Modelling Imbalanced Economy Recovery in Post-disaster

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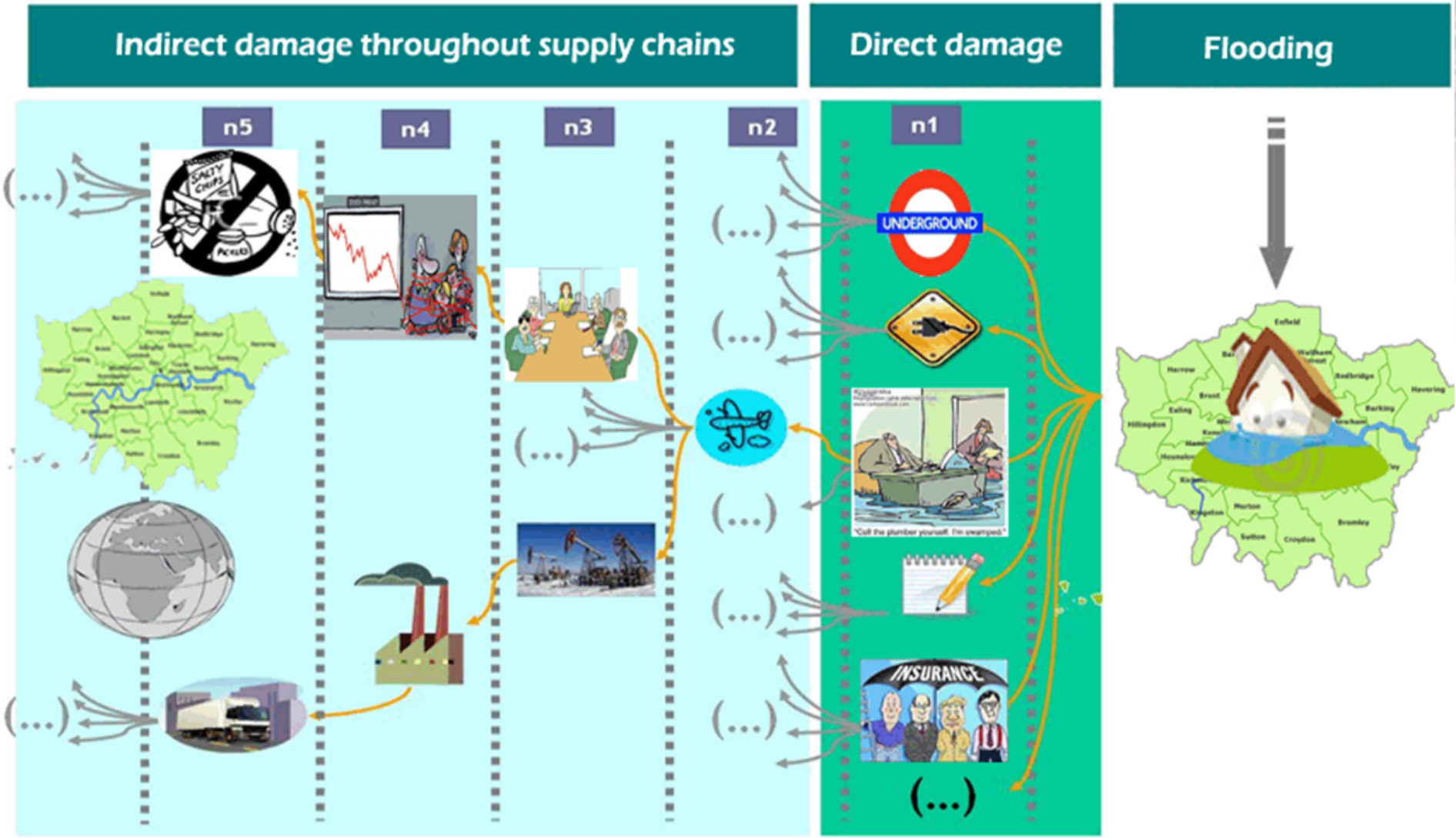
Integrated Disaster Analysis



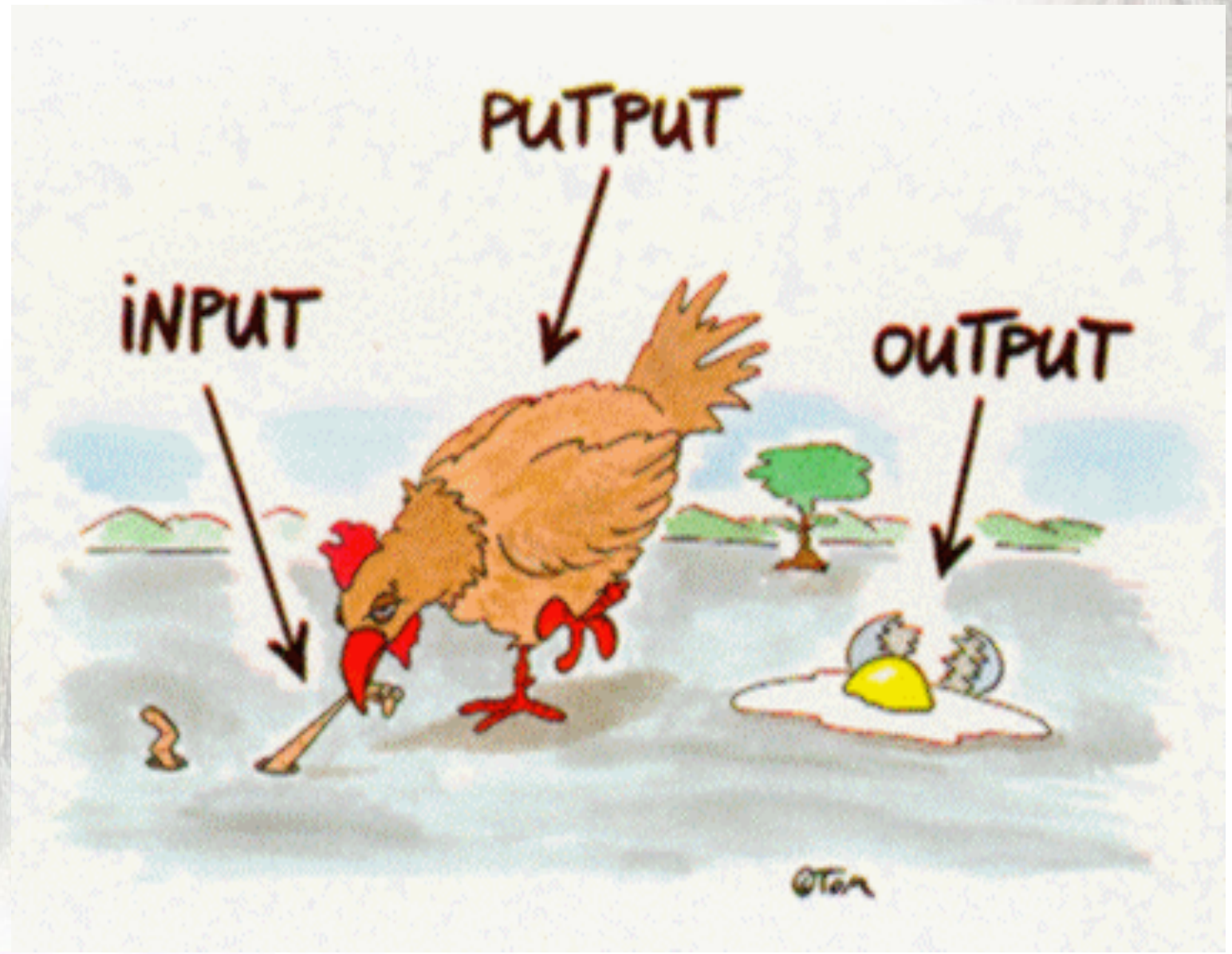
Past efforts in developing modeling principles in post disaster economy

- There is no generally accepted formula for the representation of a post-disaster economy development
- There is no general way that economic agents will adjust and an imbalance economy will change.
- Economy recovery of a post-disaster will have two steps to restore pre-disaster conditions: the first is to reach ‘as fast as possible’ the targeted output proportions and the second is to bring the economy back to the pre-disaster scale of operation.
- Some statistics have demonstrated that the imbalance may persist during a post-disaster period and economic agents have to adapt themselves in a very dynamic manner.
- Housing destruction and labour can be constraint on production capacity

Using input-output analysis framework

- Wassily Leontief's PhD dissertation in Germany on Kreislaufwirtschaft,
- developed input-output analysis in the 1930s
- Will there be unemployment after war?
- Environmental Repercussion and the economic system (1970)
- Nobel Prize in 1973

Using input-output analysis framework



Using input-output analysis framework

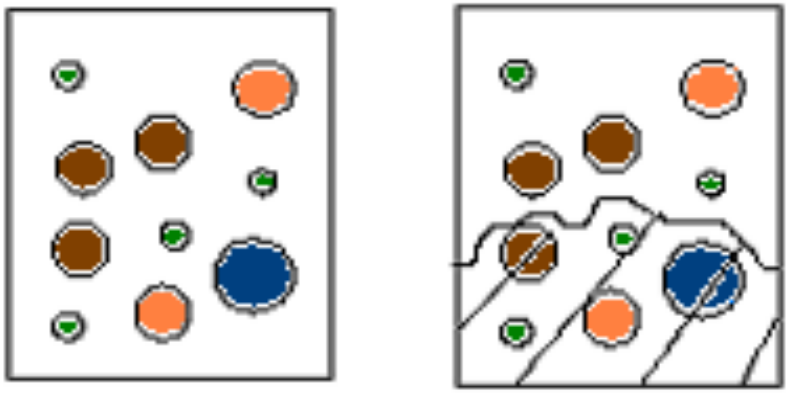
- IO analysis is grounded in the technological relations of production and provides a full accounting for all inputs into production.

- IO analysis is a powerful tool to assess the economic effect of a natural catastrophe at a regional and sectoral level through intermediate consumption and demand.

- Although IO analysis is mainly a model of production, it's fully capable of analyzing households and other institutions.

- IO model's simplicity and integration ability with engineering models and data

Using input-output analysis framework



(a) Pre-disaster (b) Post-disaster

Post disaster shows flood affecting part of the country.

Size of dot = output, colour of dot = sector.

- We view the economy as a system of circular flow interrelations among production and consumption, then the interrelations are broken by the incident and a multitude of imbalances is expected in supply-demand relations during its recovery

- Event accounting matrix: *records the intensity of the impacts on each activity and transaction in the first instance, and the response of each activity or transaction after a disaster in the second instance*

- Factors considered in recovery: labour (loss + productivity), capital survived and recovered, households demands and rationing priorities in recovery.

Four steps in modeling recovery

Two major factor impact total economic production capacity – labour + industrial capitals

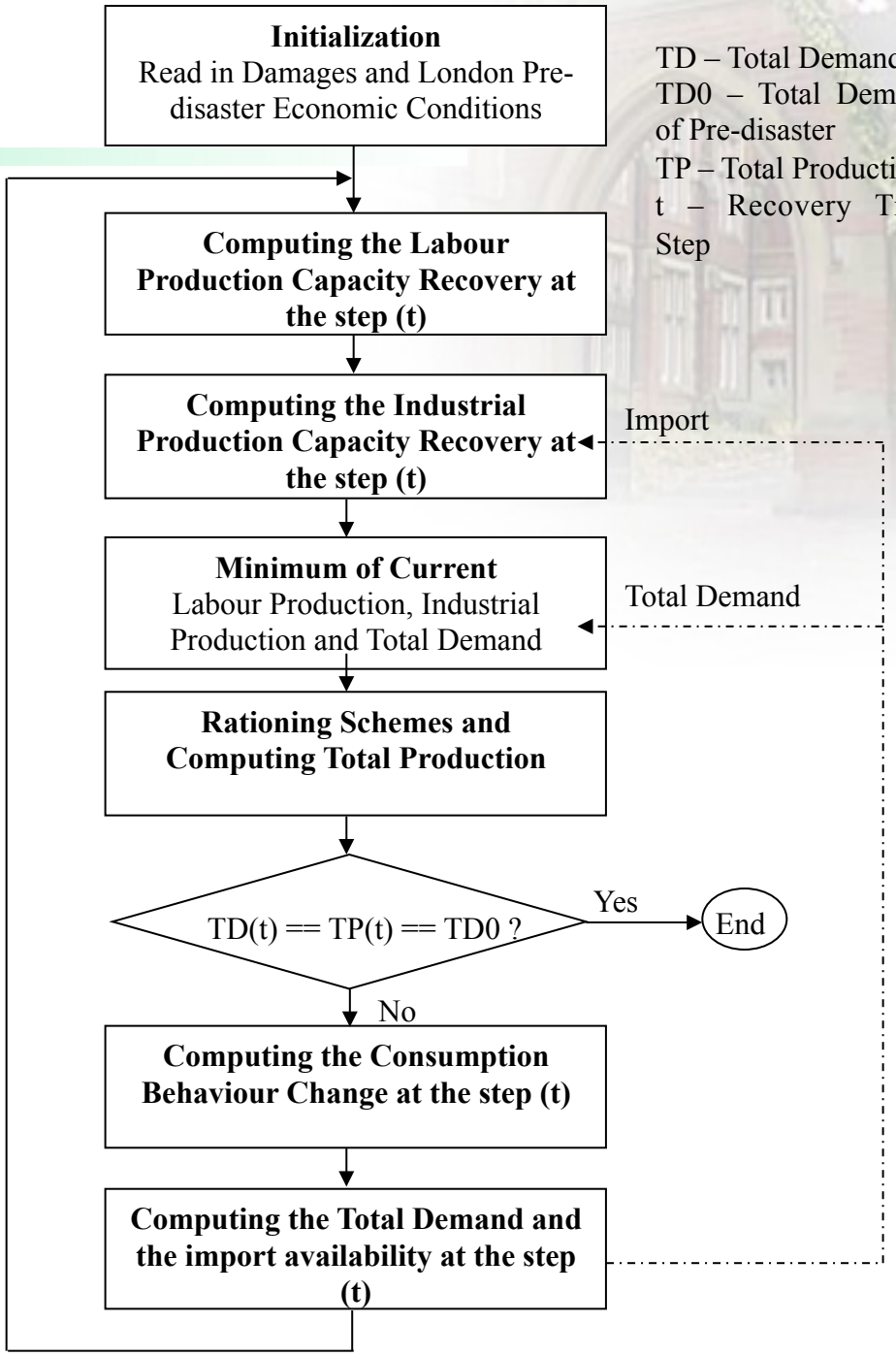
Step 1: the labour loss (labour not available for travelling + labour delayed for work).

Step 2: industrial capital recovery is captured by the damage demand through the local production and import.

Minimizing the above two to obtain next round Production Capacity

Step 3: a rationing scheme: e.g. a priority order in terms of recovery.

Step 4: Production Capacity meets pre-disaster level – end, or repeat loop(s).

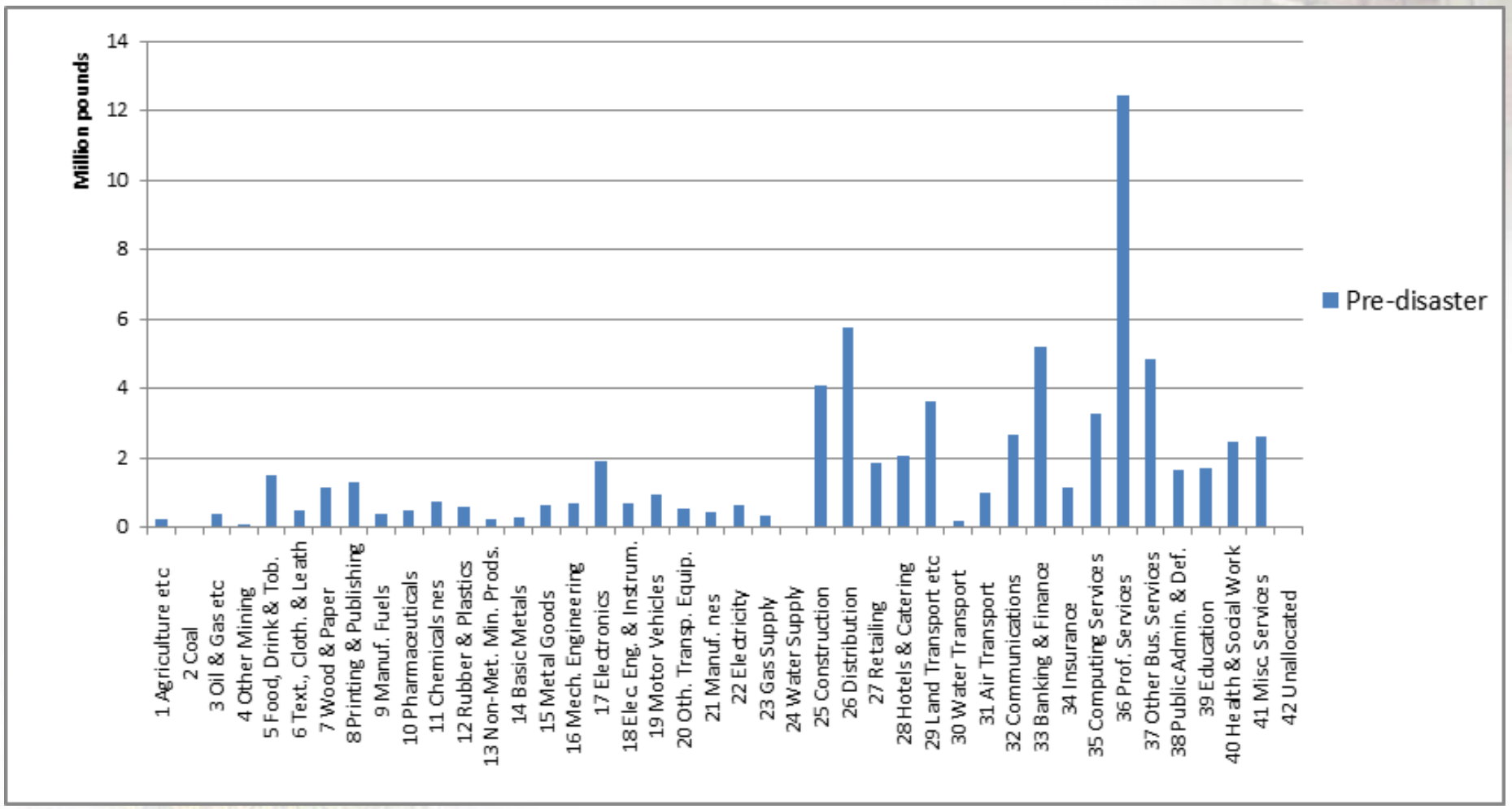


A few words about the rationing scheme

$$\mathbf{x}^0(i) = \sum_j \mathbf{A}(i,j)\mathbf{x}^0(j) + \begin{cases} \mathbf{f}^0_{\mathbf{hh}}(i) \\ \mathbf{f}^0_{\mathbf{gov}}(i) \\ \mathbf{f}^0_{\mathbf{cap}}(i) \\ \mathbf{f}^0_{\mathbf{exp}}(i) \\ \mathbf{f}^0_{\mathbf{rec}}(i) \end{cases}$$

X is the total Production Capacity. **AX** is the industrial intermediate consumption; **f** is final demand – household (hh), government (gov), capital investment (cap), exports (exp) and reconstruction (rec)

Hypothetical flooding in London



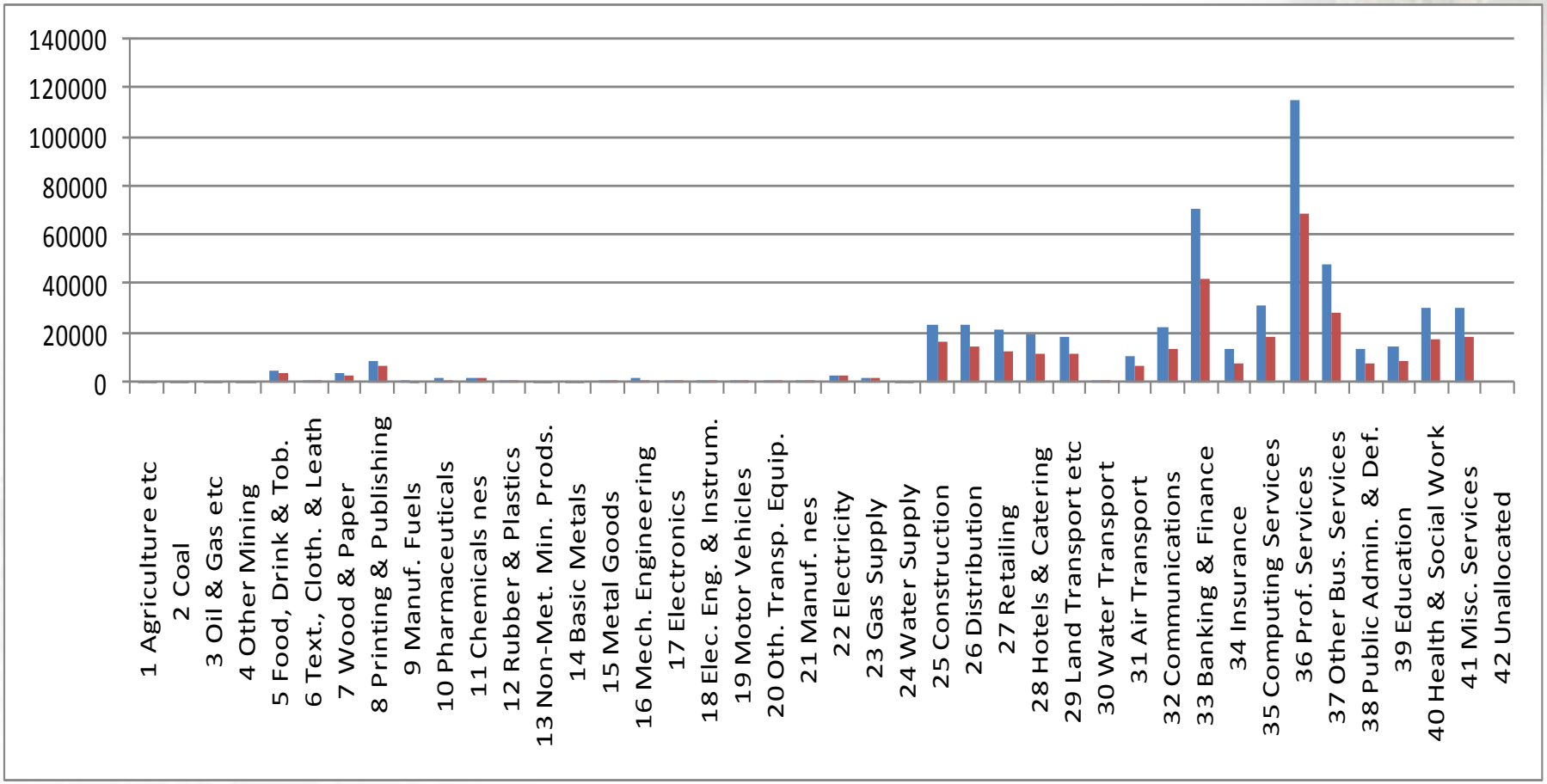
Introduce a major flood…

1 Agriculture etc	30%	12 Rubber & Plastics	20%	23 Gas Supply	10%	34 Insurance	40%
2 Coal	10%	13 Non-Met. Min. Prods.	20%	24 Water Supply	10%	35 Computing Services	40%
3 Oil & Gas etc	10%	14 Basic Metals	20%	25 Construction	30%	36 Prof. Services	40%
4 Other Mining	10%	15 Metal Goods	20%	26 Distribution	40%	37 Other Bus. Services	40%
5 Food, Drink & Tob.	20%	16 Mech. Engineering	20%	27 Retailing	40%	38 Public Admin. & Def.	40%
6 Text., Cloth. & Leath	20%	17 Electronics	20%	28 Hotels & Catering	40%	39 Education	40%
7 Wood & Paper	20%	18 Elec. Eng. & Instrum.	20%	29 Land Transport etc	40%	40 Health & Social Work	40%
8 Printing & Publishing	20%	19 Motor Vehicles	20%	30 Water Transport	40%	41 Misc. Services	40%
9 Manuf. Fuels	20%	20 Oth. Transp. Equip.	20%	31 Air Transport	40%	42 Unallocated	40%
10 Pharmaceuticals	20%	21 Manuf. nes	20%	32 Communications	40%	43 Labour	50%
11 Chemicals nes	20%	22 Electricity	10%	33 Banking & Finance	40%		

Table 1. Event Matrix Γ^0

Hypothetical flooding in London

- So what if a flooding hits London which results in 50% labour cannot travel to work and 30%, 10% and 50% of machinery or work place cannot function normally in agriculture, industry and services sectors , respectively.



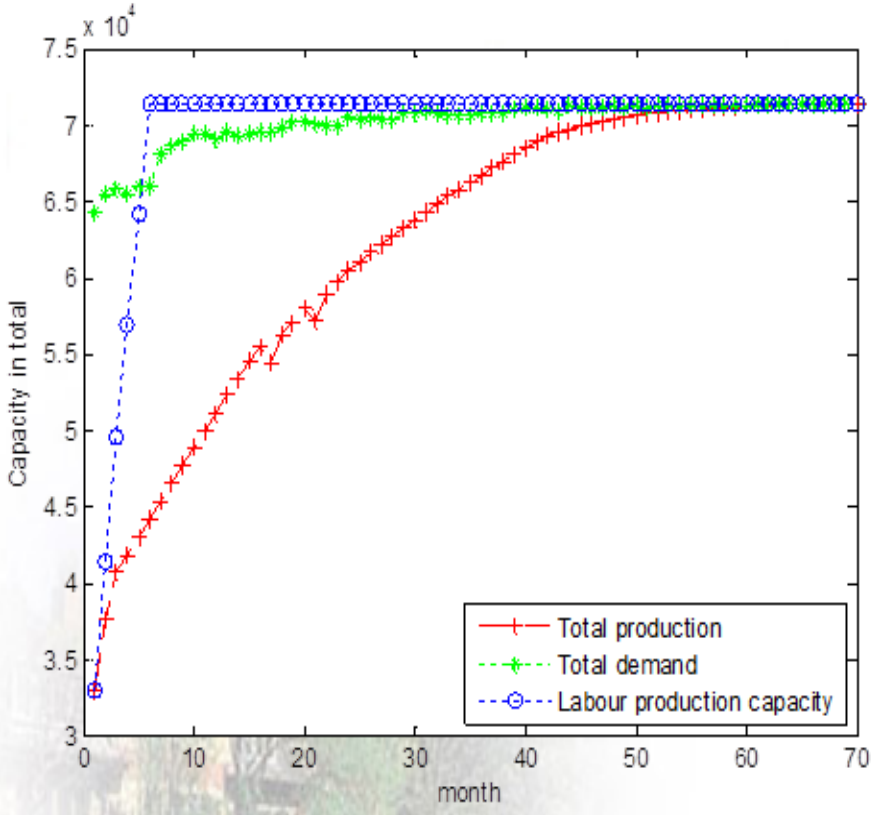
Hypothetical flooding in London

- If we only account for the direct economic loss, London 2020 industrial outputs will shrink to 342 billion pounds from 552. The loss will be 48%, but if we account for both direct and indirect loss, London economic output will further reduce to 191 billion pounds. The economic shrinks 65%. The labour will lose 67%.

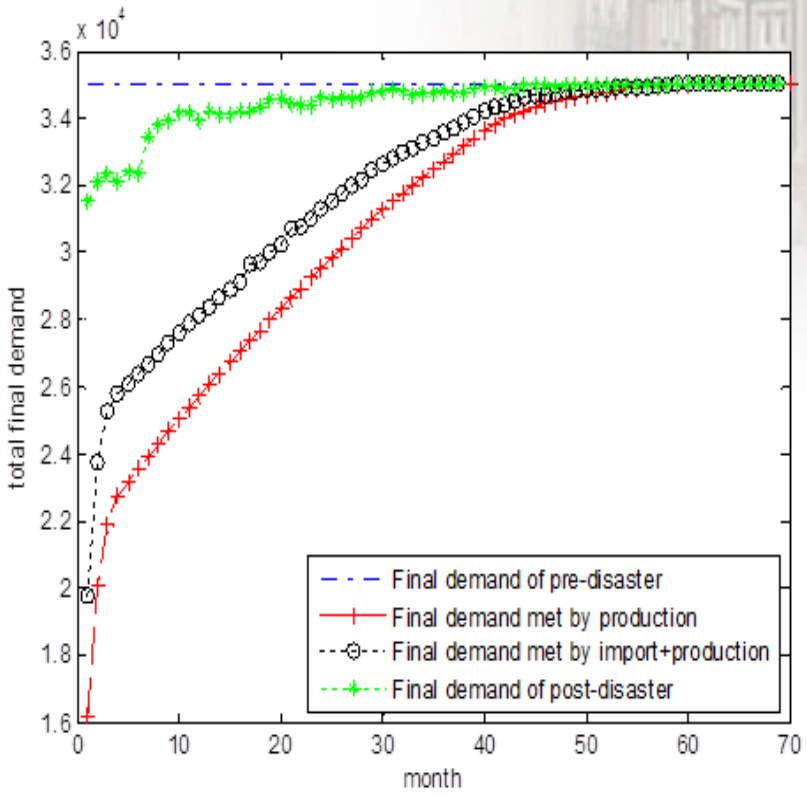
- If we recover the economic from there, assuming all production activities have give the propriety to fulfill London resident's consumption, and the government investment pattern has no changes:

- London's economic will be restored to 360 billion pounds in 2018, and further to 551 billion pounds by 2020.

Recovery ...

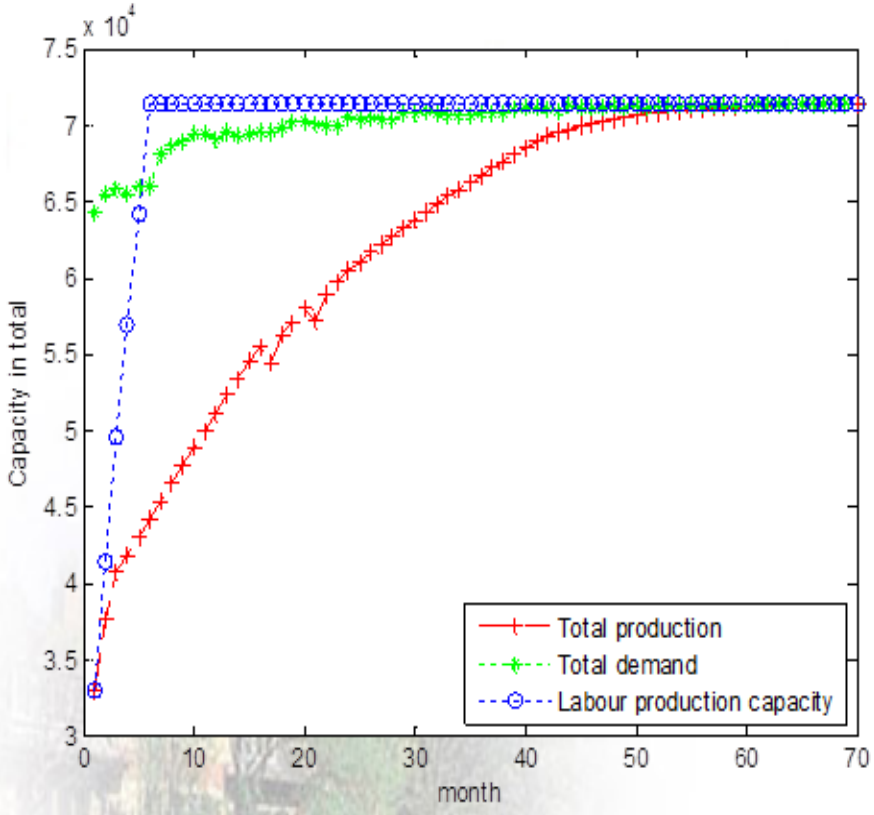


The total production inequalities between different factors during the recovery



The total final demand inequalities between different factors during the recovery

Recovery ...



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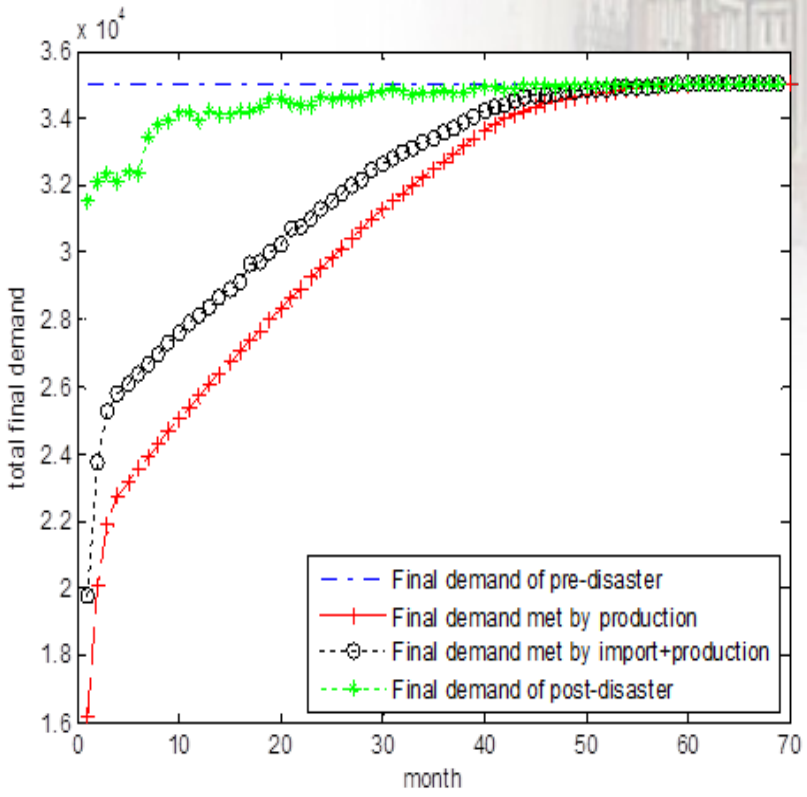
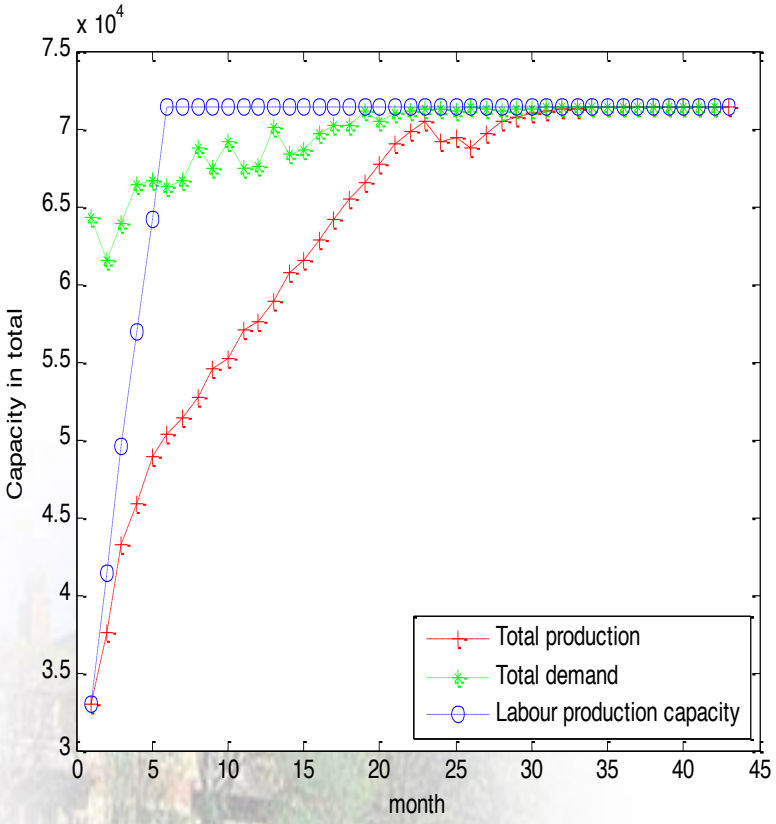
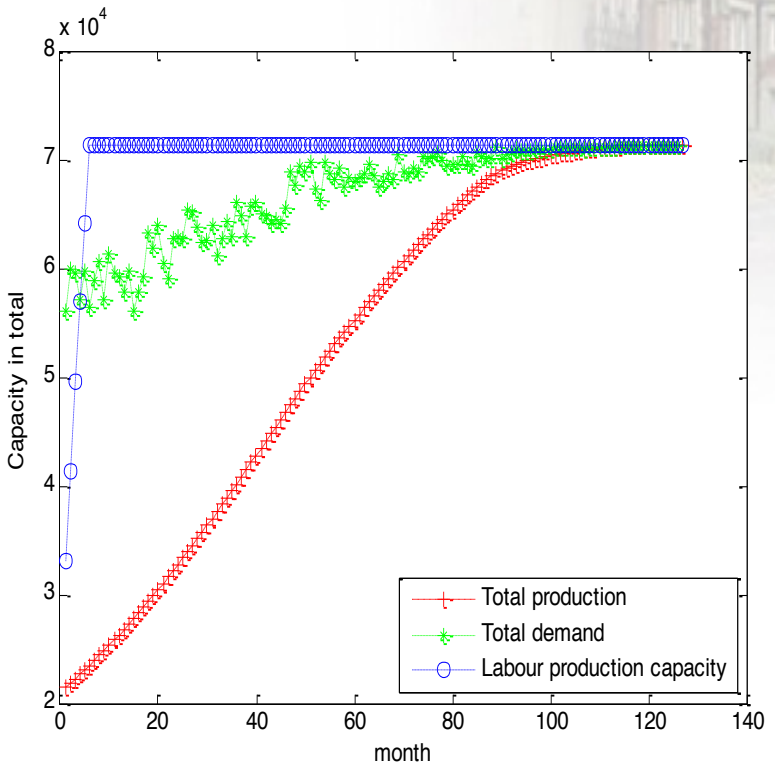


The total final demand inequalities between different factors during the recovery

Sensitivity analysis: different scale of direct damage

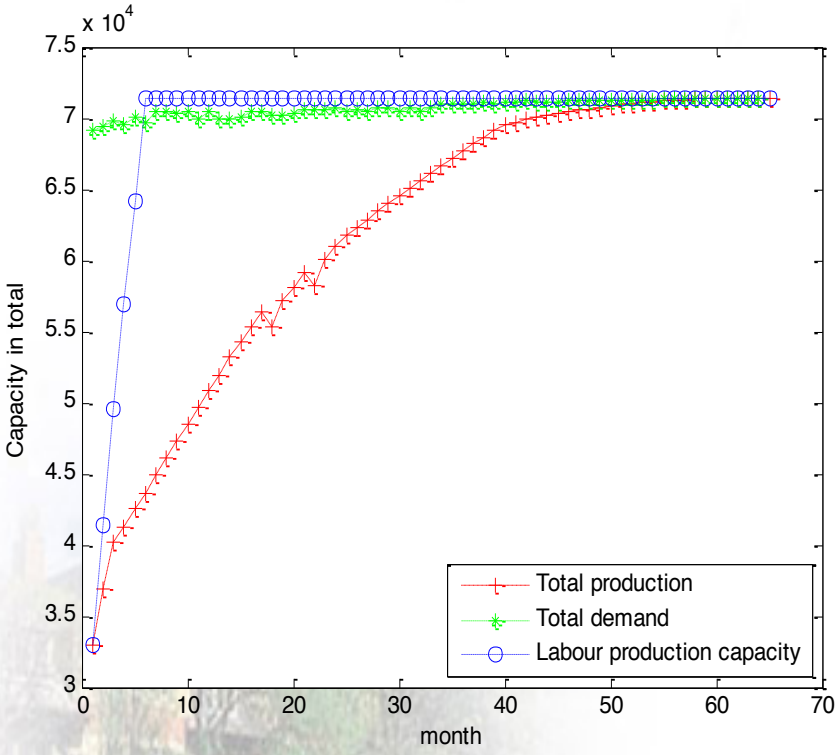


Unequal recovery given 10% direct loss

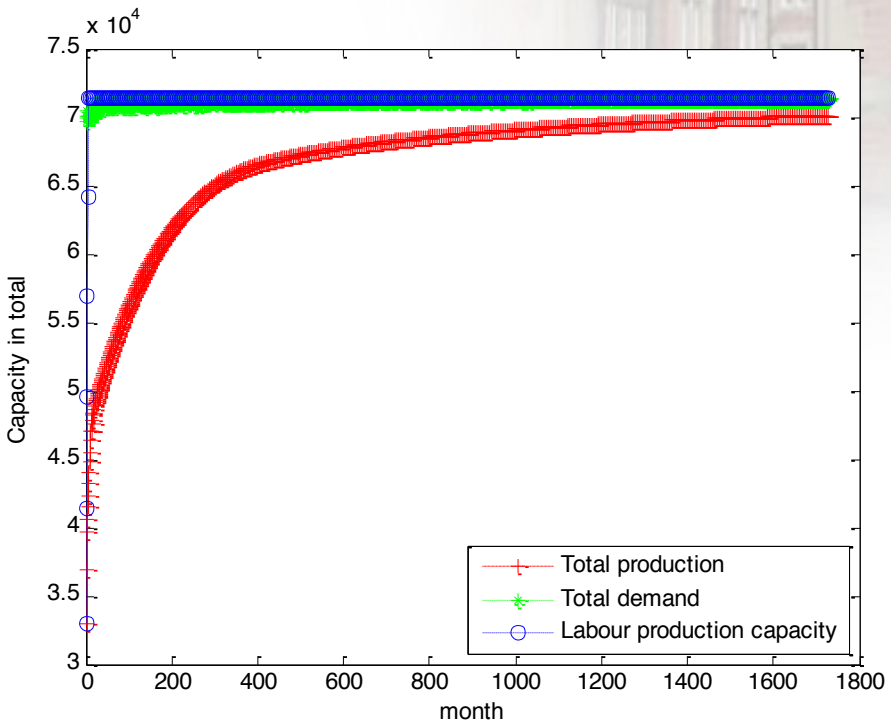


Unequal recovery given 70% direct loss

Sensitivity analysis: different scale of direct damage



The recovery based on the damage demand prior scheme



The recovery based on the final demand prior scheme

Integrated Disaster Analysis

Flooding in one location can impact the whole UK economy. Neglecting these knock-on costs (i.e. the true footprint of the flood) means we might be ignoring the economic benefits and beneficiaries of flood risk management interventions. In 2007, for example, floods cost the economy about £3.2 bn directly, but the wider effect might actually add another 50% to 250% to that.

Flood footprint is a measure of the exclusive total socioeconomic impact that is directly and indirectly caused by a flood event to the flooding region and wider economic systems and social networks.