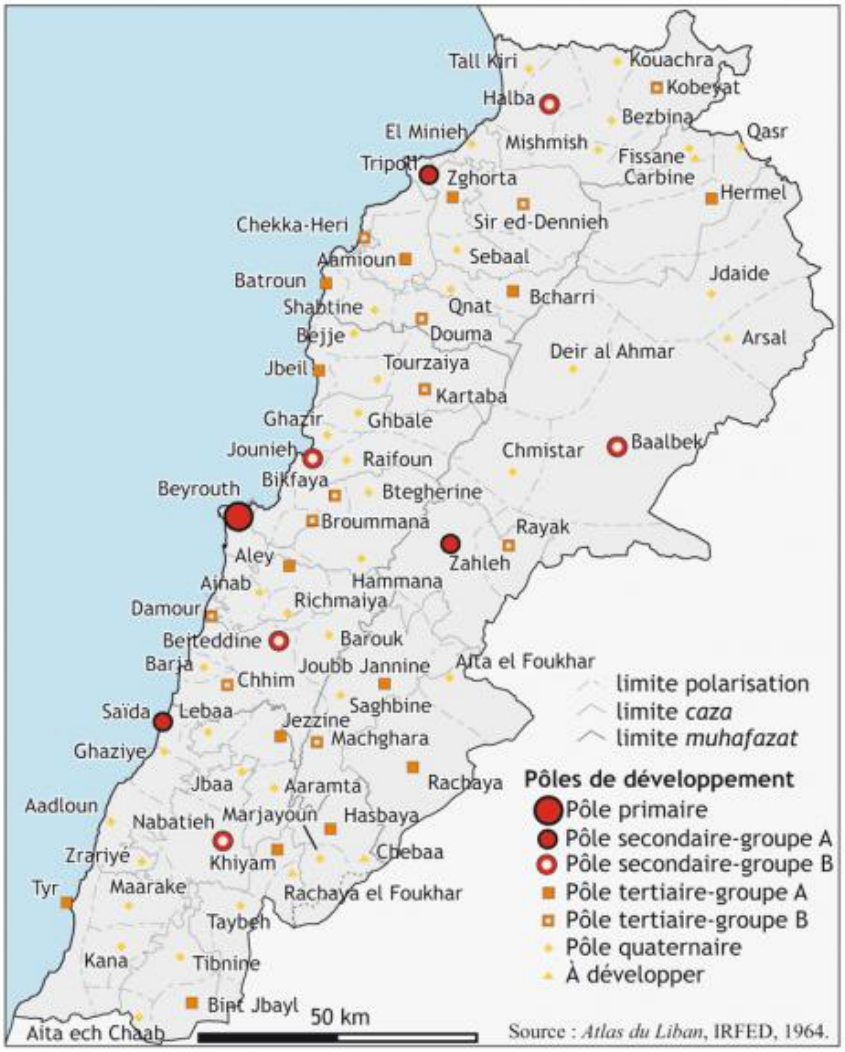
Demand by domestic and imported goods

- National structure applied for regions

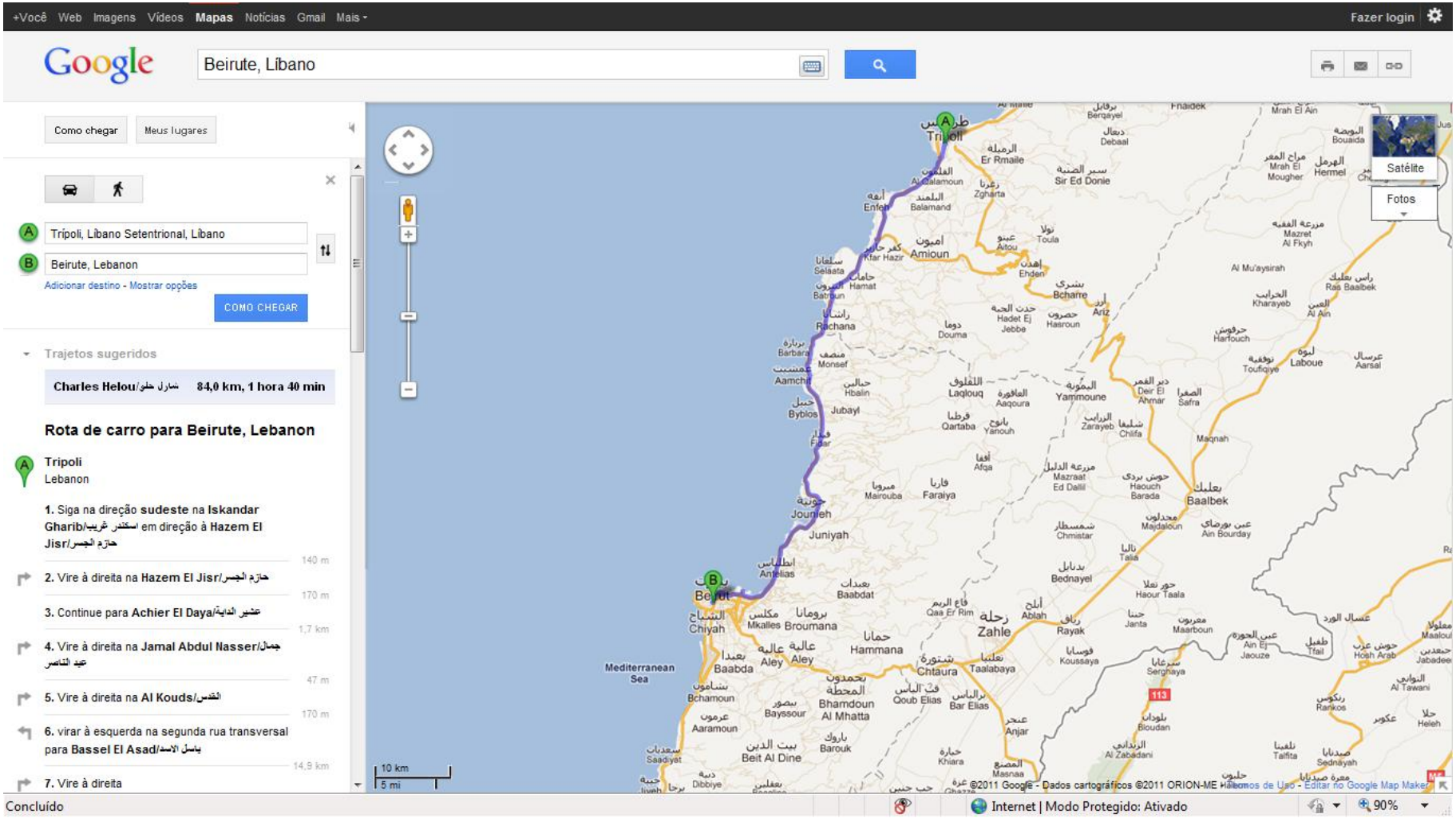
Gravity approach

- Matrix of distances (Google maps) + “Horridge formula”

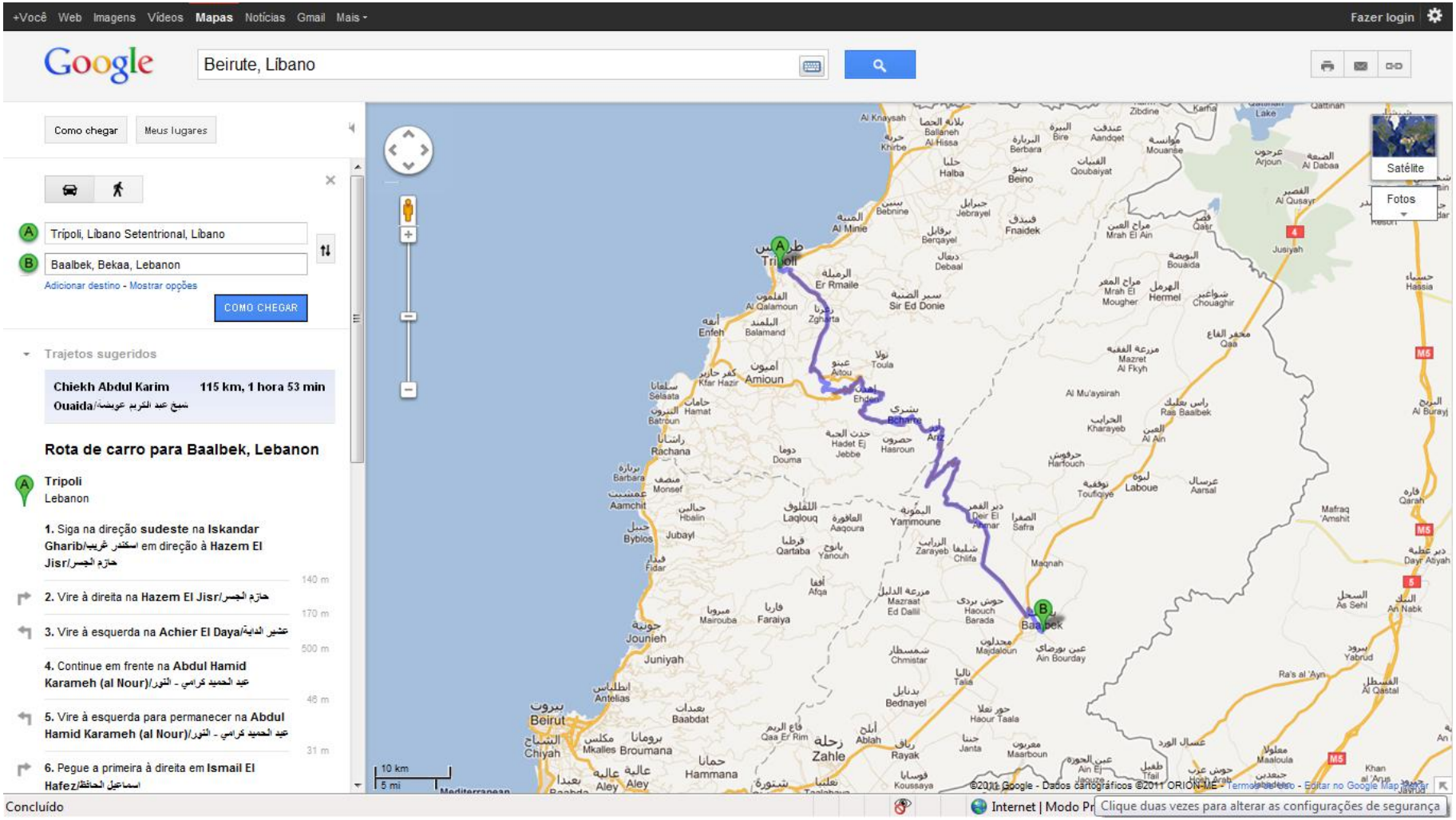
Polarization in Lebanon



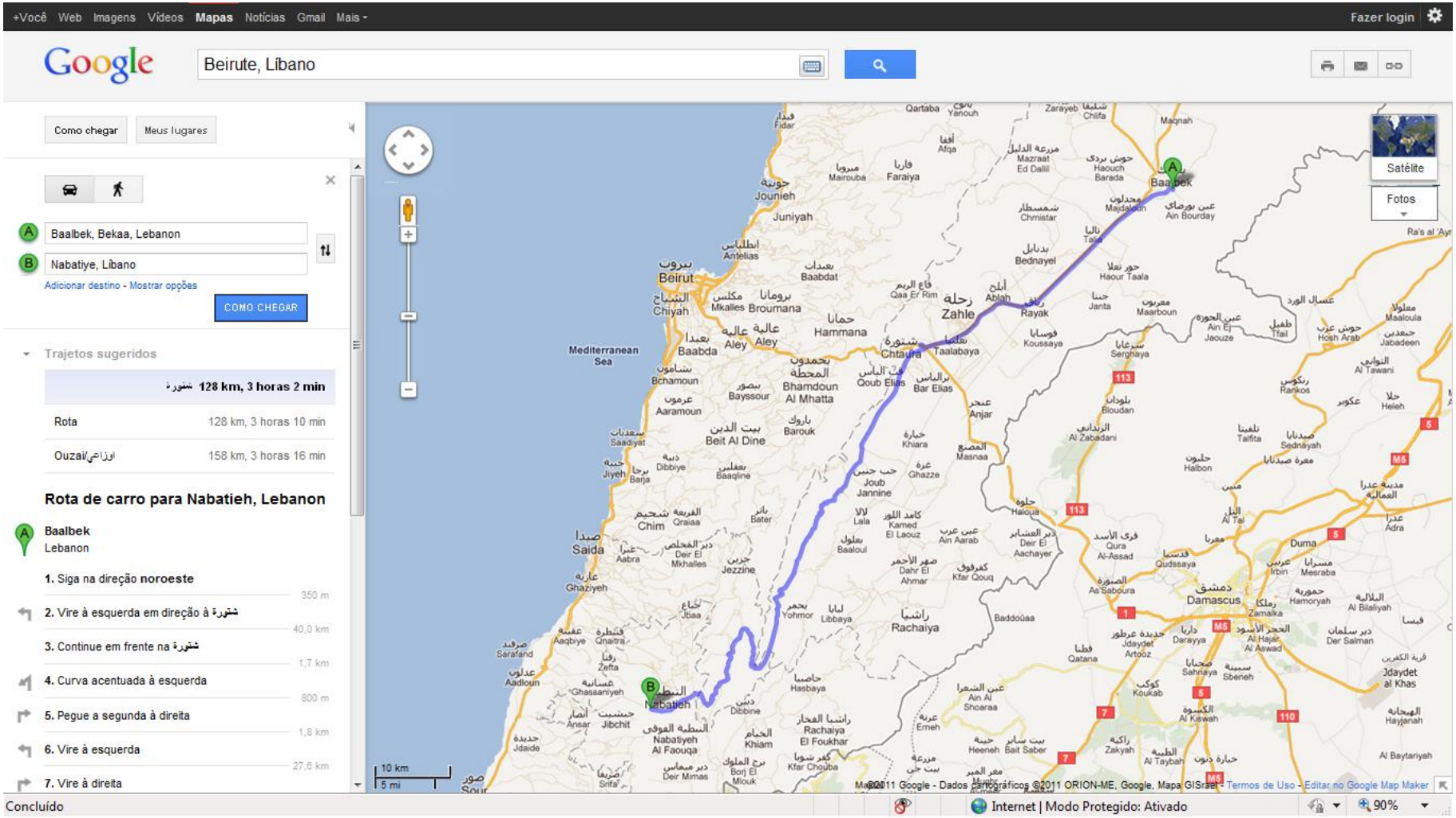
Beirut – Tripoli



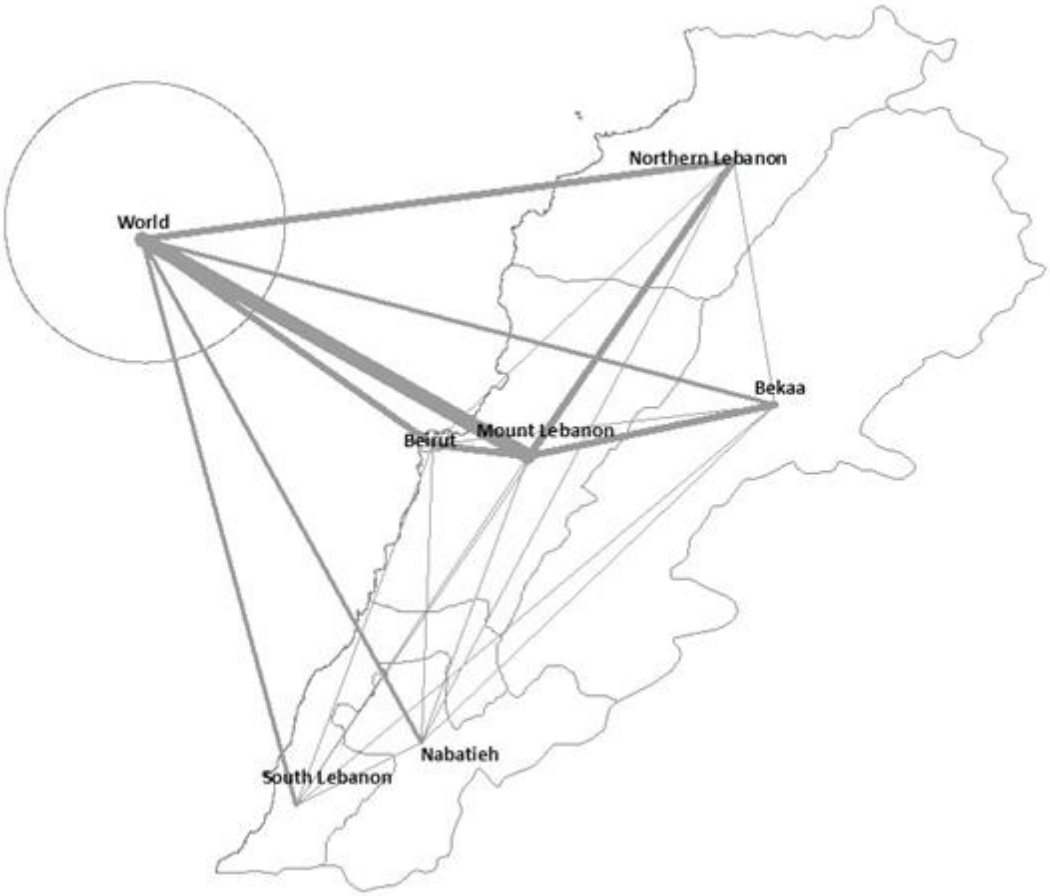
Baalbek – Tripoli



Baalbek – Nabatieh



Hierarchy of trade flows in Lebanon



Interregional input-output adjusted system (IIOAS)

Sectoral valued added

- Use national coefficients (share of sectoral VA in sectoral output)

TABLO code (IIOAS)

- **I**nterregional **I**nput-**O**utput **A**djustment **S**ystem
- Chenery-Moses approach
- Same (national) sectoral technology across regions

Interregional CGE

CGE core

Additional data needed

- Labor payments: employment and salary data + national accounts (37,1% of VA)
- Capital payments: capital to labor payments from 1997 national input-output model plus adjustment to reach the target (44,2% of VA)
- K stocks – 2,3 times GDP distributed according to sectoral/regional shares in capital payments
  - Underlying assumption: equilibrium in capital market
- Elasticities ("guestimates")

What other simplifying assumptions will be needed?

- Get tax data from national accounts

CRunGEM - BMLIBAN

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Picture | Text | Model/Data | Closure | Shocks | Output files | Solve | Results

ARZ Model

Interregional Computable General Equilibrium Model for Lebanon

The University of Sao Paulo Regional and Urban Economics Lab - NEREUS

November 2011

EN 23:40 16/11/2011

Outline

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The 2006 War

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Simulations

The ARZ model is used to simulate the short run impacts of the 2006 War in Lebanon

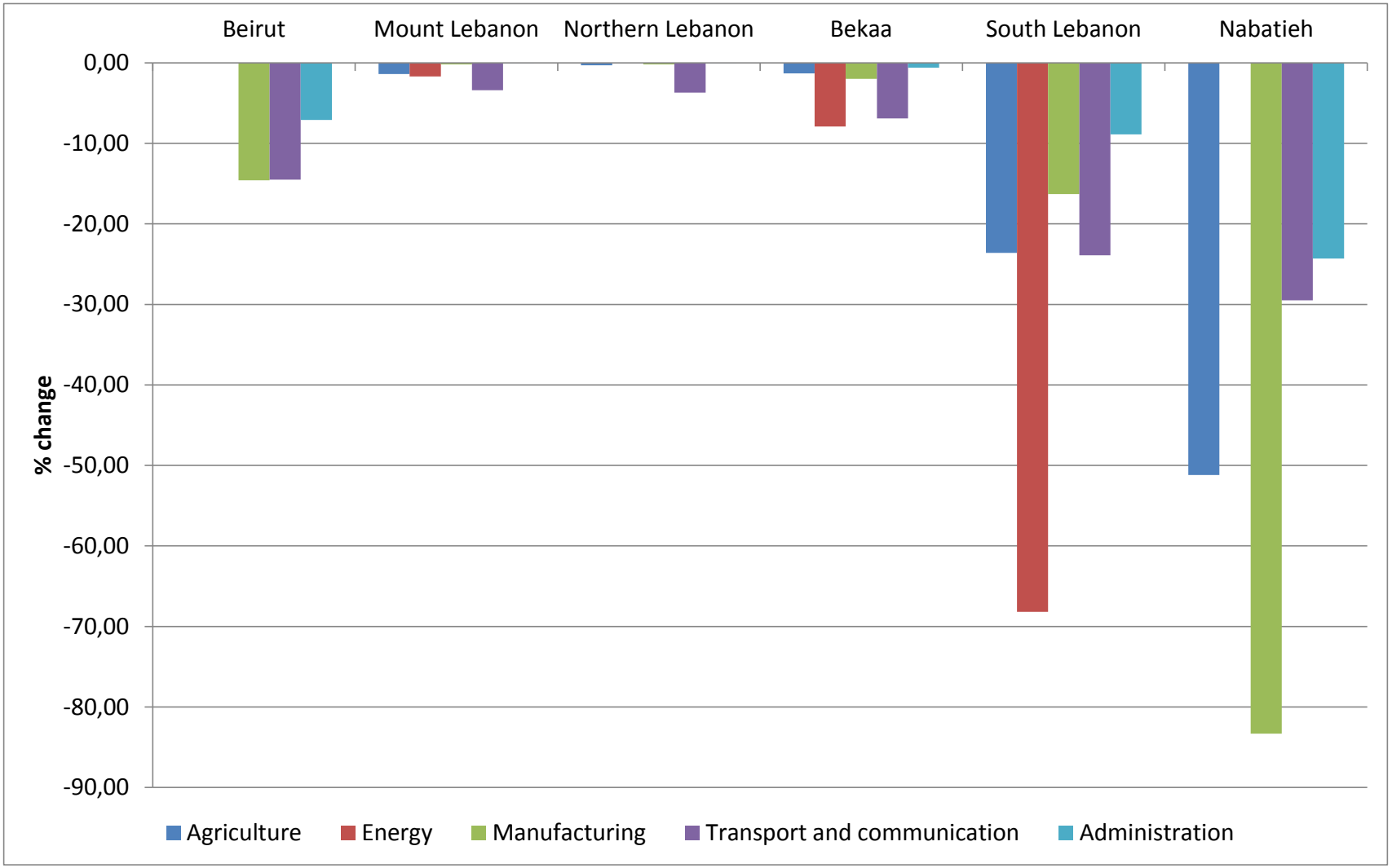
The model is applied to analyze the effects of reductions in sectoral capital stocks according to official information on direct damages

All exogenous variables are set equal to zero, except the changes in sectoral capital stocks

Results of the simulation computed via a 2-4-6 Gragg procedure with extrapolation, under a **short-run closure**

Uncertainty about key trade elasticities: qualitative sensitive analysis to look at the potential range of the **total costs under different degrees of resilience** (both technological and spatial)

Destruction of capital stocks (percentage change)

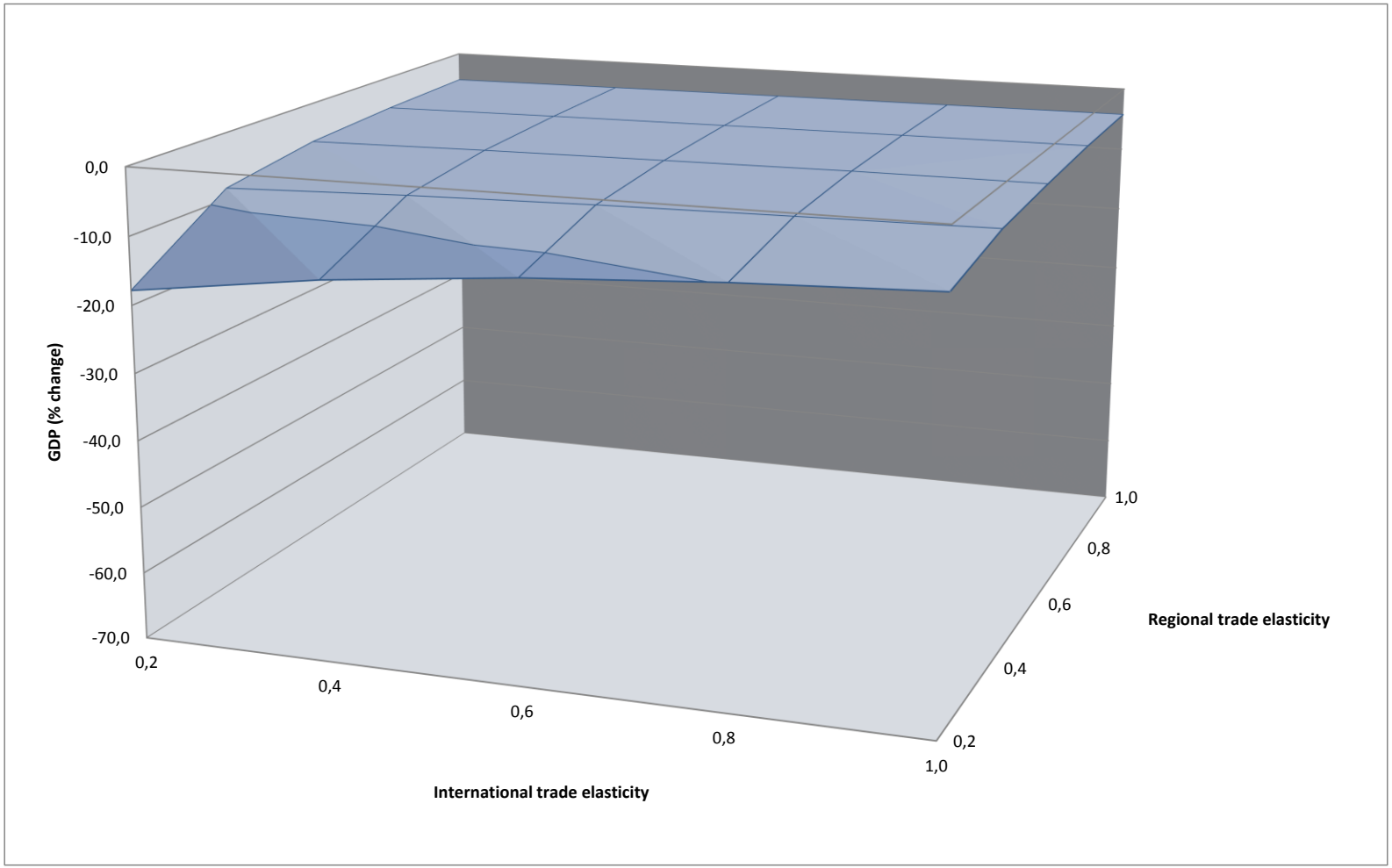


Macro-regional effects (GDP/GRP effects)

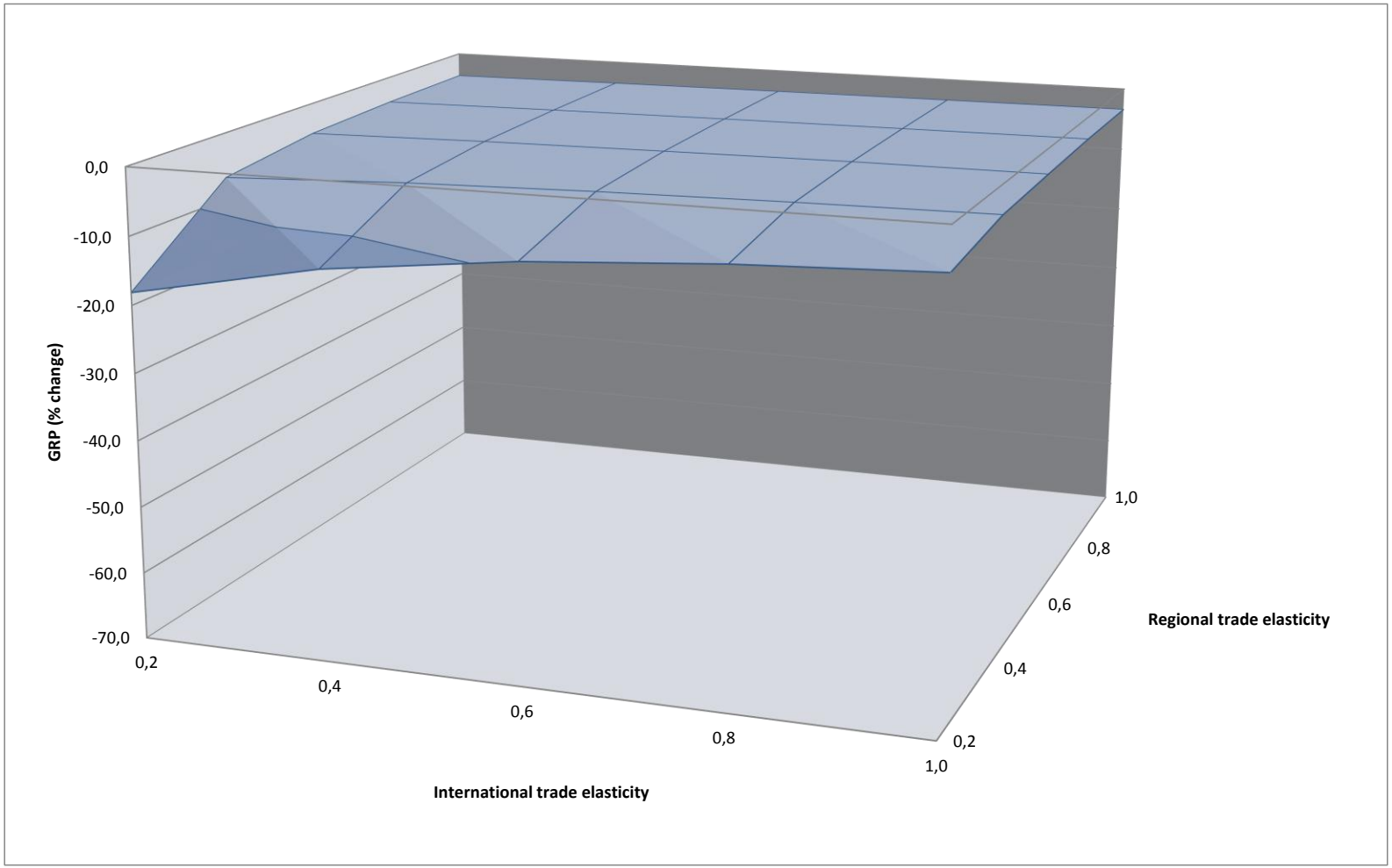
Beirut	-4,61
Mount Lebanon	-2,44
Northern Lebanon	-2,05
Bekaa	-2,21
South Lebanon	-14,43
Nabatieh	-50,15
LEBANON	-6,26

Obs. In % change

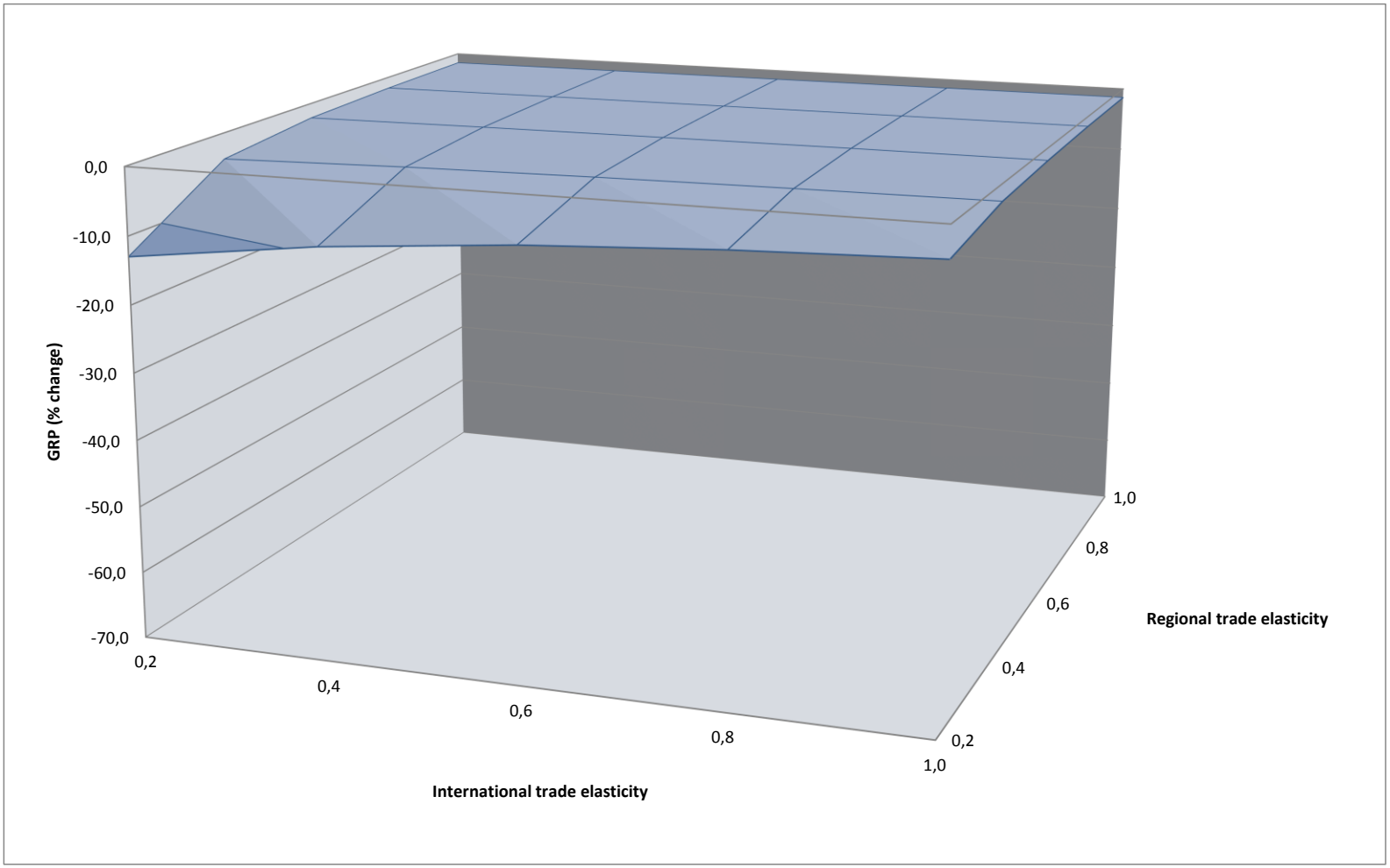
GDP – Lebanon


0,0
-10,0
-20,0
-30,0
-40,0
-50,0
-60,0
-70,0
GDP (% change)
0,2
0,4
0,6
0,8
1,0
International trade elasticity
1,0
0,8
0,6
0,4
0,2
Regional trade elasticity

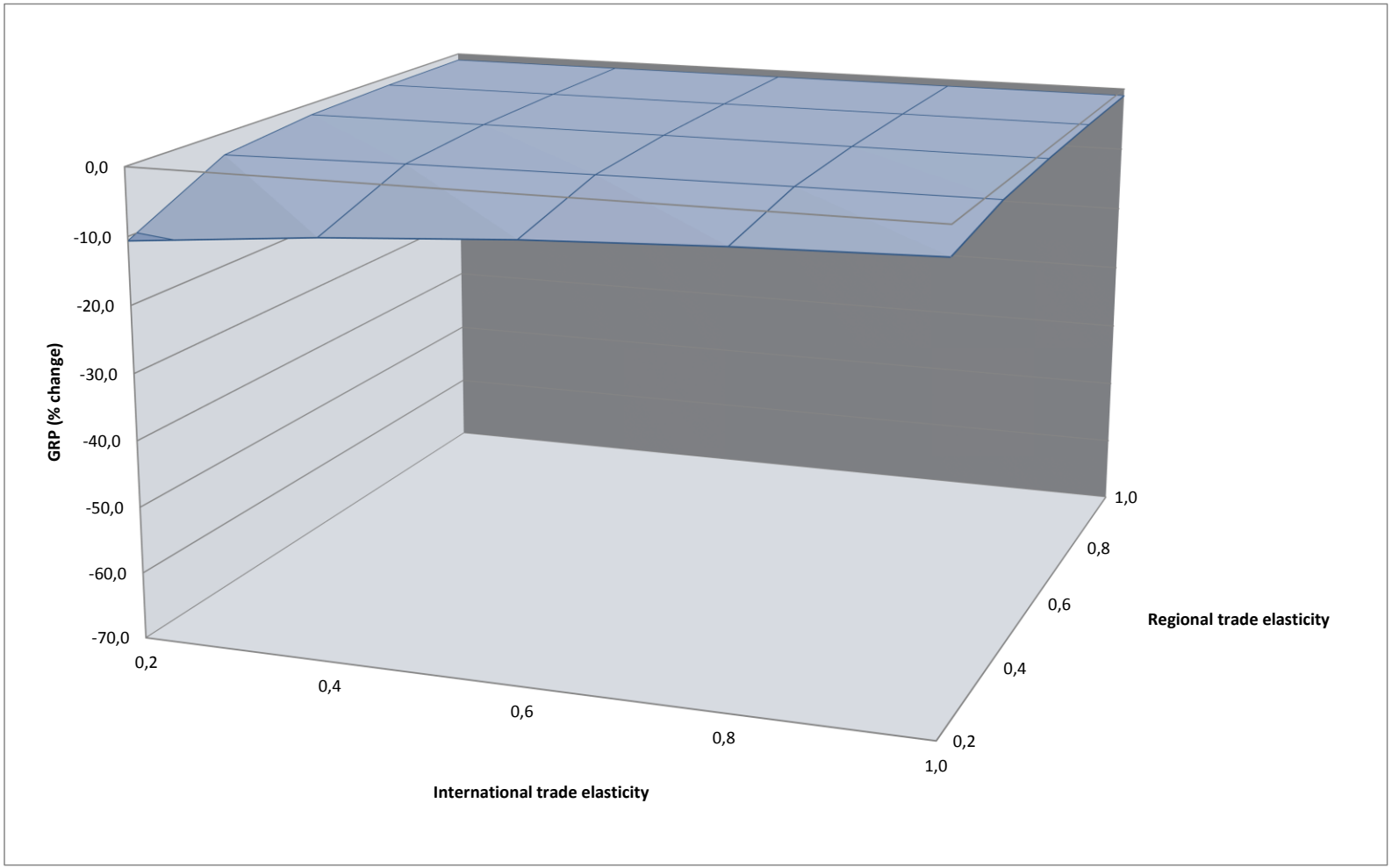
GRP – Beirut


0,0
-10,0
-20,0
-30,0
-40,0
-50,0
-60,0
-70,0
GRP (% change)
0,2
0,4
0,6
0,8
1,0
International trade elasticity
0,2
0,4
0,6
0,8
1,0
Regional trade elasticity

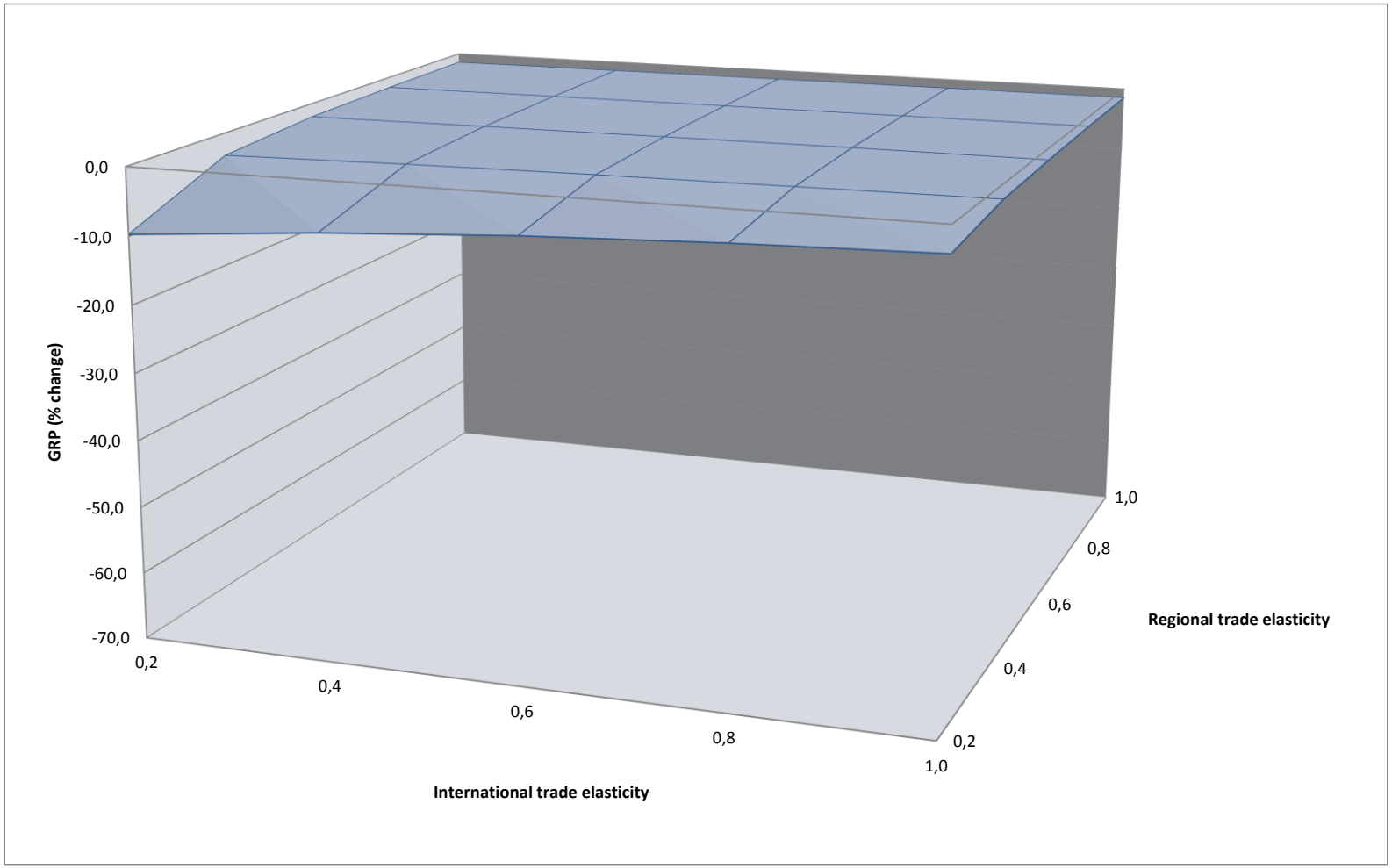
GRP – Mount Lebanon



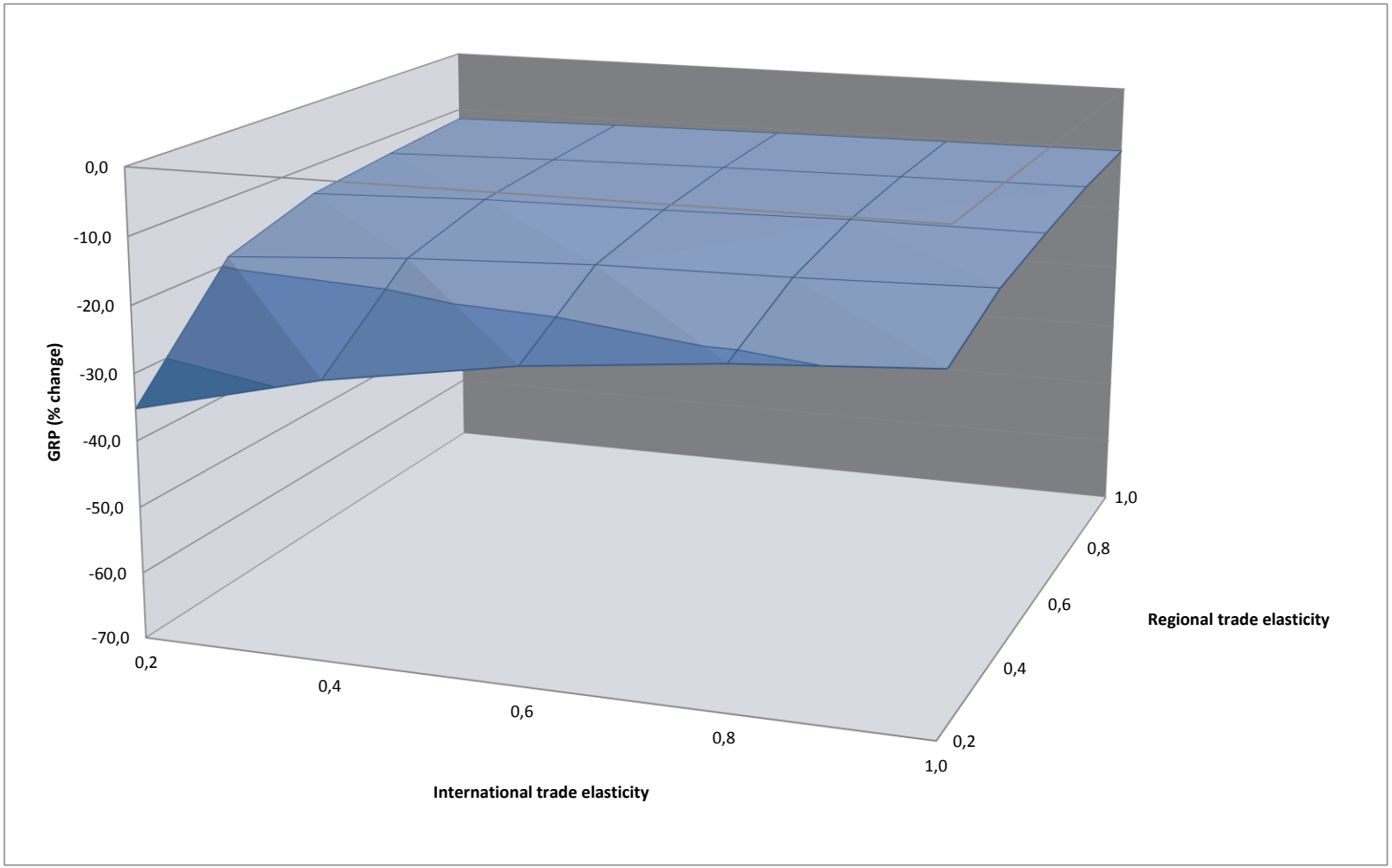
GRP – Northern Lebanon



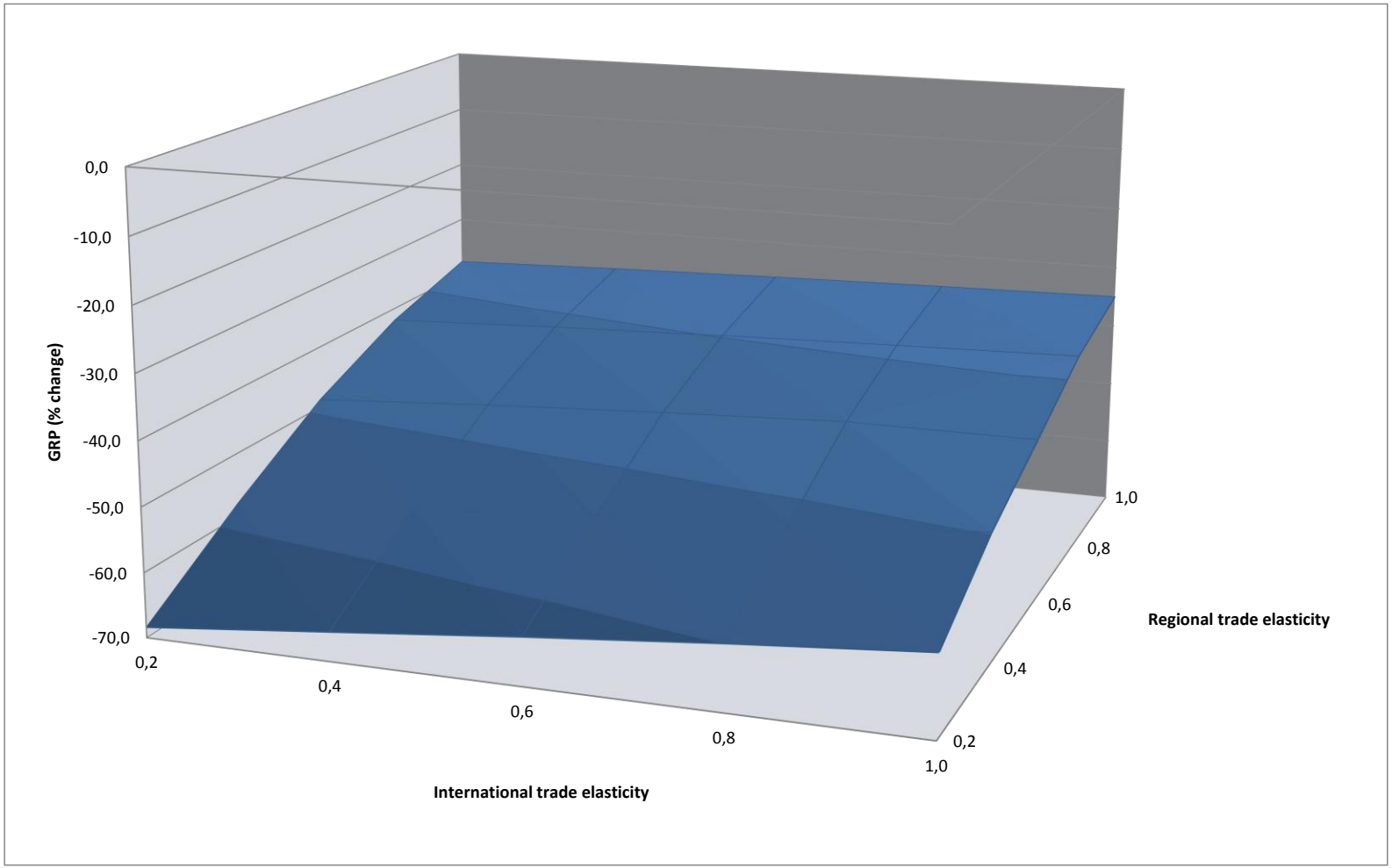
GRP – Bekaa


0,0
-10,0
-20,0
-30,0
-40,0
-50,0
-60,0
-70,0
GRP (% change)
0,2
0,4
0,6
0,8
1,0
International trade elasticity
1,0
0,8
0,6
0,4
0,2
Regional trade elasticity

GRP – South Lebanon



GRP – Nabatieh

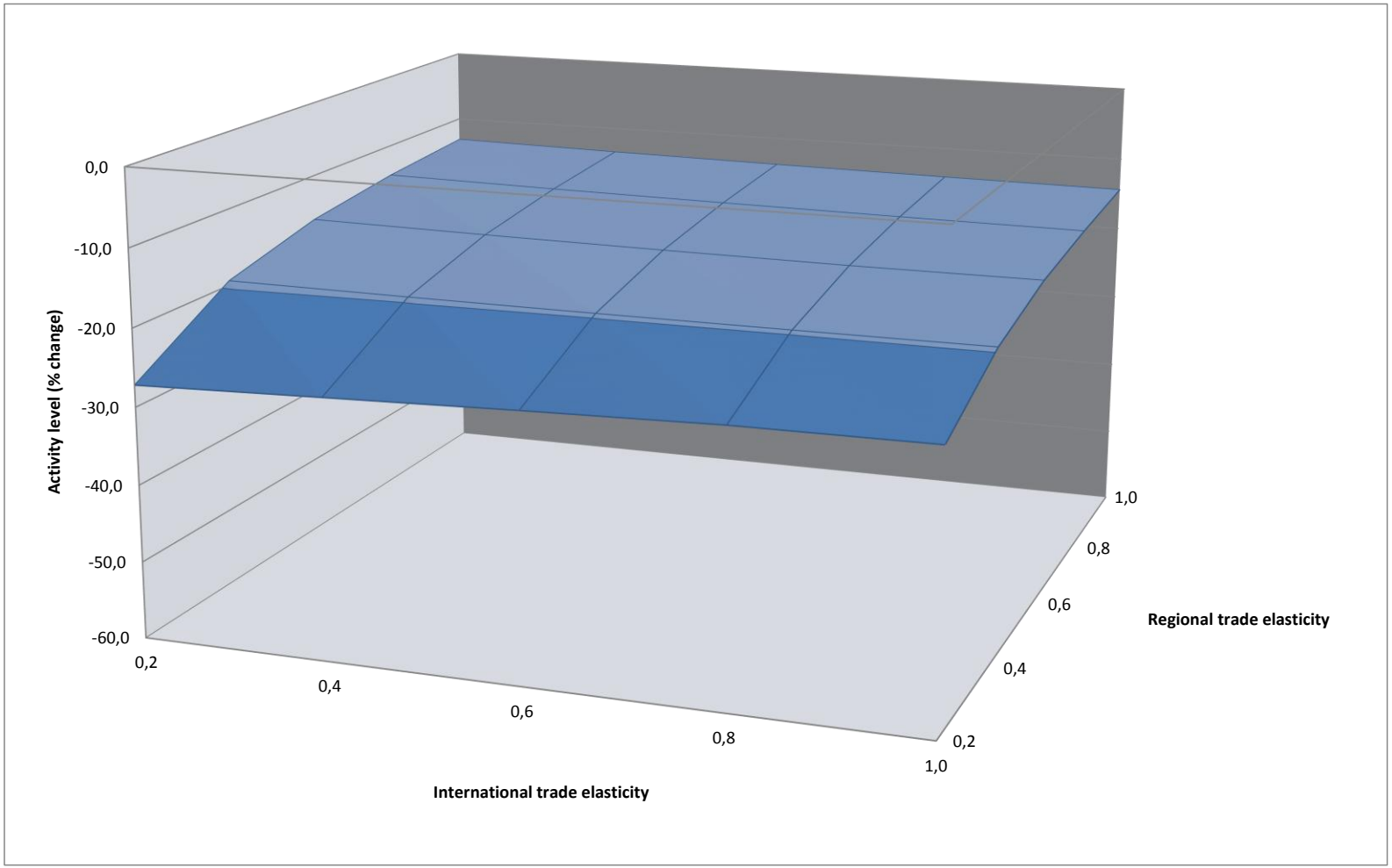


Sectoral effects

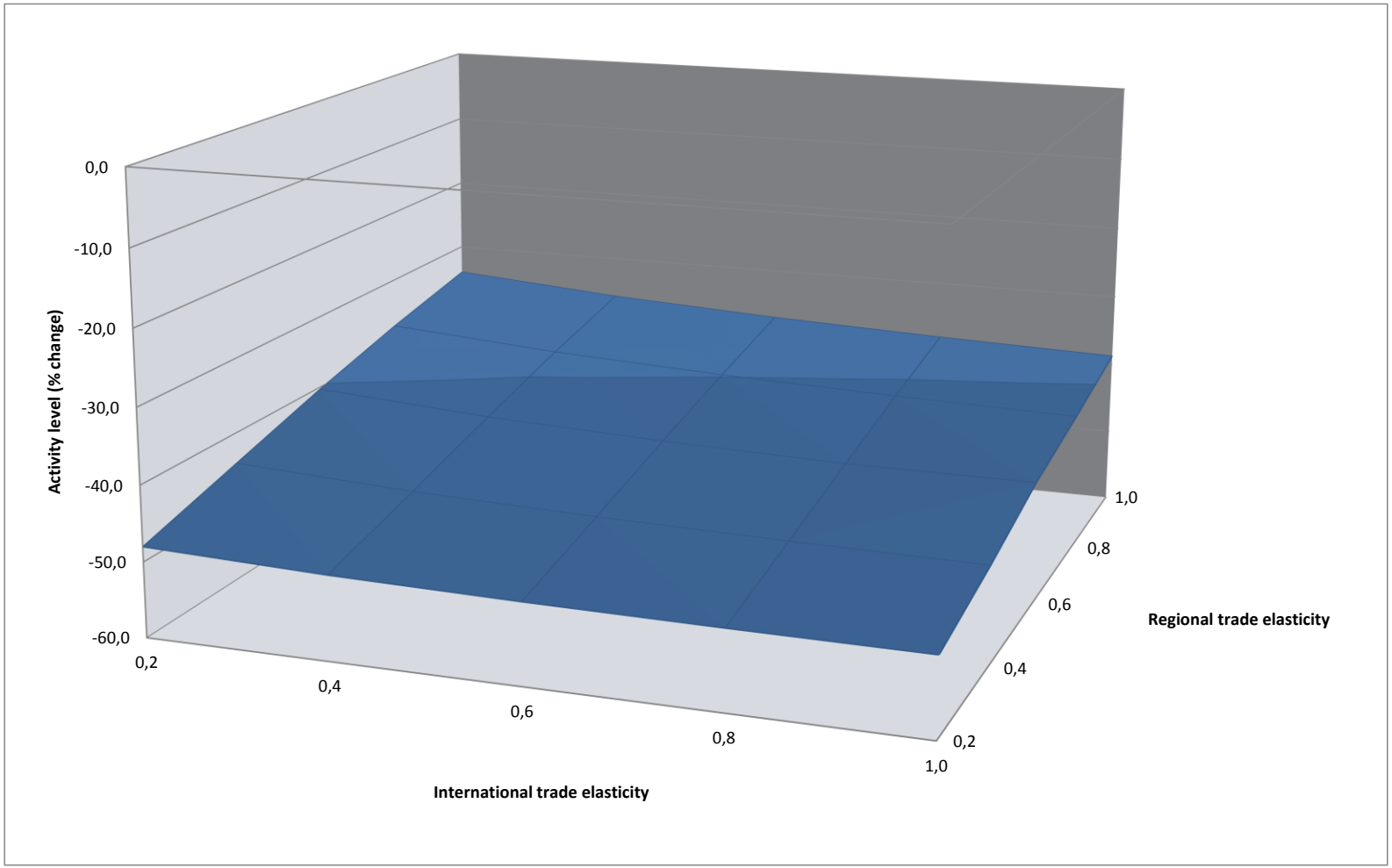
1. Agriculture and livestock	-17,89
2. Energy and water	-44,15
3. Manufacturing	-30,51
4. Construction	-4,48
5. Transport and communication	-7,81
6. Other services	-2,84
7. Trade	-1,81
8. Administration	-5,14

Obs. In % change

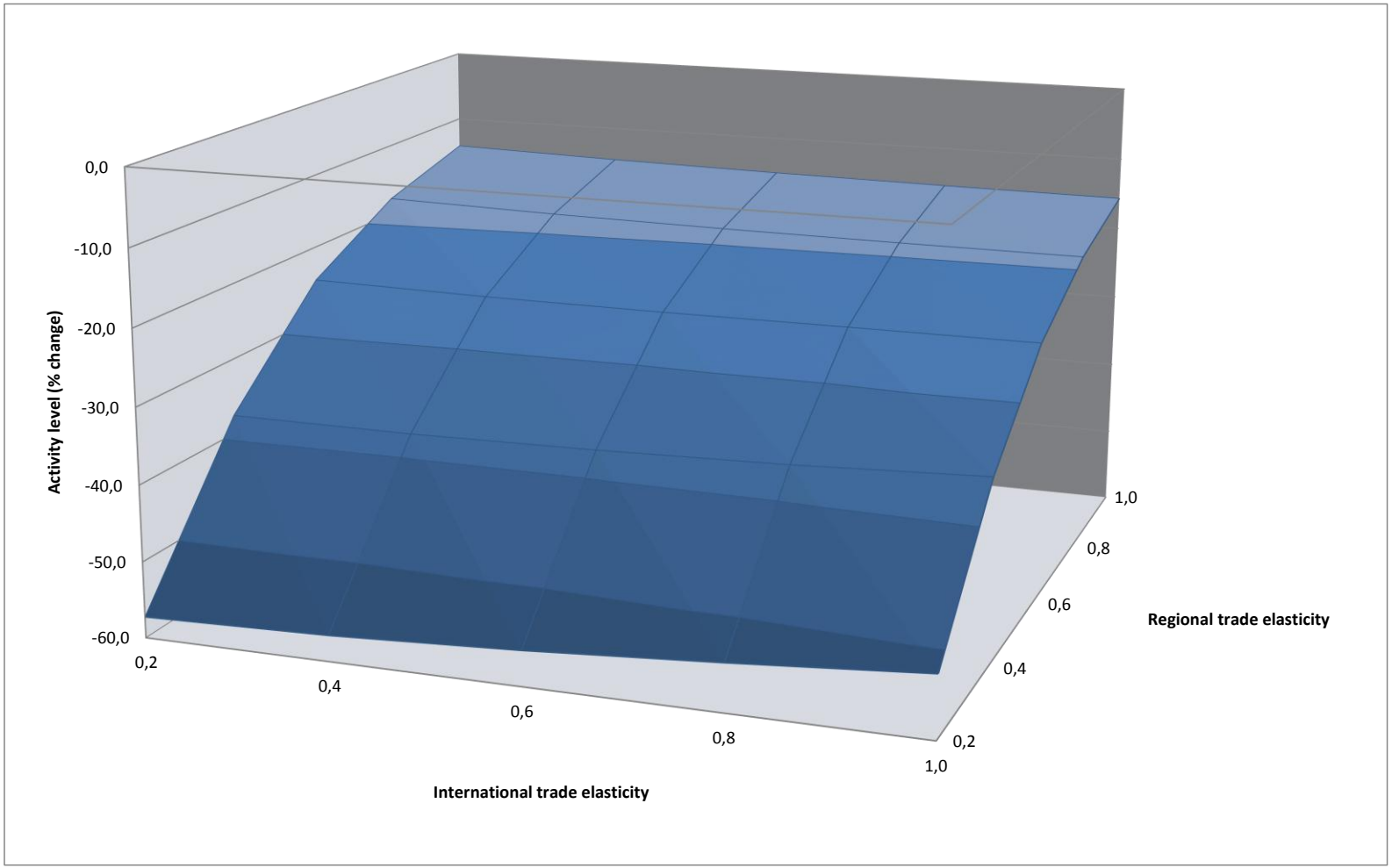
Activity level – Agriculture



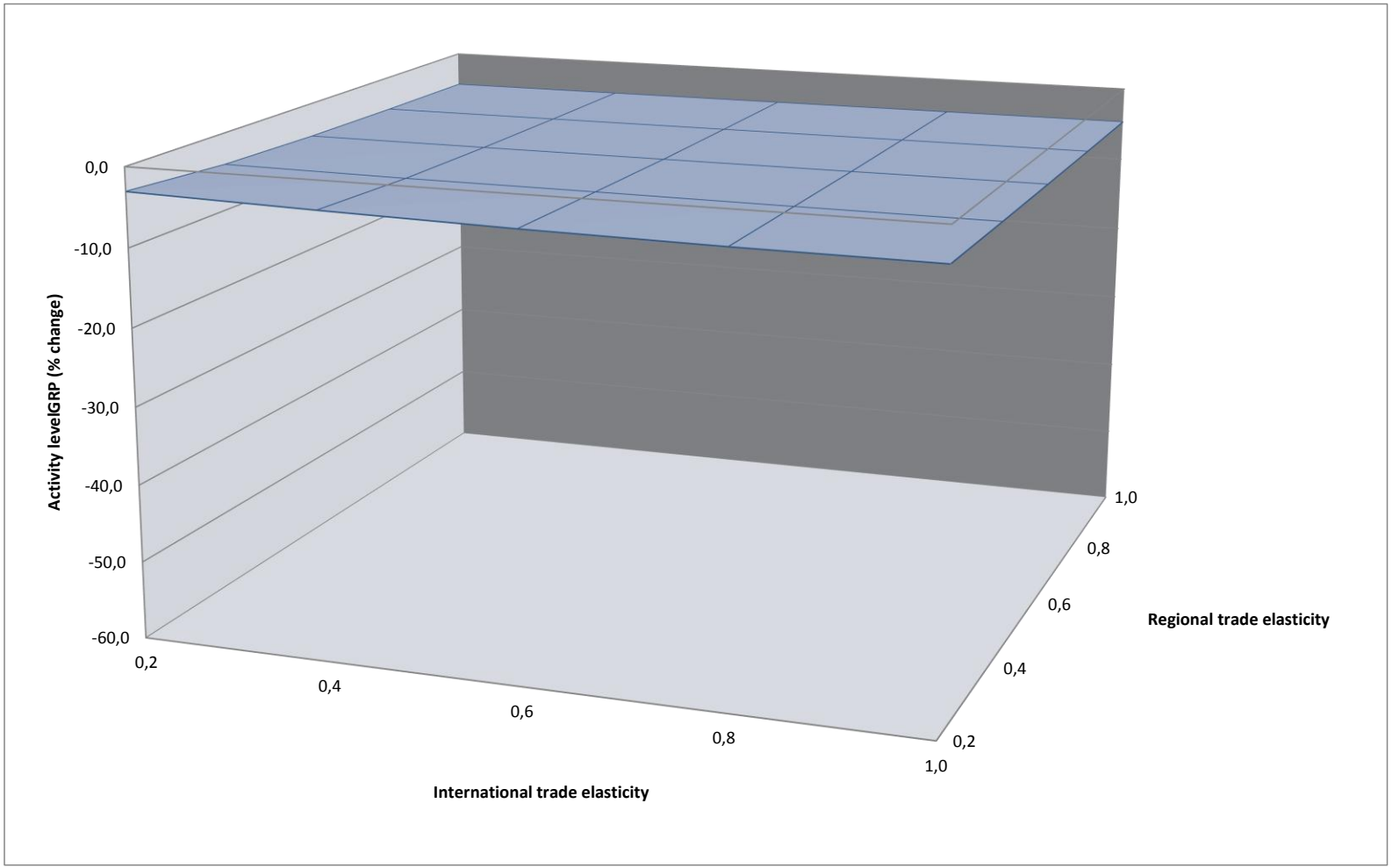
Activity level – Energy



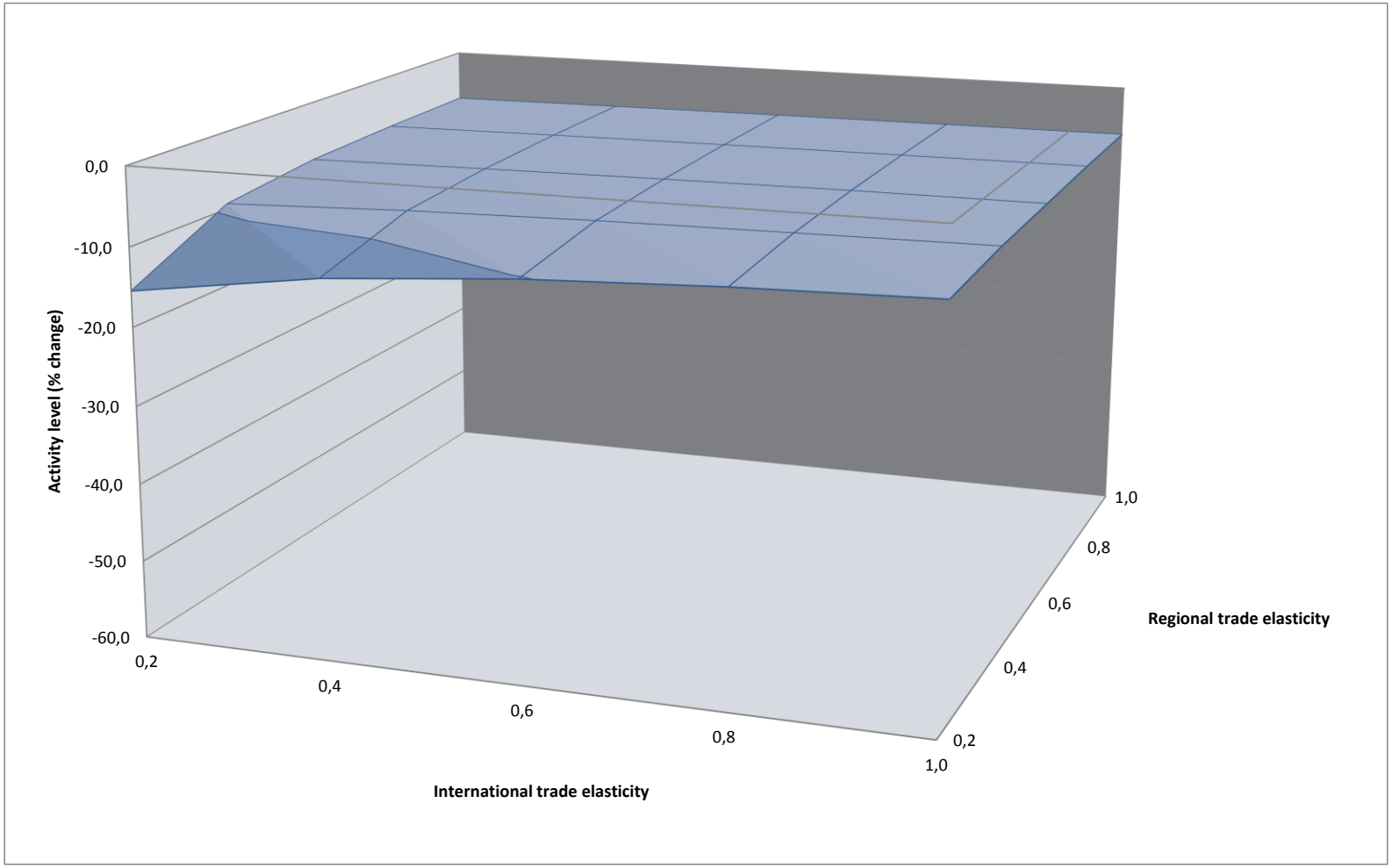
Activity level – Manufacturing



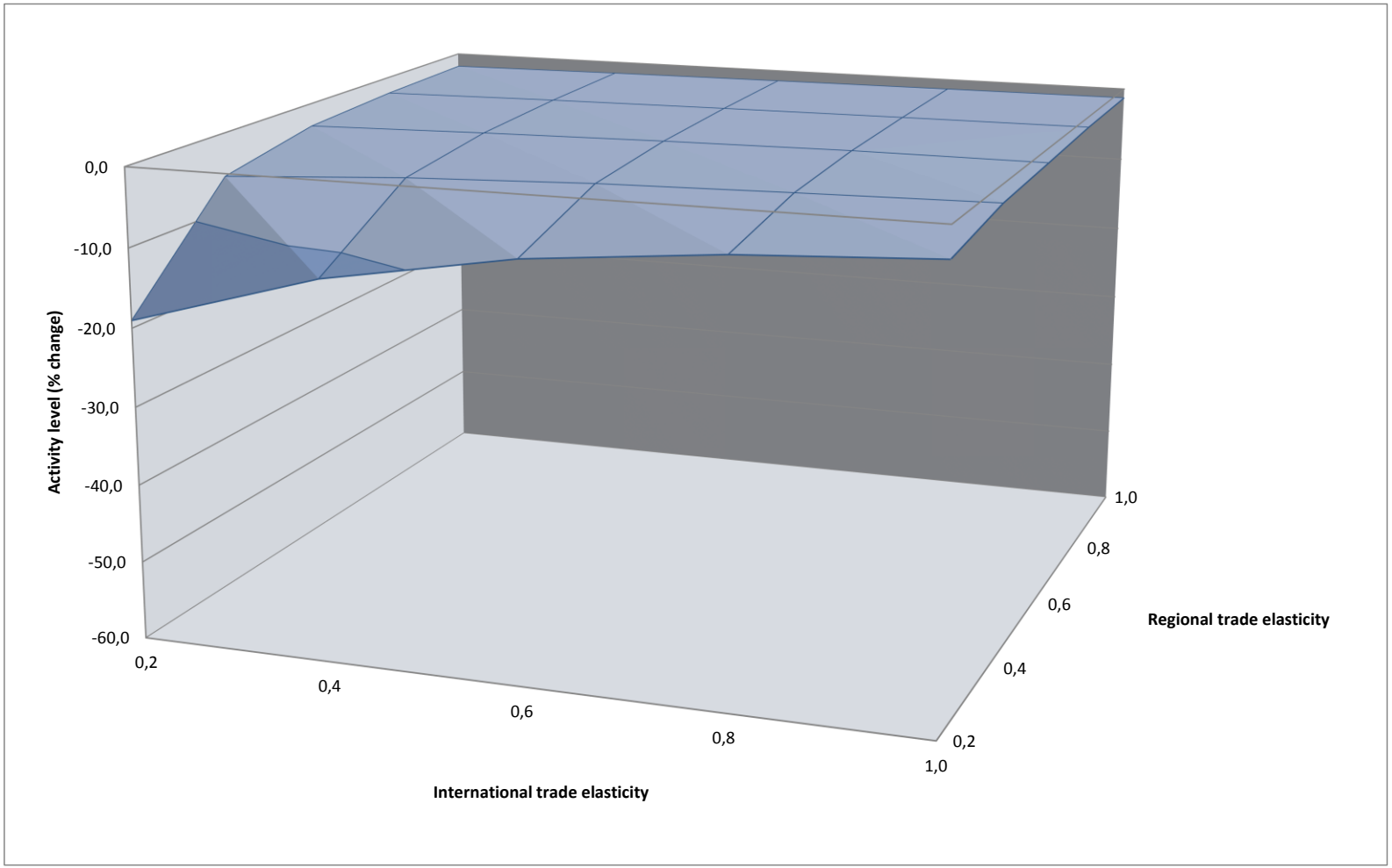
Activity level – Construction



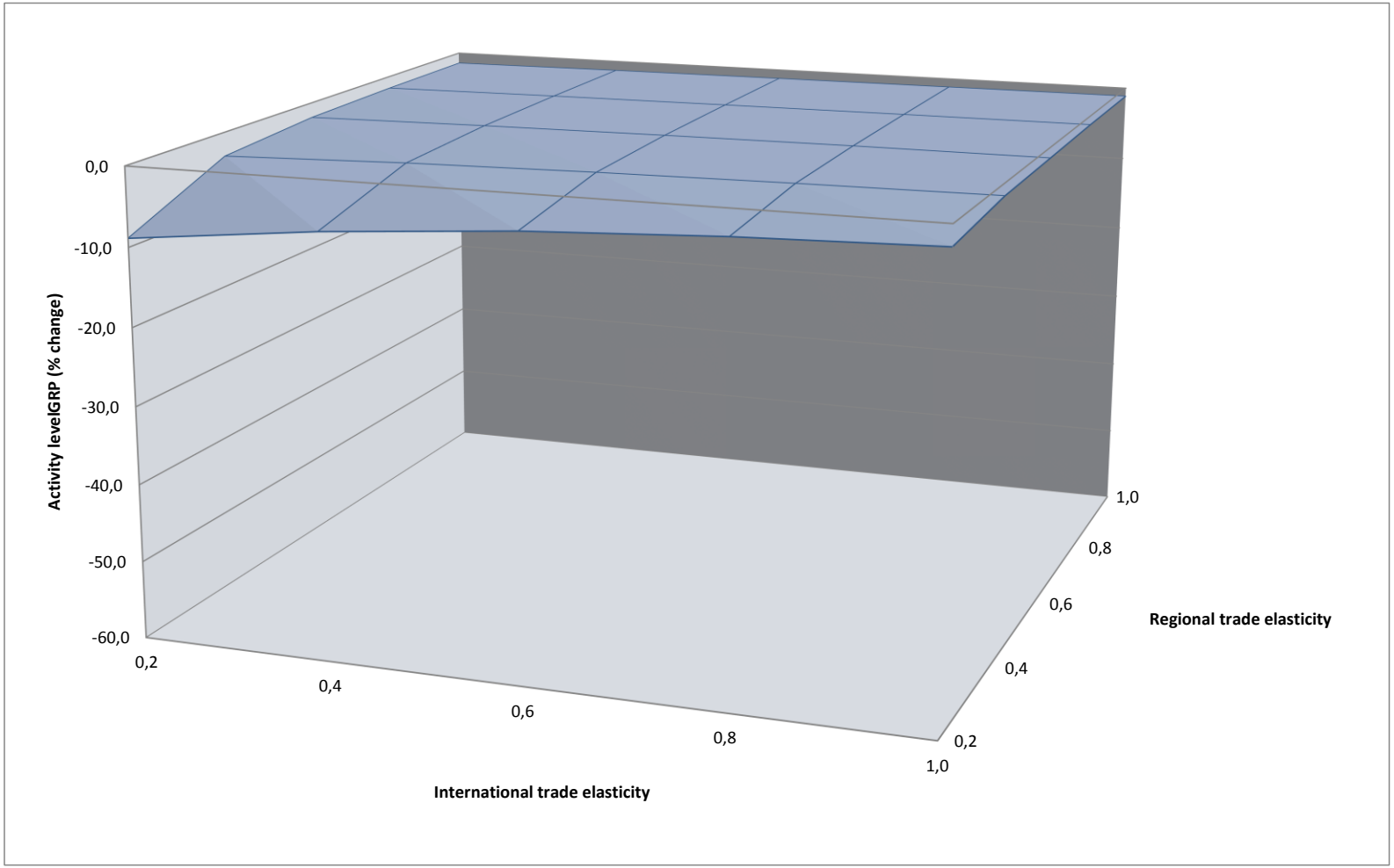
Activity level – Transport and communication



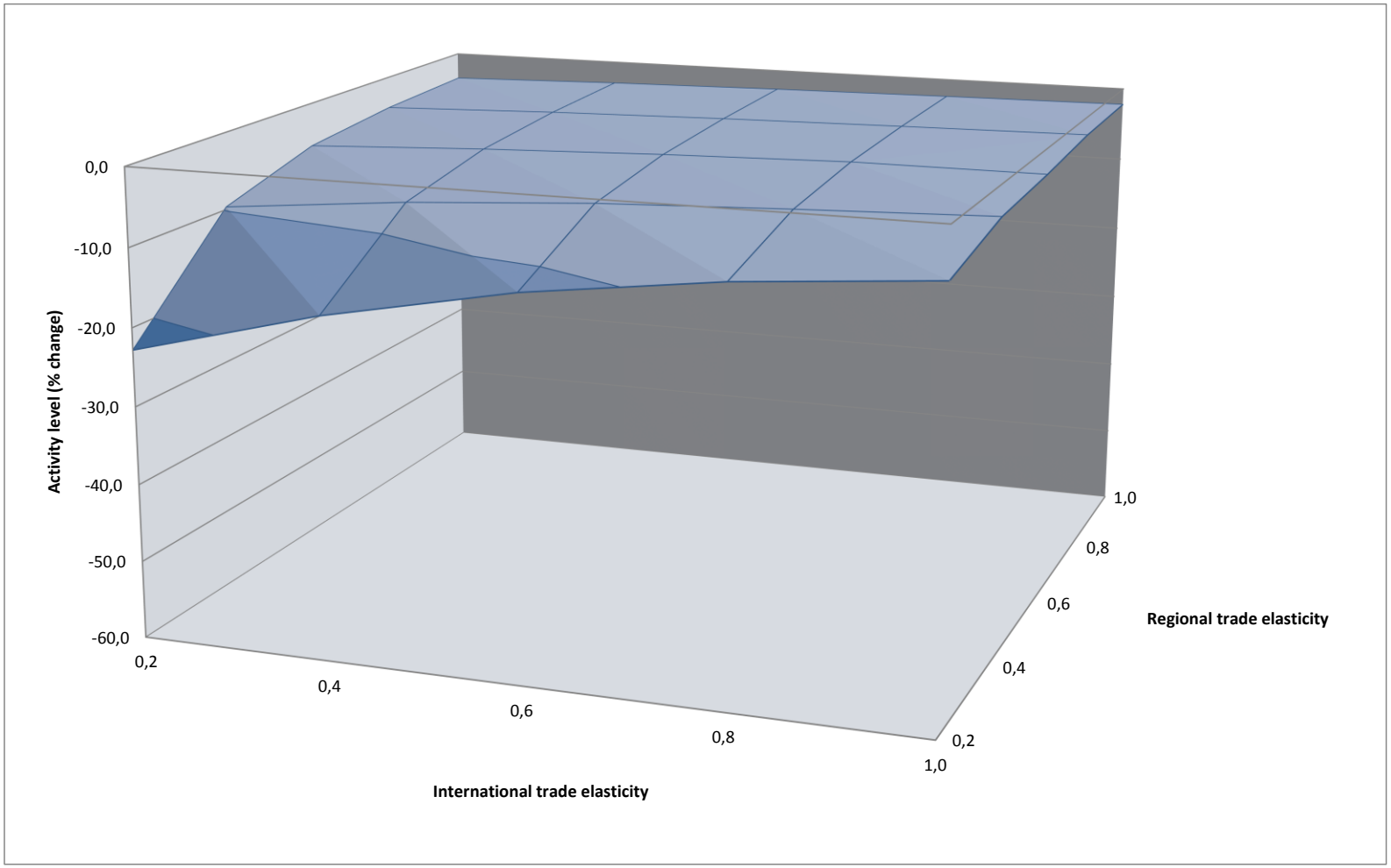
Activity level – Other services



Activity level – Trade



Activity level – Administration



Summary

Low degree of technological resilience (substitution of primary inputs)

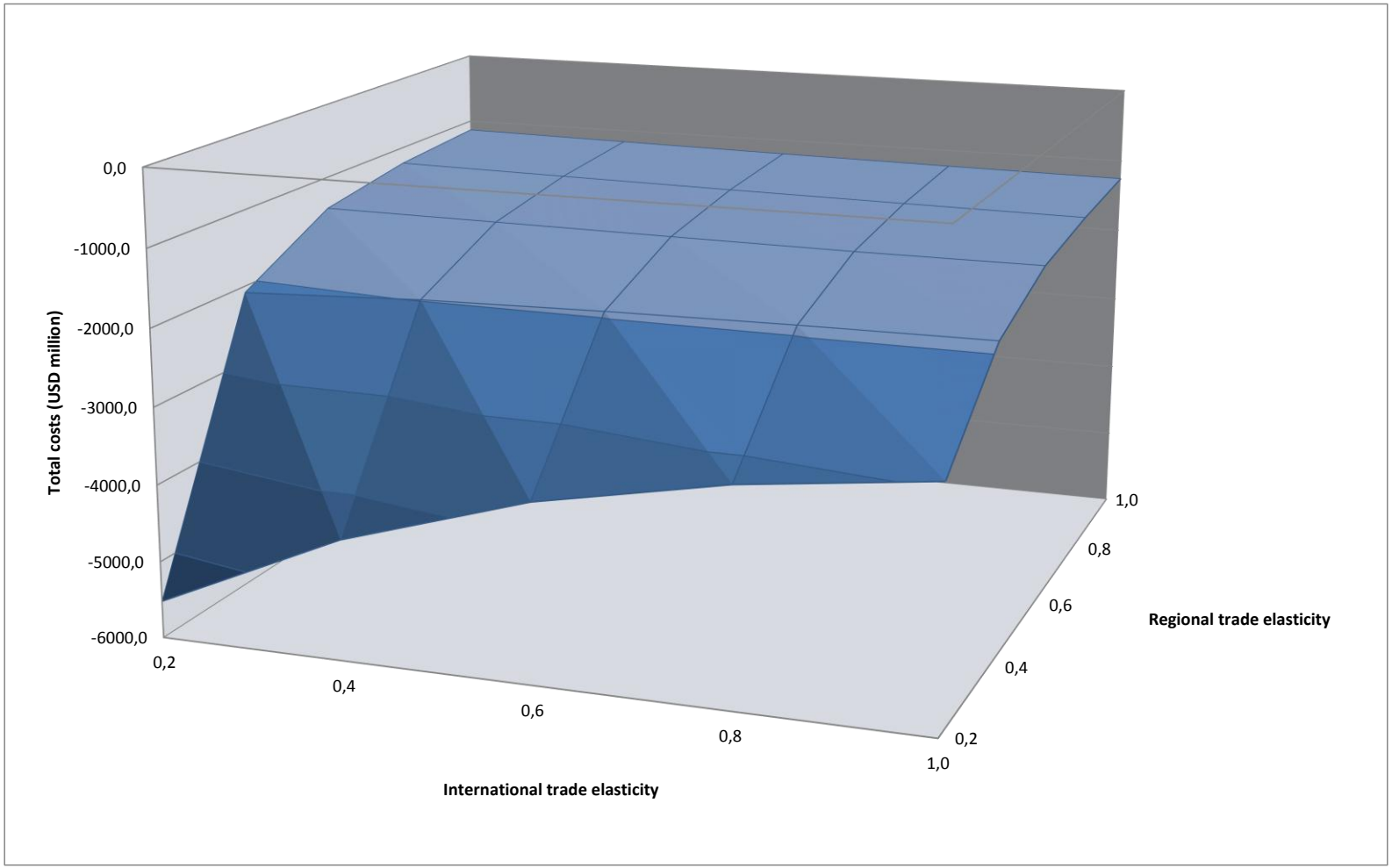
Spectrum of spatial resilience (substitution of suppliers)

Direct damage: USD million 1.105

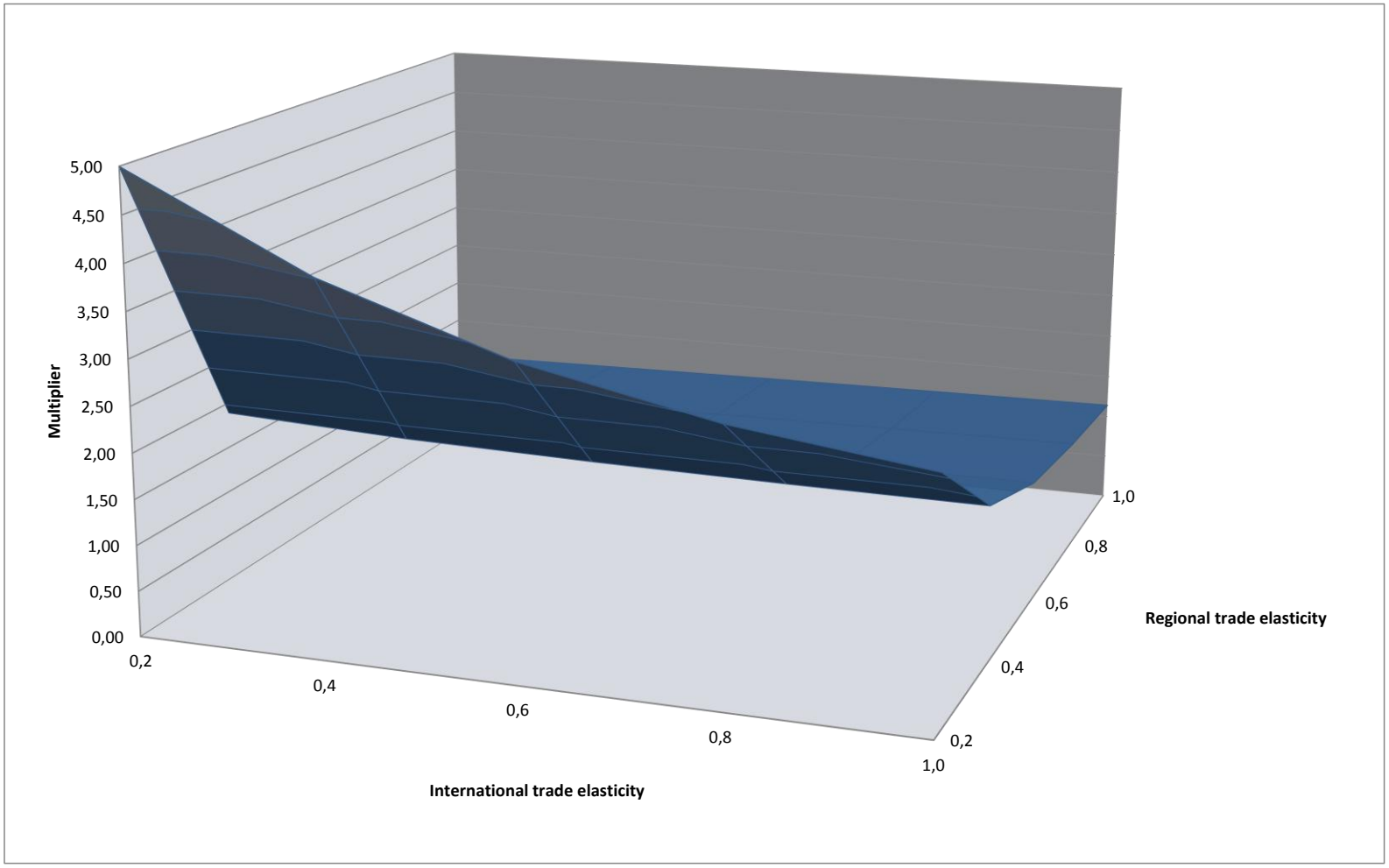
Total impact: USD million 1.644 [1.138; 5.521]

Total impact-damage ratio: 1,49 [1,03; 5,00]

Total costs – USD million

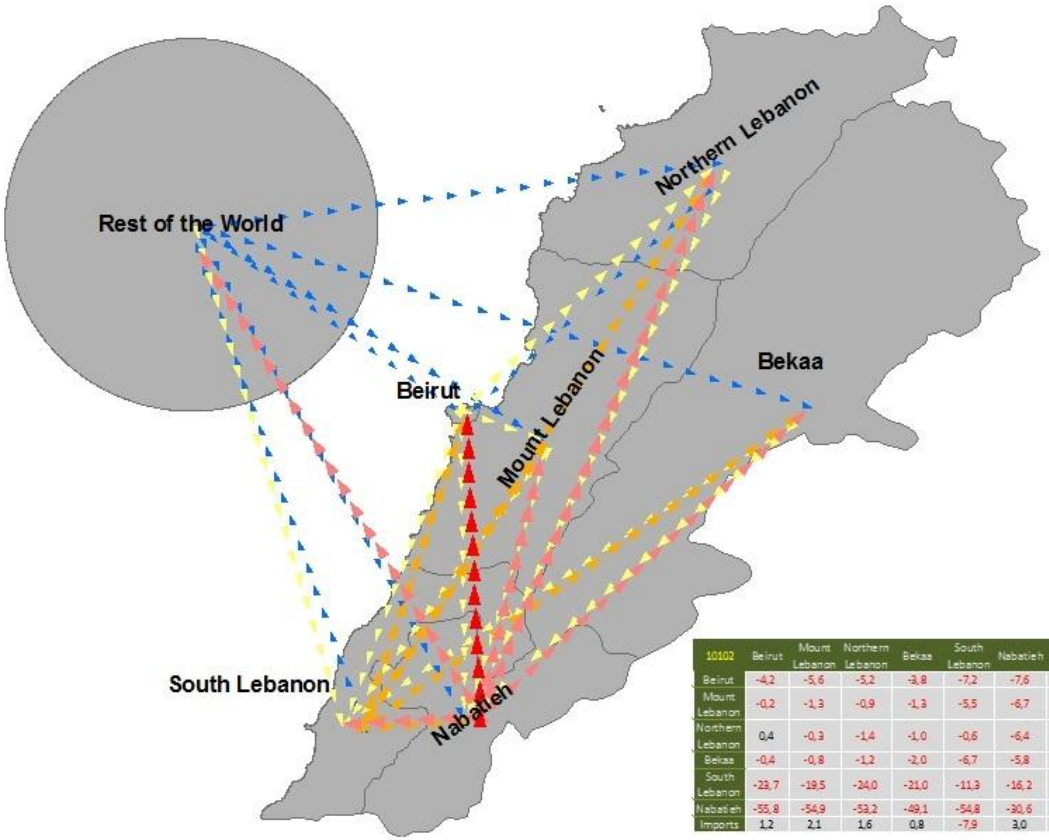


Total impact-damage ratio



Interregional and international trade may serve as a shock absorber

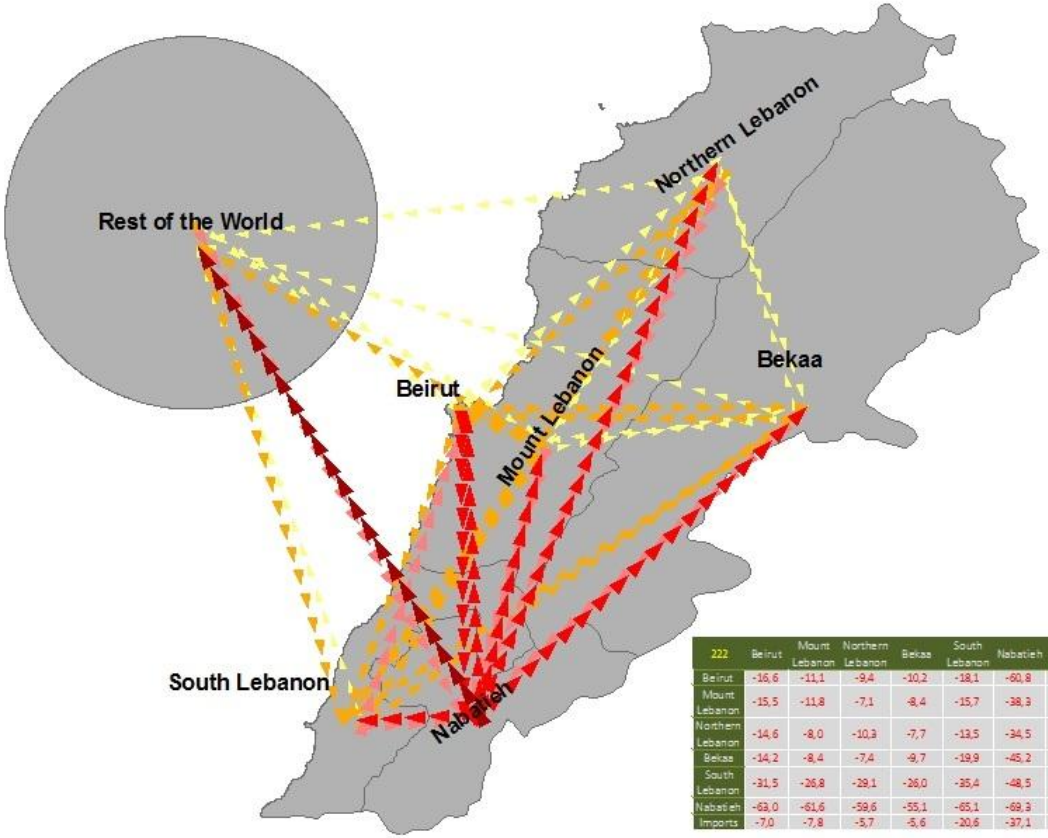
Higher degree of resilience



10102	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	Exports
Beirut	-4,2	-5,6	-5,2	-3,8	-7,2	-7,6	-0,3
Mount Lebanon	-0,2	-1,3	-0,9	-1,3	-5,5	-6,7	-1,4
Northern Lebanon	0,4	-0,3	-1,4	-1,0	-0,6	-6,4	-0,7
Bekaa	-0,4	-0,8	-1,2	-2,0	-6,7	-5,8	-1,9
South Lebanon	-23,7	-19,5	-24,0	-21,0	-11,3	-16,2	4,8
Nabatieh	-55,8	-54,9	-53,2	-49,1	-54,8	-30,6	-51,8
Imports	1,2	2,1	1,6	0,8	-7,9	3,0	0,0

Interregional and international trade may serve as a shock absorber

Lower degree of resilience



222	Beirut	Mount Lebanon	Northern Lebanon	Bekaa	South Lebanon	Nabatieh	Exports
Beirut	-16,6	-11,1	-9,4	-10,2	-18,1	-60,8	-2,8
Mount Lebanon	-15,5	-11,8	-7,1	-8,4	-15,7	-38,3	-15,4
Northern Lebanon	-14,6	-8,0	-10,3	-7,7	-13,5	-34,5	-6,5
Bekaa	-14,2	-8,4	-7,4	-9,7	-19,9	-45,2	-8,0
South Lebanon	-31,5	-26,8	-29,1	-26,0	-35,4	-48,5	-9,1
Nabatieh	-63,0	-61,6	-59,6	-55,1	-65,1	-69,3	-92,2
Imports	-7,0	-7,8	-5,7	-5,6	-20,6	-37,1	0,0

Outline

Motivation

The 2006 War

Methodology

Simulations

✓ Final remarks

Further developments

Use finer establishment data (including location) for disaster analysis (e.g. localized disruption in production)

Analytical important disruption links

Use trade linkages for the analysis of specific infrastructure disruption (e.g. road infrastructure, bridges)

Use dynamic setting for forecasting exercises (e.g. recovery and reconstruction) – to be implemented

Population displacement analysis – labor market and population module