



# **Java visual tools for economic, social and epidemiologic statistical model simulation**

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**Irpel** (The Tuscan Regional Institute for Economic Planning) is a regional research institute. It develops and steadily updates macro and micro simulation models for economic, social and environmental policy evaluations.

### **Some examples of institutional requests are:**

Macroeconomic forecast of regional sectorial production, gdp, employees under some global scenarios (world, european and italian scenarios)

Economical impact of public and private fixed investment or public current expenditures (gdp, sectorial production and employment).

Economical effect of a direct and indirect tax rate change (change in household income, saving, consumption etc.)

The effect of change in population age distribution and/or household composition on regional public expenditure and social transfer benefits.

## Steps of policy making

Policy making is a recent multidisciplinary study field, developed within political sciences and linked with other subjects such as economy, sociology and statistics.

The policy maker identify a problem or a demand for government action



Policy maker asks to researcher the analysis about the problem



Policy maker decides the government action to solve the problem or to satisfy population requests



Main tools used by IRPET for ex-ante and ex-post policy evaluation are:

- ❑ Structural and short term economic analisys
- ❑ Accounting matrices and impact simulation models
- ❑ Causal relations and structural models
- ❑ Microsimulation models

To give policy maker some little more than the packaged research output, IRPET has tried to create simple simulation tools very easy to use and to distribute.

We build these programs by Java programming language that has several characteristics:

Java is open source (cheaper development)

Java is object oriented (this facilitates the code reuse)

Java runs everywhere (simpler distribution)

Java is the a widespread language (simpler to find code examples)

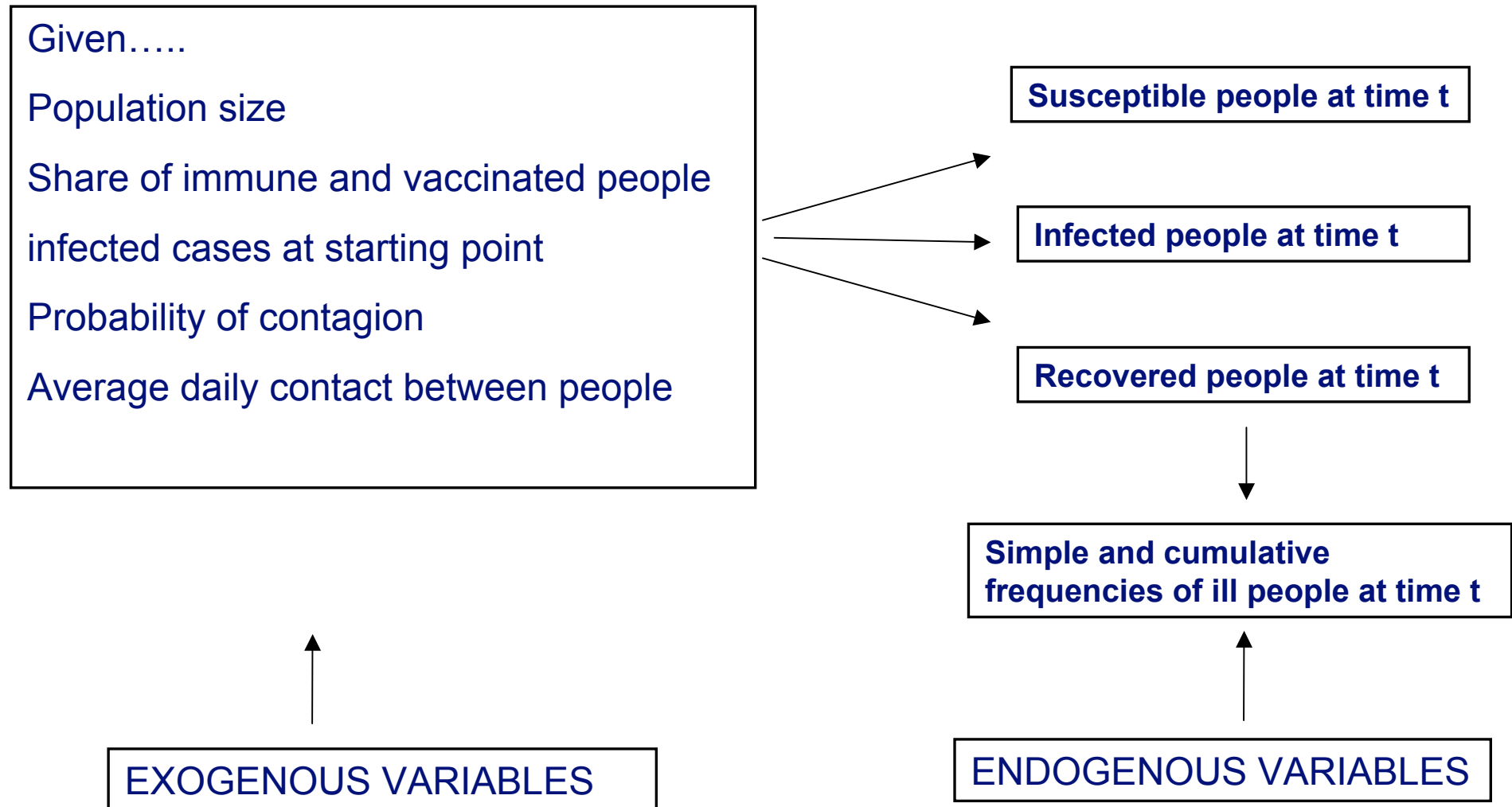
Java build applets (usefull for web pages applications)

Jar file are executable and single small files (simpler distribution)

### **Examples of developed tools**

SIR model      Input- Output models      Structural health services simulation

SIR is a simple Epidemic model used to simulate the transmission of communicable disease through individuals.



# Sir model form

Change of total immunized and vaccinated population and daily contact

Changed of initial cases infection probability and disease duration

**MODELLO SIR**

**Simulazione dei contagi influenzali**

Modificando i parametri dell'epidemia e della popolazione su cui agisce potremo osservarne l'evoluzione sui grafici e sulla tabella nei successivi 180 giorni a partire da oggi. Help

**Popolazione**

**% Immuni**

**% Vaccinati**

**Contatti**

**Casi infetti attuali**

**Probabilità di contagio**

**Giorni di incubazione**

**Giorni di malattia**

**MALATI**

y<sub>max</sub>: 3500000      y: 569277.0

giorni: 56

y<sub>min</sub>: 0

Giorni	Incidenza	Vaccinati ...	Malati	Infetti	Sani
0	0	350000	0	1000	2834000
1	0	350000	333	1152	2833514
2	0	350000	666	1382	2832951
3	0	350000	1000	1726	2832273
4	0	350000	1485	2088	2831425
5	0	350333	1715	2554	2830396
6	0	350666	2059	3132	2829141
7	0	351000	2574	3823	2827601
8	0	351485	3117	4673	2825723
9	0	352048	3810	5711	2823429
10	0	352726	4671	6973	2820628
11	0	353574	5701	8512	2817211
12	0	354603	6967	10384	2813044
13	0	355858	8512	12658	2807969
14	0	357398	10390	15416	2801794
15	0	359276	12678	18754	2794289
16	0	361570	15459	22785	2785184
17	0	364371	18833	27636	2774157
18	0	367788	22921	33454	2760835
19	0	371955	27860	40399	2744784
20	0	377030	33812	48644	2725513
21	0	383205	40959	58366	2702469

**INCIDENZA**

y<sub>max</sub>: 100      y: 7.0

giorni: 2

y<sub>min</sub>: 0

giorni: 30 60 90 120 150 180 Copia Tabella

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Graph of ill people and cumulative incidence

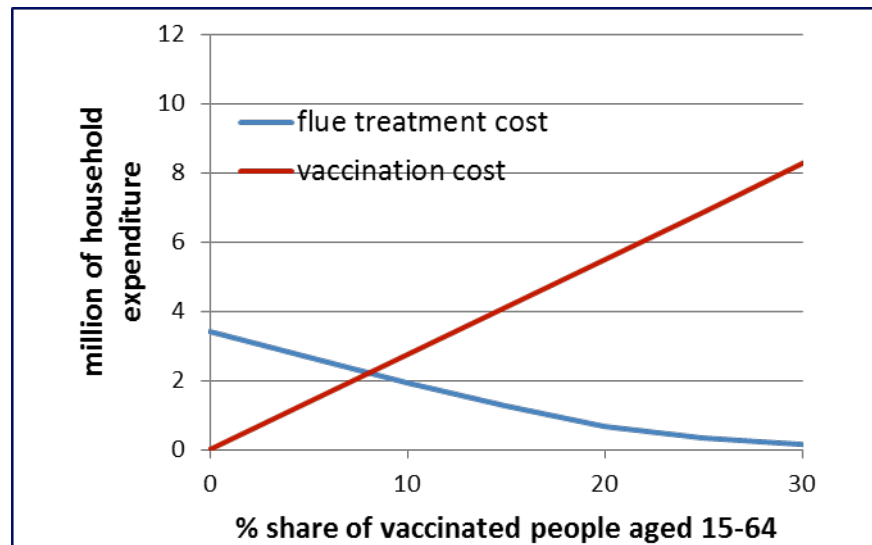
Table of Suceptible Infected Recovered people

## Vaccination impact on economy

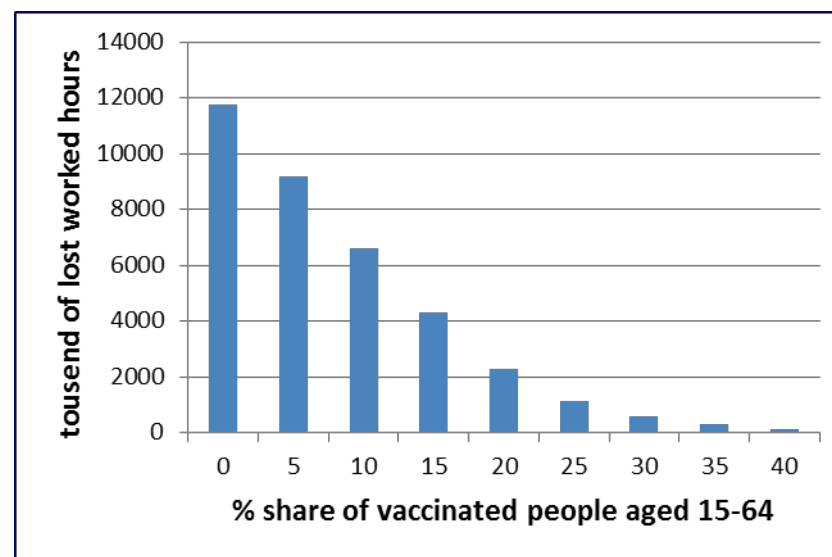
In 2009/2010 winter we have estimated over 250.000 cases of flu in Tuscany without vaccination we estimated they would have been about 620.000.

The regional health service paid vaccination only for people over 65 and people with particular diseases. The public and private unitary expenditure for e vaccine dose and injection is respectively 14.5 and 21.5 euros.

### Expenditure for vaccination and flu treatment



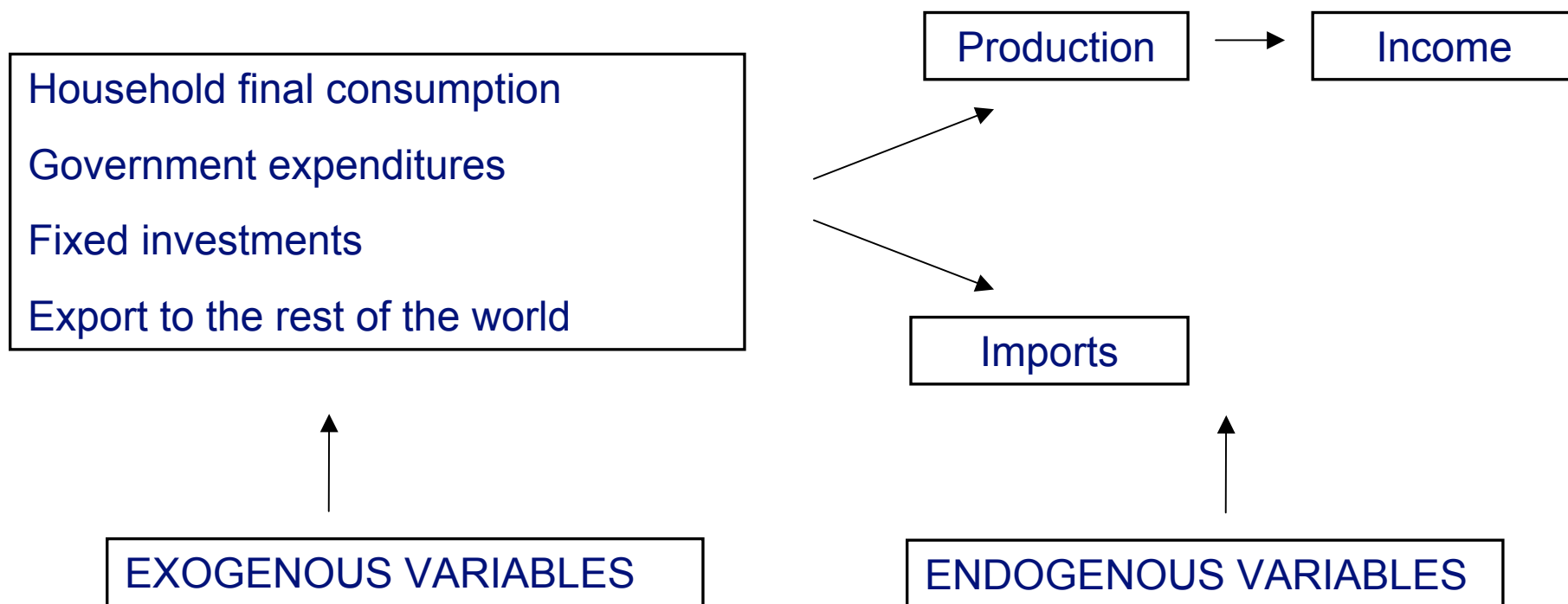
### Flu and lost worked hours



# input / output simulation framework

Input-output model simulate the evolution of production, gdp, regional and foreign import and employees at change of the final demand composed by household and government expenditure, investments, regional and foreign exports).

Imports Production Income	= F ( INTERNAL FINAL DEMAND, EXPORT )
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# Aggregate input output model form

Change of investments and public current expenditure

Selection of the public sector

Impatto Investimenti Pubblici

Simulazione di impatto degli investimenti pubblici

		Variazioni Percentuali	Differenze Assolute	Livelli assoluti	Settore che investe
<b>VARIABILI ESOGENE</b>					
Macchinari	<input type="text" value="0.00"/>	0.00	0	50.0	<input checked="" type="radio"/> Pubblica amministrazione
Costruzioni	<input type="text" value="0.00"/>	0.00	0	861.0	<input type="radio"/> Sanità
Mezzi di trasporto	<input type="text" value="0.00"/>	0.00	0	20.0	<input type="radio"/> Istruzione
Altri investimenti	<input type="text" value="0.00"/>	0.00	0	128.0	
Spesa Corrente	<input type="text" value="0.00"/>	0.00	0	9635.0	
Resto domanda finale	<input type="text" value="0.00"/>	0.00	0	163480.0	
<input type="button" value="Mostra Scenario"/> <input type="button" value="Help"/> <input type="button" value="Ripristina"/>					
		Variazioni Percentuali	Differenze Assolute	Livelli assoluti	
<b>VARIABILI ENDOGENE</b>					
PIL	<input type="text" value="0.00"/>	0.00	0	104383.0	
Importazioni regionali	<input type="text" value="0.00"/>	0.00	0	43361.0	
Importazioni estere	<input type="text" value="0.00"/>	0.00	0	26430.0	
Unità di lavoro totali	<input type="text" value="0.00"/>	0.00	0	1681.0	
Produttività settore pubblico	<input type="text" value="0.00"/>	0.00	0	61900.0	

Le differenze ed i livelli degli aggregati sono espressi in milioni euro.

I dati di base si riferiscono all'economia toscana nel 2008

L'impatto è basato sui moltiplicatori di un modello biregionale Toscana Resto d'Italia e consumo esogeno.

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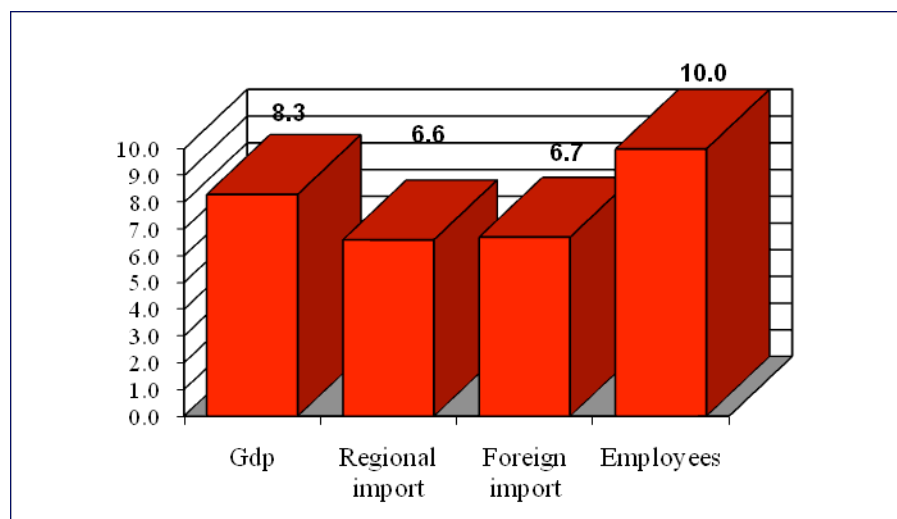
Impact on macro-economic variables

# Health expenditure impact on economy

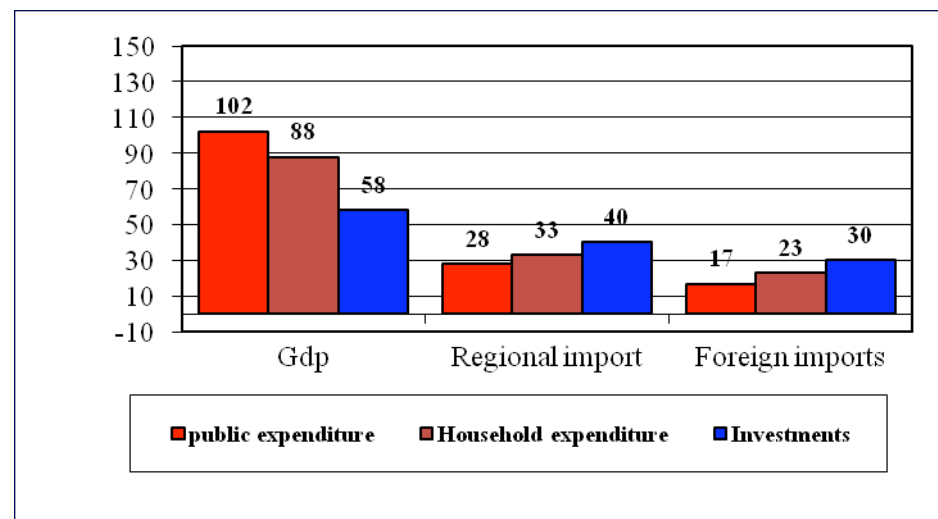
## Impact evaluation of health expenditure

Health expenditure	Economical effect					Expenditure multipliers			
	Expenditure	Gdp	Regional Import	Foreign import	Employees	Gdp	Regional Import	Foreign import	Employees (per million)
Public health expenditure	6,512	6,639	1,840	1,128	131,364	102	28	17	20
Household expenditure	1,912	1,680	635	434	31,662	88	33	23	17
Health fixed investment	682	393	270	201	7,359	58	40	30	11
Overall effect on Tuscan accounts	9,106	8,712	2,745	1,764	170,385	96	30	19	19
		8.3%	6.6%	6.7%	10.0%				

## % incidence of impact on regional accounts

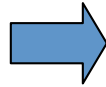


## Multipliers: Impact of a € 100 expenditure



# Sectorial impact of health expenditure

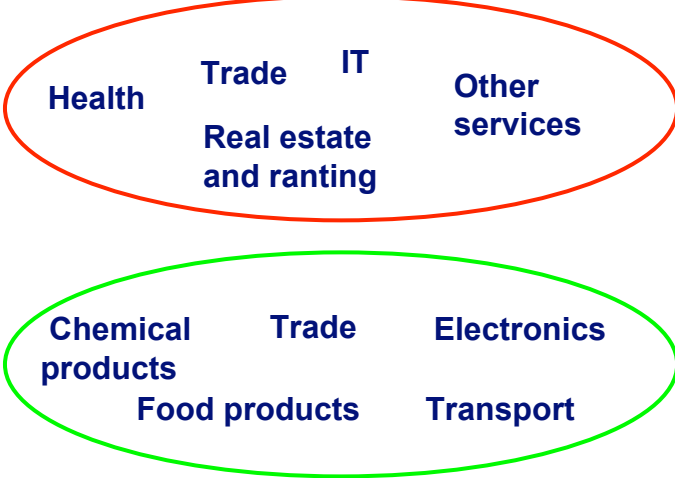
Overall expenditure  
9.106 million



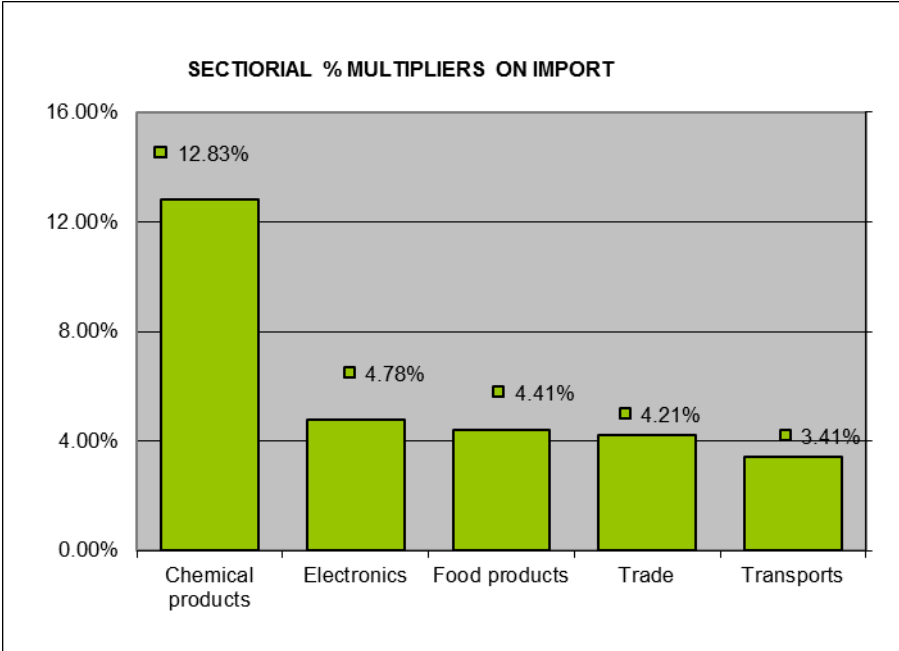
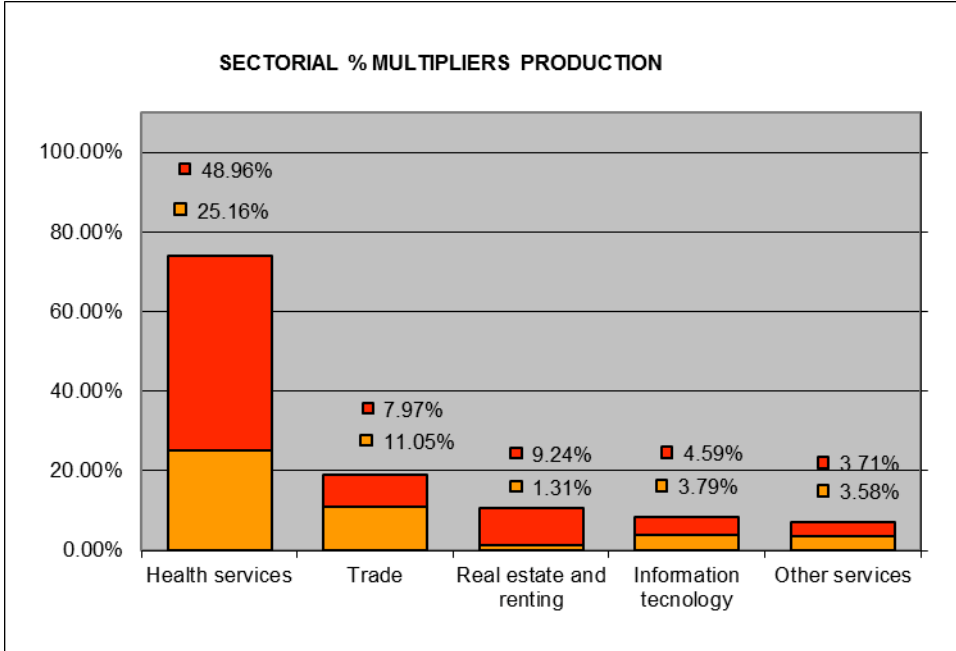
Production	14.173
Gdp	8.712
Employes	170.385

Imports:	
Regional imports	2.745
Foreign imports	1.764

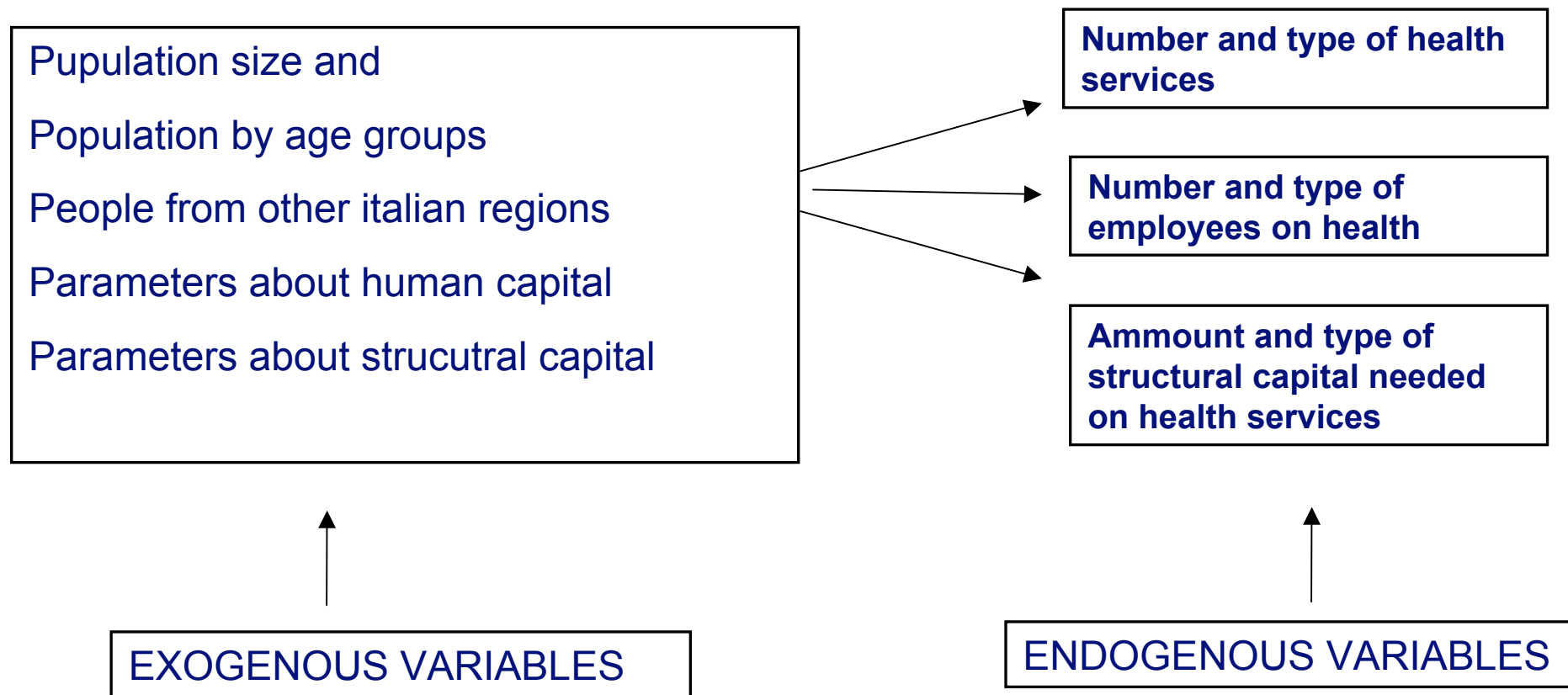


Impact of € 100 health expenditure (current + investment)...



# Structural health service model framework

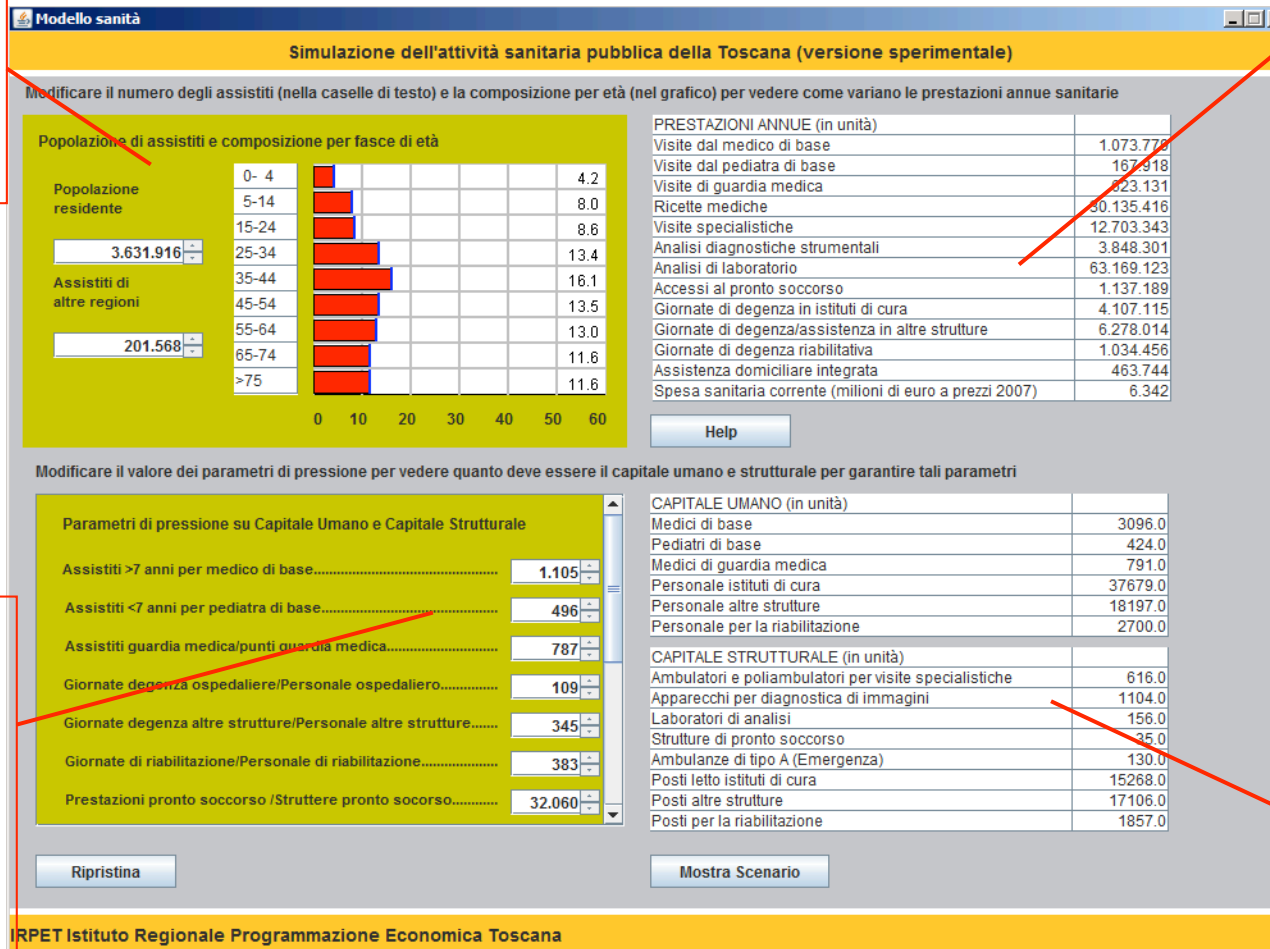
Simulation tool to see the evolution of government health expenditure and of the number and type of health services at every change of the population level and age structure plus the evolution of the capital needed to face the request of health services by population.



# Health services structural model form

Change of population size and age distribution frequencies

Effect on health services demand and health public expenditures

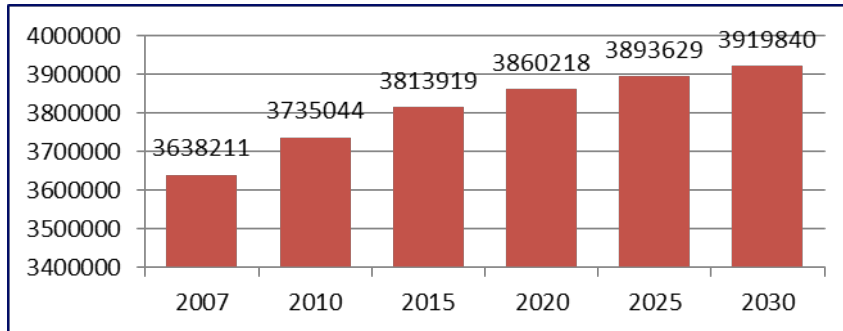


Change pressure parameters on human and structural capital

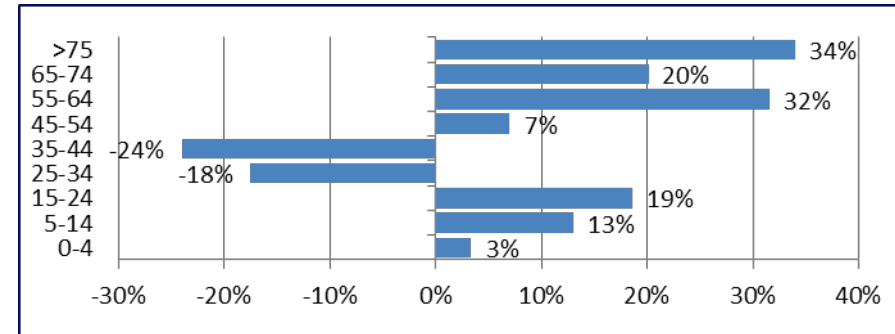
Effect on needed human and structural capital to satisfy health services demand

# Population ageing and public health services

Population growth between 2007 and 2030



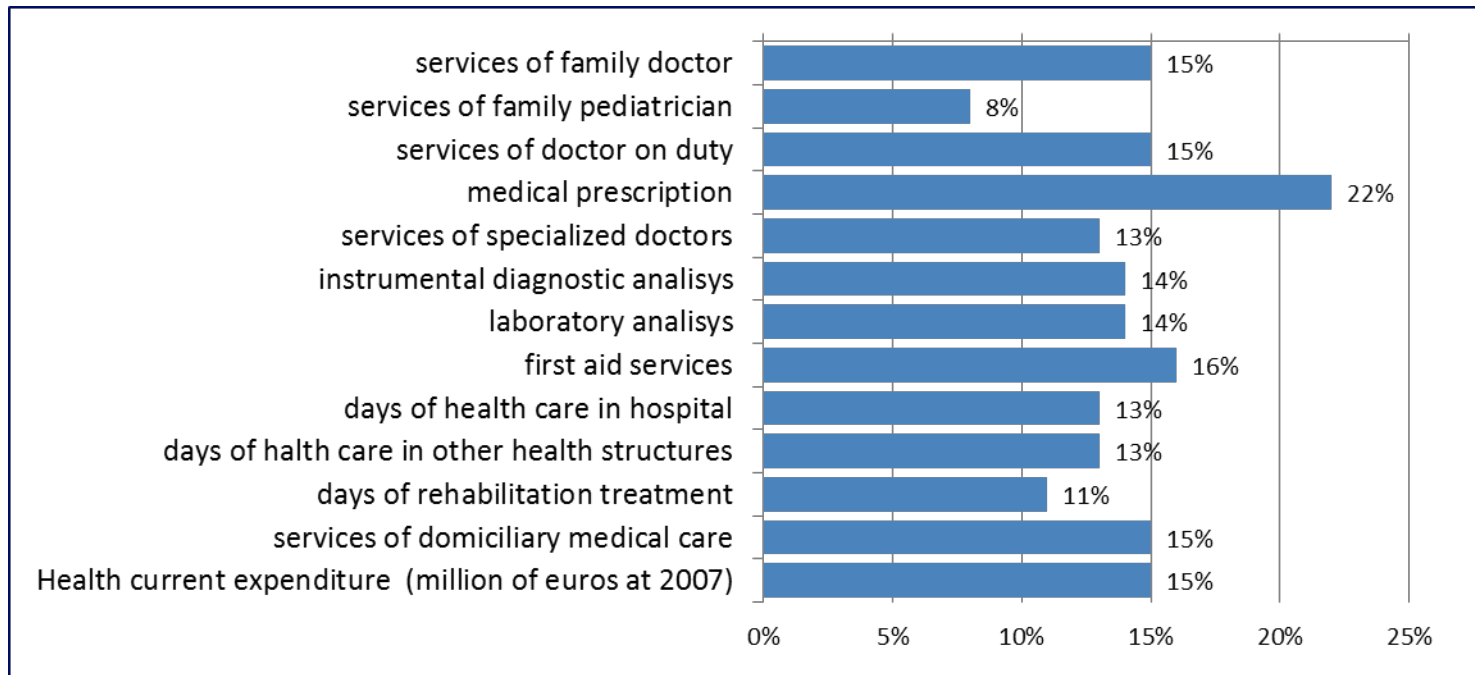
Population growth between 2007 and 2030 by age groups



Growth rate of health service between 2007 and 2030

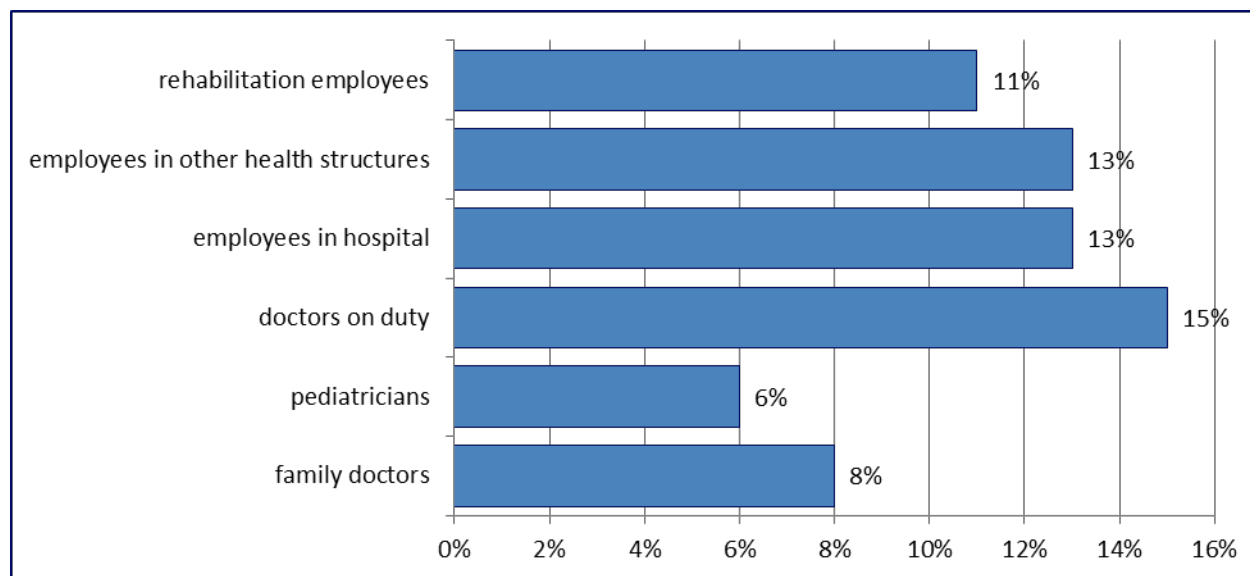
**Health expenditure.  
Constant million of  
euros at 2007**

years	public health exp.
2007	6342
2010	6534
2015	6732
2020	6912
2030	7301

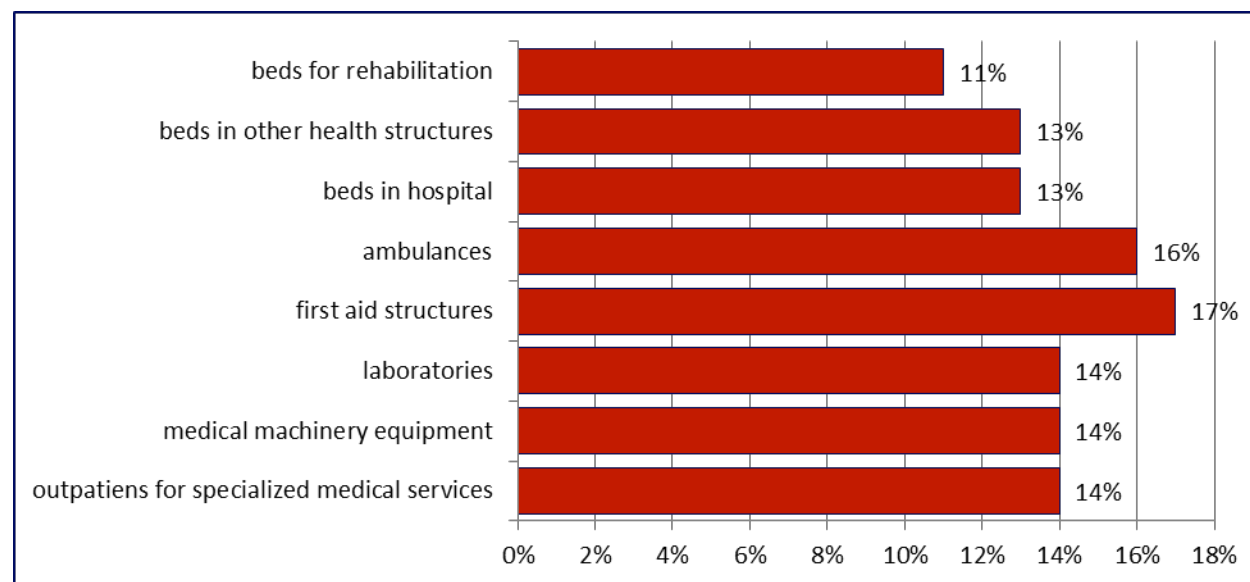


# Growth rate of fixed capital and employees on health services

## Growth rate of health services employees



## Growth rate of fixed capital



## **We developed also:**

Arima model simulations

Simulation of Economical Impact of tourists presences in Florence province

Carrying Capacity simulation

Simulation of the Effect of globalization change on life expectancy on world areas

Dynamic input output model simulation

## **We are going to develop:**

Dynamic population simulation linked to foreign inward flows

Economical and environmental impact of energy production investments

Change on income distribution for each change of tax rate on several income groups

Mismatch between job demand and job supply changing productivity, gdp and population growth



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