

Understanding the role of SDG5 within a network of SDG interactions

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Outline

- Sustainable Development Goals
 - ICSU–ISSC Report 2015
 - Methodology - network approach

- Dynamics of a simple model
 - Equal 'direct effort' - evolving the model forwards in time
 - Optimisation over allocations of 'direct effort'

- Conclusions

Millennium Development Goals

The Millennium Development Goals Report
2015



The education of women and girls has a positive multiplier effect on progress across all development areas.

...

Gender perspectives should be integrated fully into all goals of the post-2015 development agenda.

MDGs Report, pages 29 and 31.

Sustainable Development Goals



- 17 Goals, 169 direct targets and 'means of implementation targets' in total.
- Goals 1-16 together have 107 direct targets.

Sustainable Development Goals

Sustainable Development Goals and their two-letter abbreviations used here:

1. Poverty	PO (5)	2. Hunger	HU (5)	3. Health	HE (9)
4. Education	ED (7)	5. Gender	GE (6)	6. Water	W (6)
7. Energy	EN (3)	8. Growth	GR (10)	9. Industry	II (5)
10. Inequality	IN (7)	11. Cities	CI (7)	12. SCP	SC (8)
13. Climate	CC (3)	14. Oceans	O (7)	15. Ecosystems	TE (9)
16. Peace	PE (10)				

- In parentheses, the number of individual targets associated with each Goal.
- Goal 17 concerns the 'means of implementation' of the others – omitted here.
- What are the consequences of setting so many different targets?
- Do some Goals depend strongly on others, or are they independent?
- Which Goals are therefore harder to achieve?

ICSU–ISSC Report



REVIEW OF TARGETS FOR
THE SUSTAINABLE DEVELOPMENT GOALS:
THE SCIENCE PERSPECTIVE



- ICSU
International Council for Science
- ISSC
International Social Science Council
- Report discusses and criticises the
SDGs *from the science perspective*
- Few reports discuss all the SDGs
using a consistent methodology:
this one does

ICSU–ISSC Report: conclusions

- The SDGs are an improvement over the MDGs because the SDGs address systematic issues, e.g. inequality, unsustainable consumption patterns, lack of institutional capacity, environmental degradation.

But:

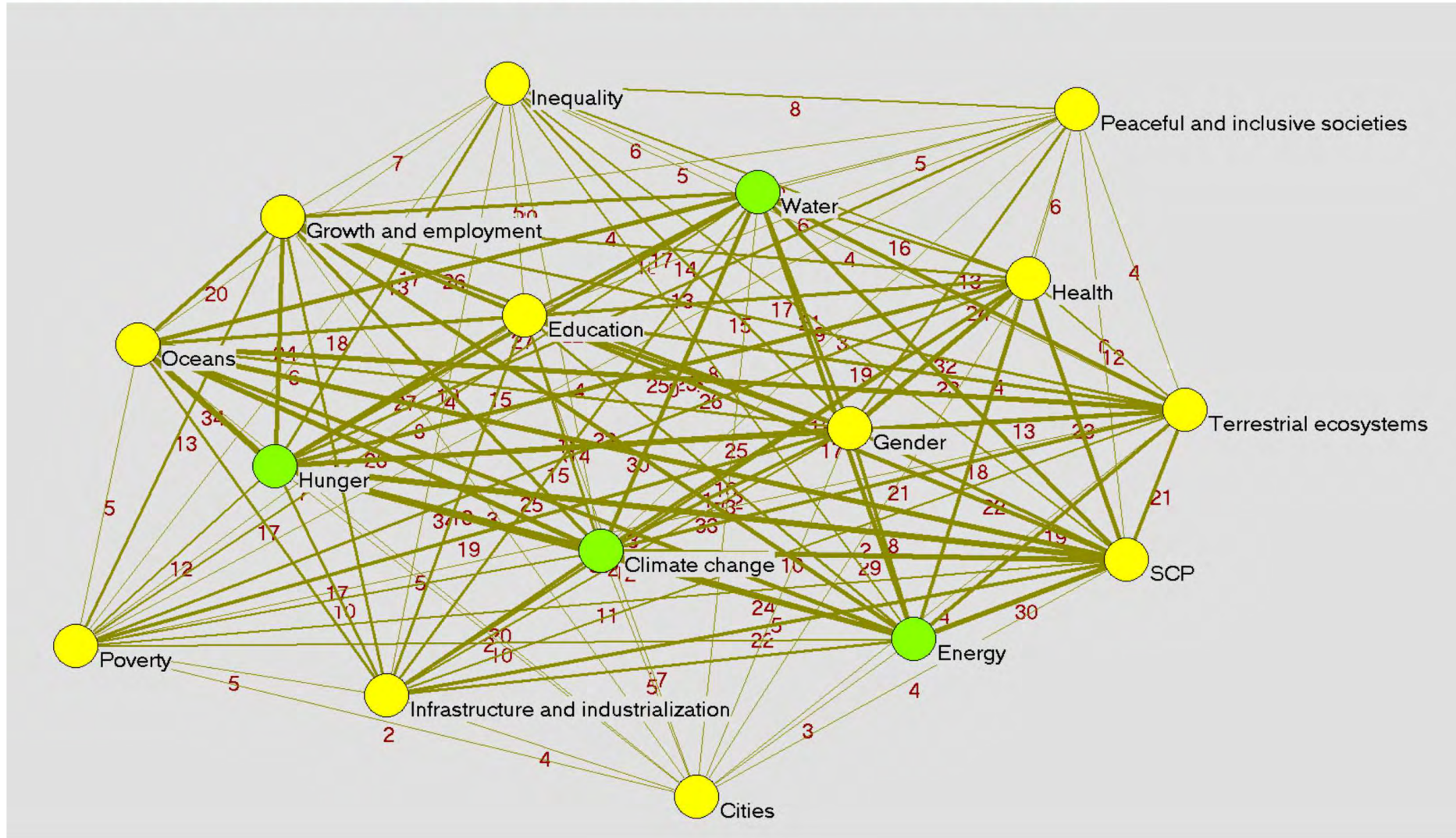
- There is no 'overall' Goal binding the 17 Goals together.
- There is no sense of which parts of society/gov't will drive the changes.
- Trade-offs and complementarities among Goals are not specified.
- Looking in detail at the wording, only 29% of the targets are well-structured, 54% should be more specific, and **17% need significant work so that they are meaningful.**

Key question: **What are the interlinkages between Goals?**

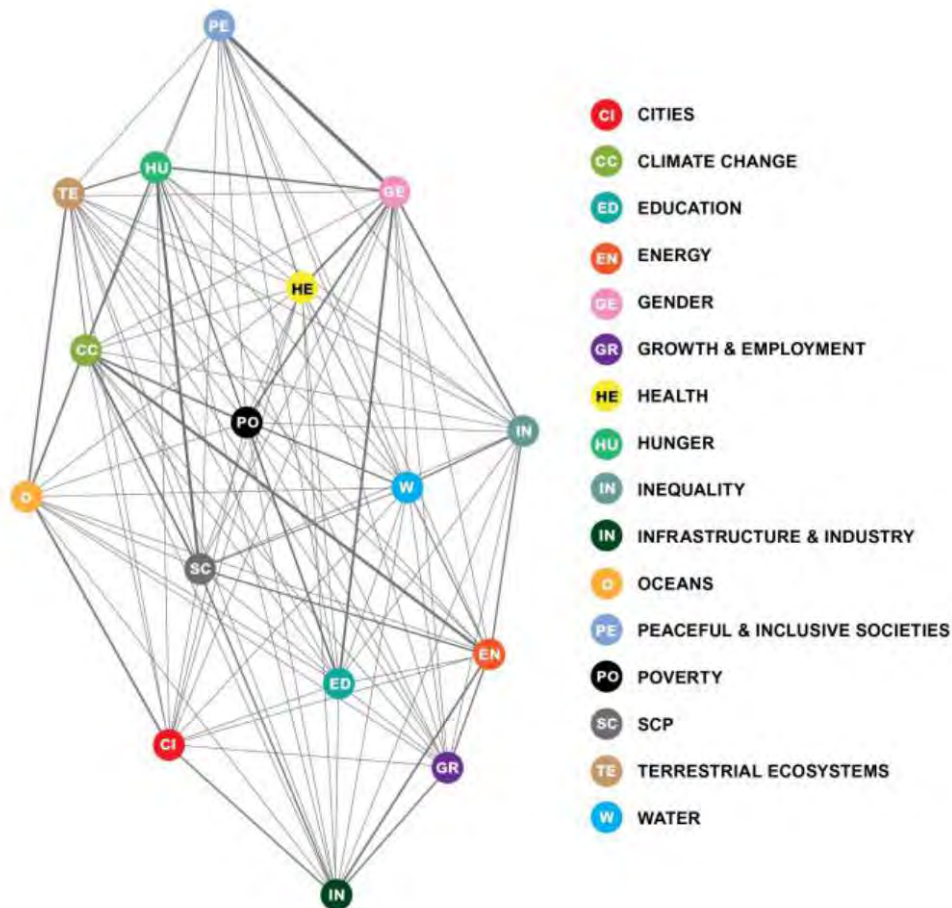
UN DESA Analysis of ICSU Report

Figure 5

Links between SDG targets and other goals made by scientists in a review of SDGs: The whole SDG system



UN analysis and Briefing Note



Data source: ISCU/ISSC report^{Error! Bookmark not defined.}. Notes: The numbers on the links indicate the percentage of targets linking the two goals (number of links between two goals divided by the sum of targets under the two goals). SDG17 on “means of implementation” (which links to all other goals) was excluded from the analysis.

The network of goals as perceived by the ISCU/ISSC report. The width of lines between two goals indicates the number of links through SDG targets as suggested by the scientific literature.

As the number of targets under each goal varies greatly, links between two goals are weighted by the total number of targets under the two goals.

When SDG17 on ‘means of implementation’ (which is linked to all other goals) is excluded from the analysis, **SDG1 on poverty is the most central node** for the system.

In other words, in the view of scientists, **progress on poverty eradication is central** to other goals.

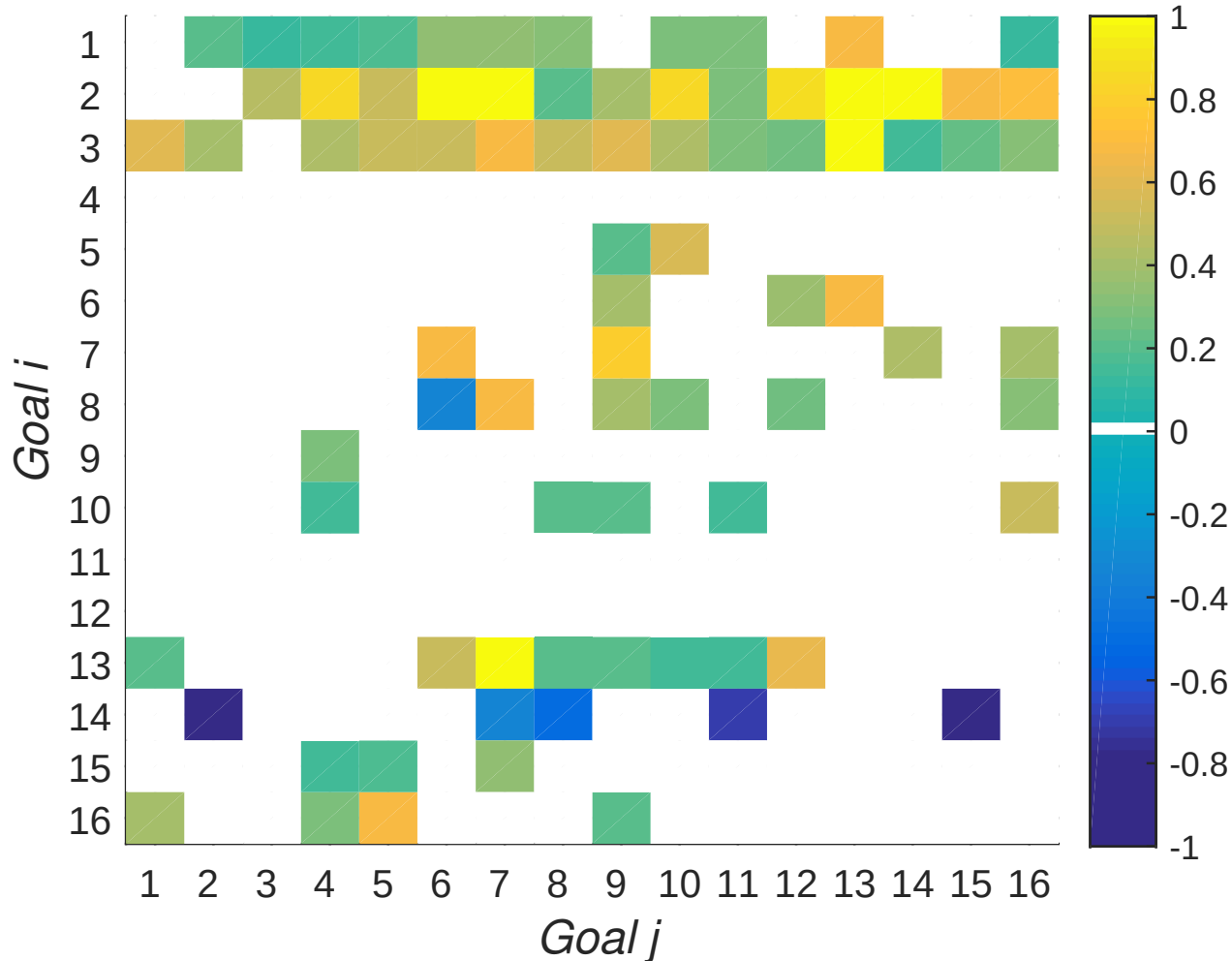
Methodology

- The ICSU-ISSC Report contains commentary that shows directed linkages between Goals, e.g.

Women's involvement [Goal 5] in economic growth [Goal 8] is central given their roles in both waged employment and unwaged work.

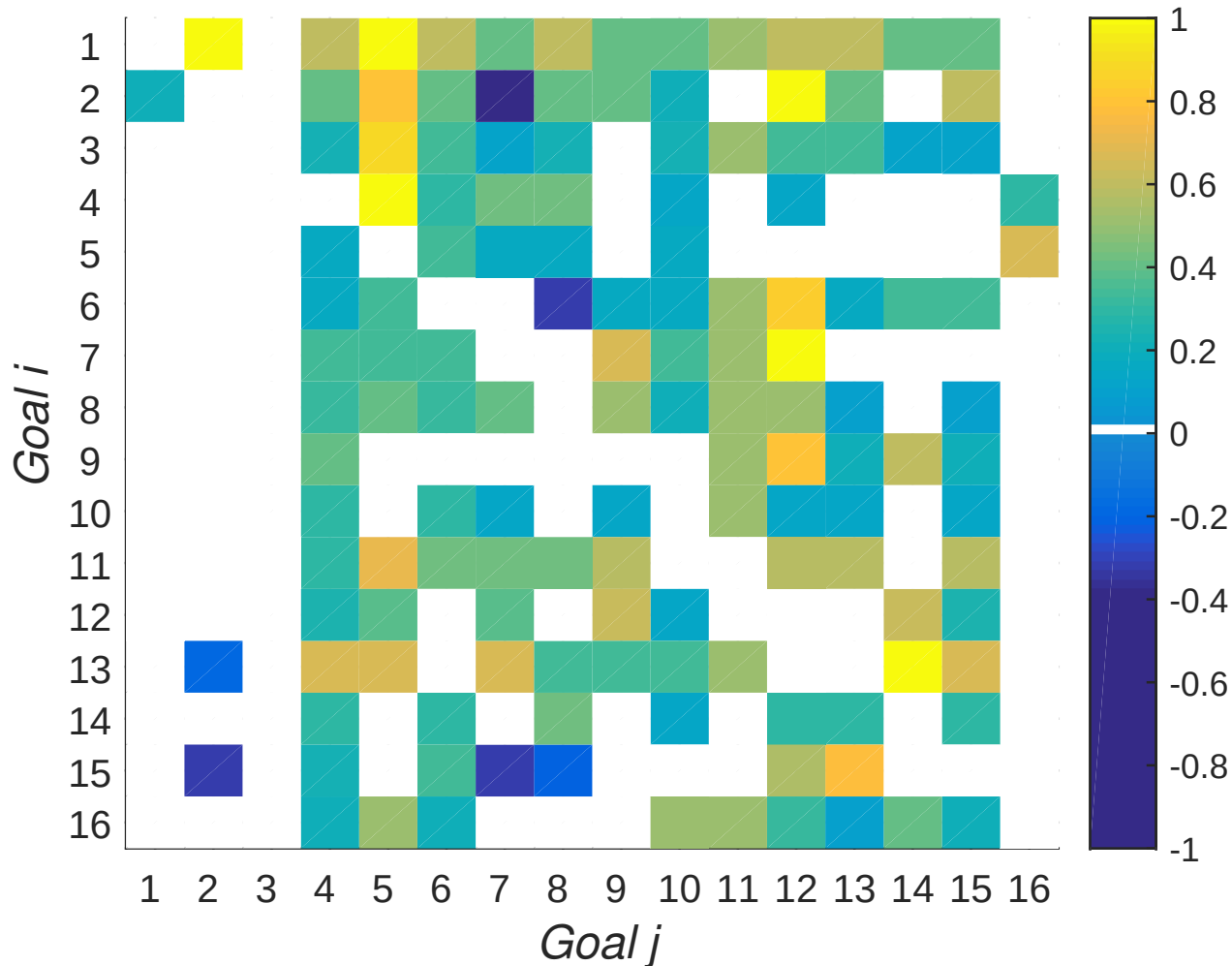
- The Report does this systematically for every Goal in turn.
- And it is precise: in the above example the Report states that the targets 8.5, 8.6, 8.7 and 8.8 are facilitated by Goal 5: this is 4 out of 10 possible parts of Goal 8.
- Use this commentary to build **weighted, directed edges**, using the number of targets in the destination Goal that are referred to. For the example above we have an edge weight of 4/10.
- Edge weights A_{ij} might be negative - **'trade-offs'**.
- Pros: reasonably consistent approach; expert opinion on all Goals together.
Cons: very general, really a qualitative approach, not quantitative.

Influences on Goal i : A^{in} (rows)



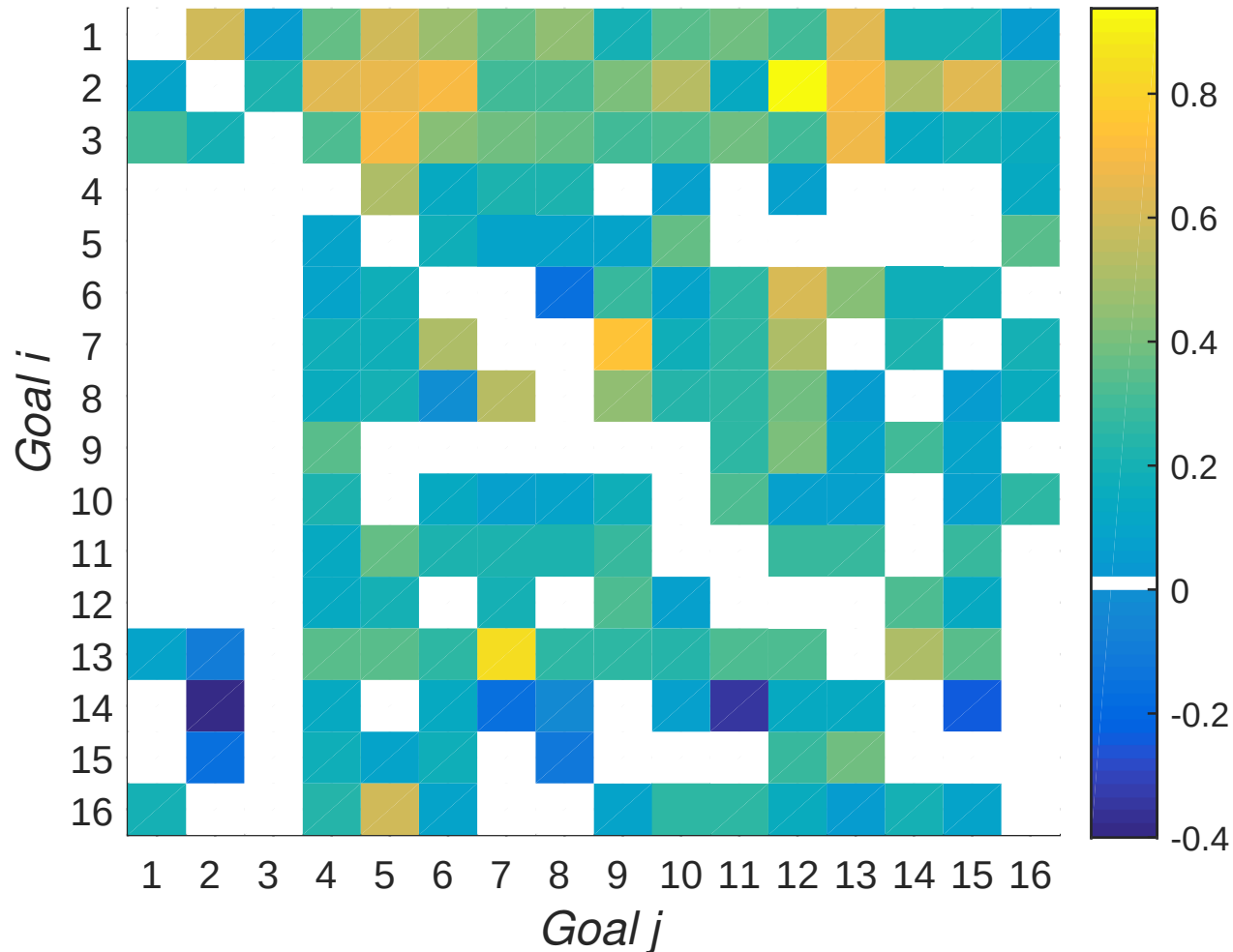
A^{in}_{ij} is the weight of the directed edge from Goal j to Goal i , from the perspective of Goal i .

Influences from Goal j : A^{out} (columns)



A_{ij}^{out} is the weight of the directed edge from Goal j to Goal i ; from the perspective of Goal j .

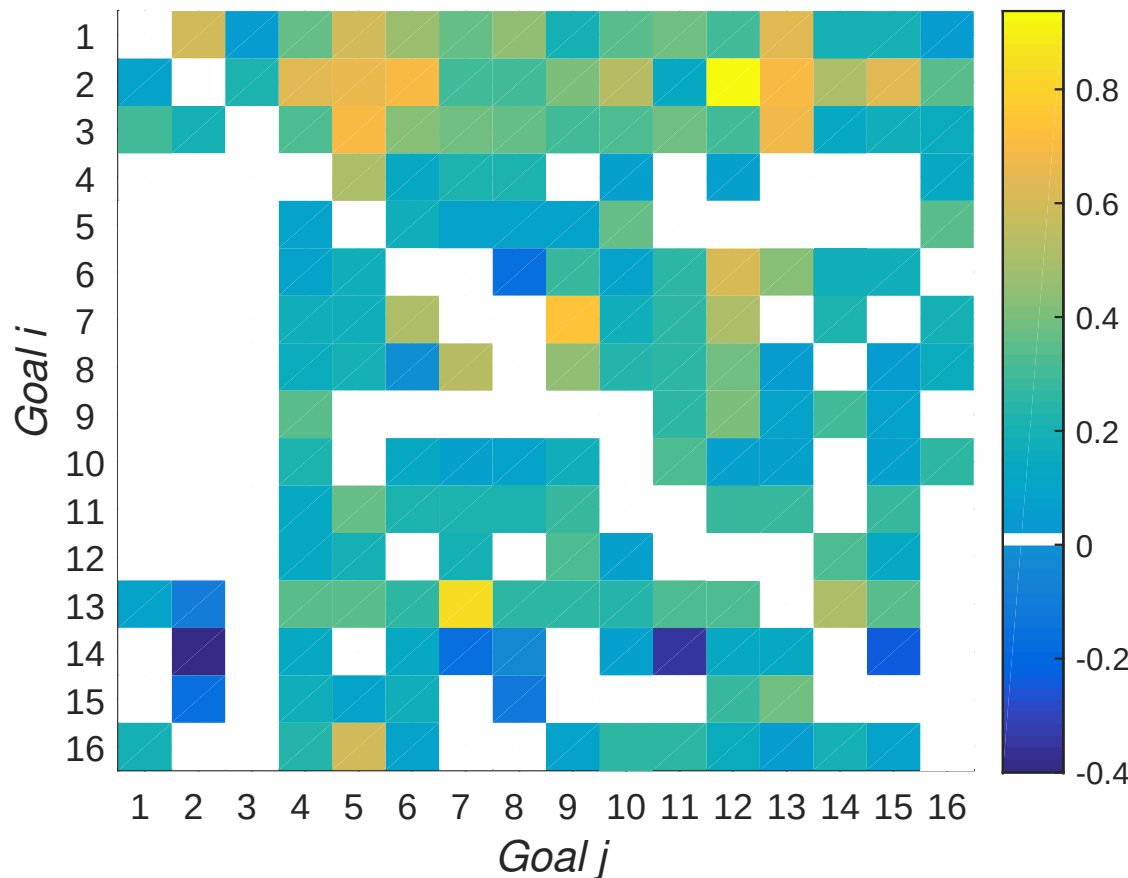
Complete adjacency matrix A



A_{ij} is the average of the weights of the directed edges from Goal j to Goal i ; this is a measure of how much influence progress on Goal j has on Goal i .

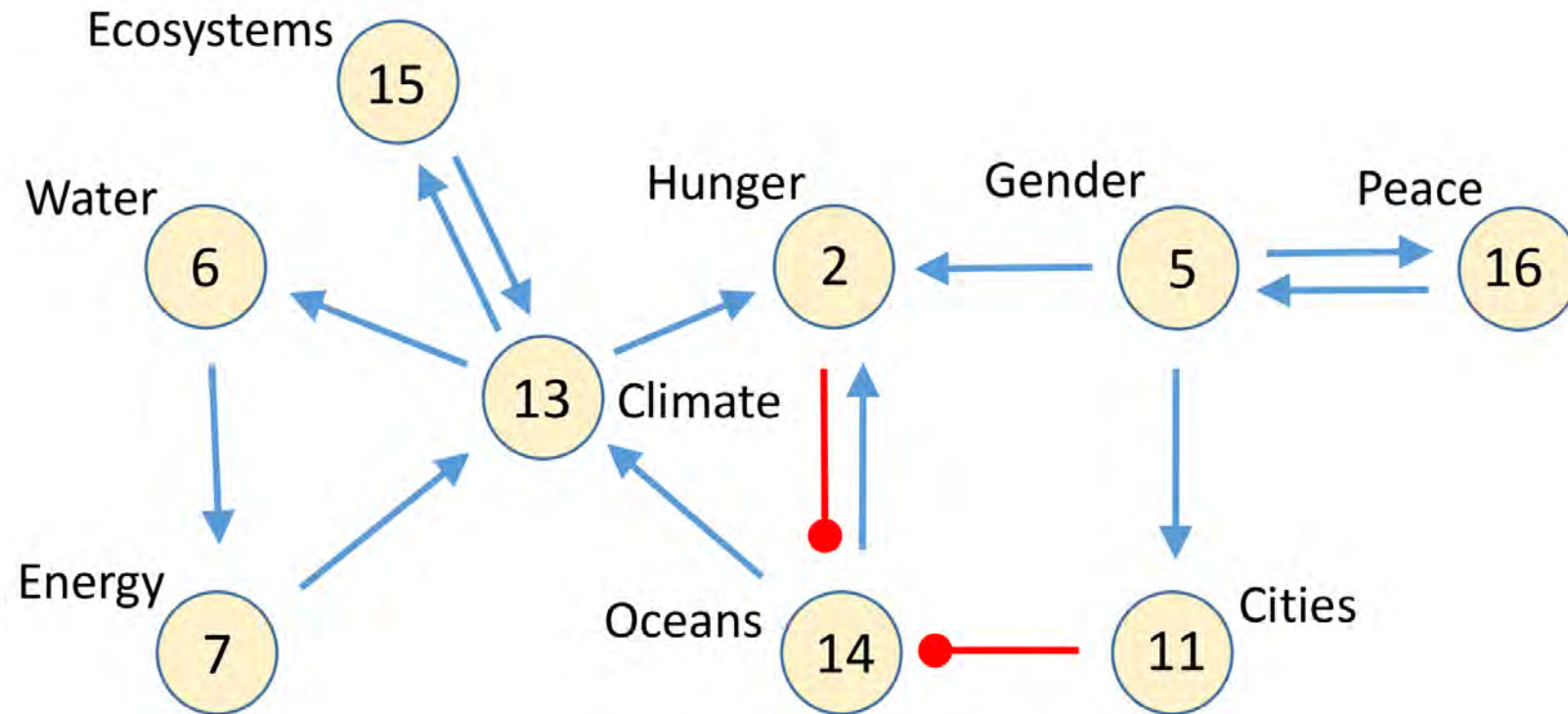
Highest value edge weights

Out of 240 possible directed edges there are:



- 46 for which $A_{ij} \geq 1/3$
- 2 for which $A_{ij} \leq -1/3$
- Many of the positive edges are from $\{4, \dots, 16\} \rightarrow \{1, 2, 3\}$.
- 2 most negative edges are 2 (Hunger) $\rightarrow$ 14 (Oceans), and 11 (Cities) $\rightarrow$ 14 (Oceans)

Highest value edge weights in cycles



- All these edge weights have magnitude $|A_{ij}| \geq 1/3$
- Positive edges in blue. Negative edges in red.
- There are a few short self-reinforcing loops (Jain & Krishna).

Part 2: Dynamics of a simple model

Direct and indirect effort

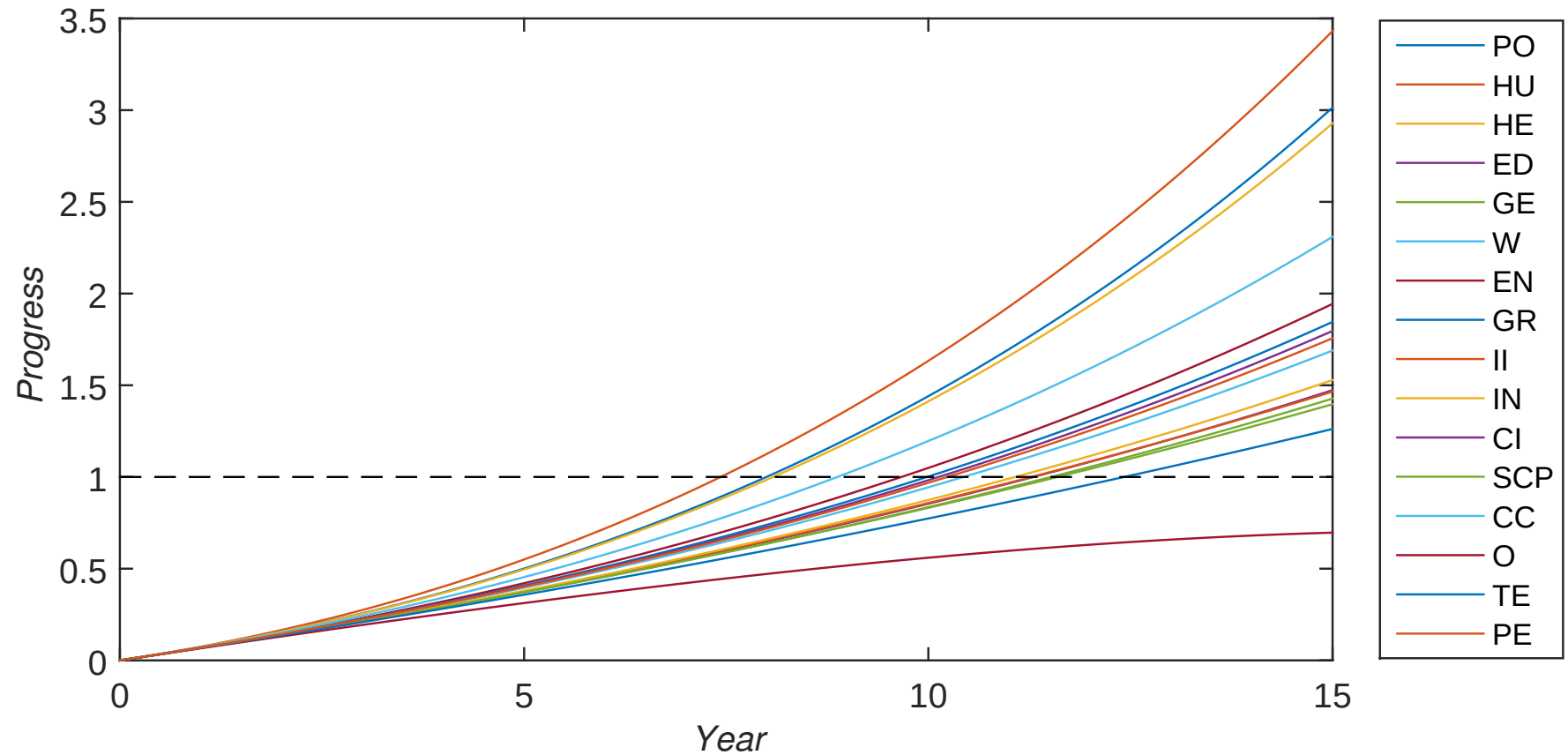
Propose a very simple model:

$$\dot{x}_i = m_i + \frac{\varepsilon}{15} \sum_{j=1}^N A_{ij} x_j \quad \Rightarrow \quad \mathbf{x}(t) = -\frac{15}{\varepsilon} A^{-1} \left[I - \exp \left(\frac{\varepsilon t}{15} A \right) \right] \mathbf{m}$$

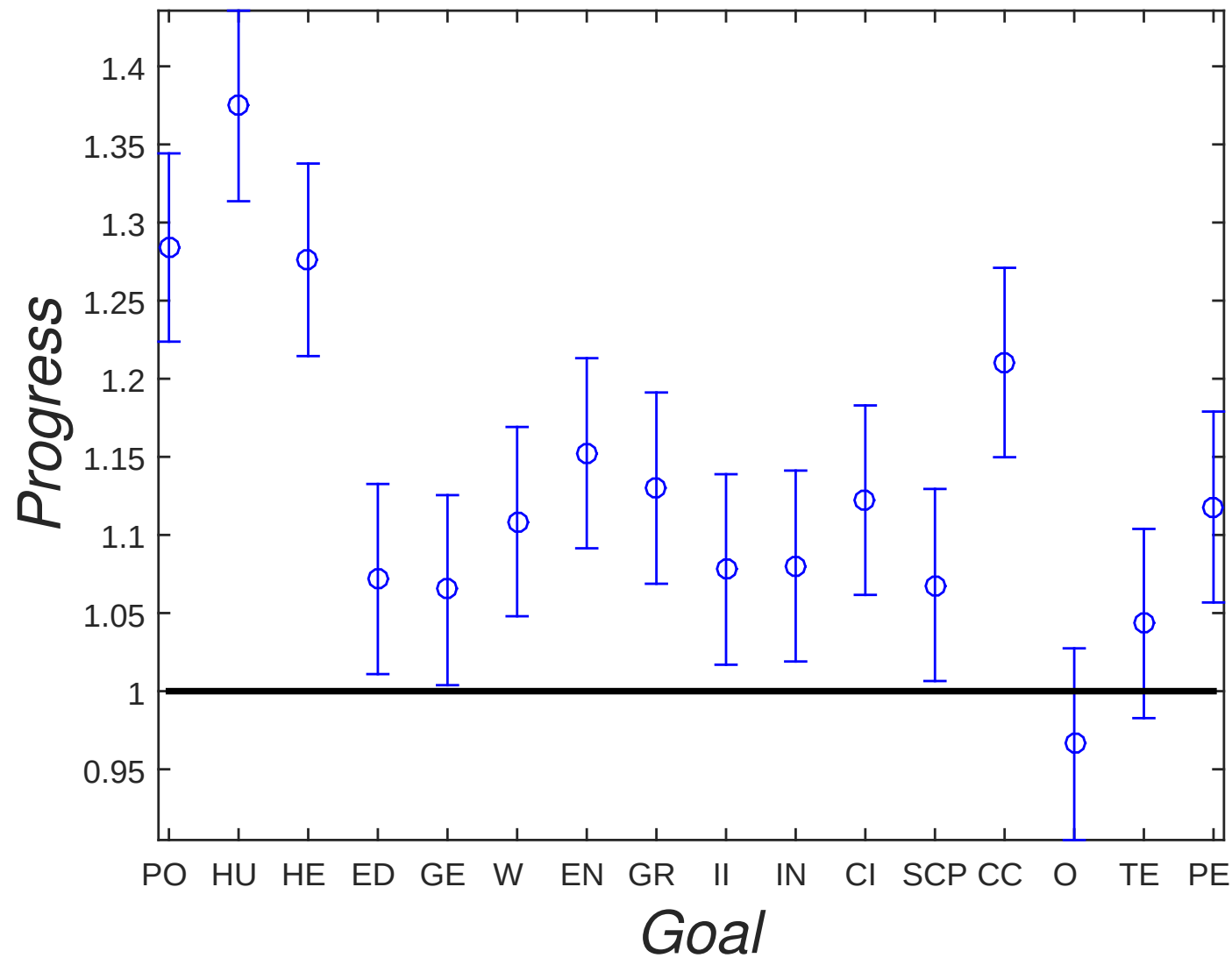
- m_i represents the **direct effort** towards Goal i .
- Normalisation: require $\frac{1}{16} \sum_{i=1}^{16} m_i = 1/15$.
- ε represents the level of **indirect effort**, i.e. the influence on Goal i of progress on other Goals.
 - If $\varepsilon = 1.0$ and the entry $A_{ik} = 1$ then complete achievement of Goal k (i.e. $x_k = 1$) drives the same increase in progress on Goal i as the direct effort m_i does.
 - If $\varepsilon = 0.1$ and $A_{ik} = 1$ then complete achievement of Goal k produces a 10% increase in progress towards Goal i .
- Integrate over $0 \leq t \leq T = 15$ years.

Evolving forwards, $m_i = 1/15$ equal

$\varepsilon = 0.5$:



Evolving forwards, $m_i = 1/15$ equal

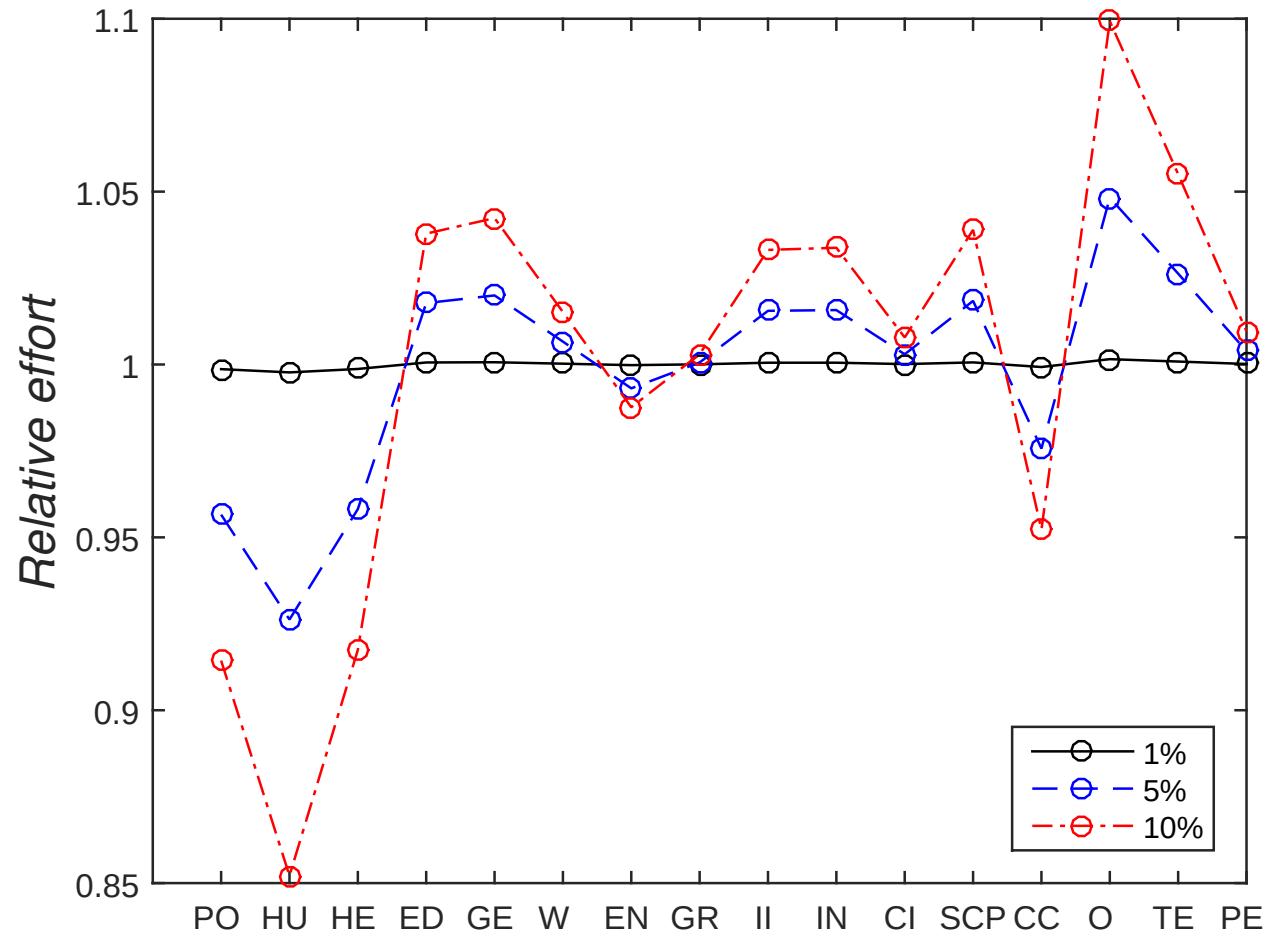


Progress on each SDG when indirect effects are 10% of direct effects.

Optimising the direct effort 1/2



Question: how should we choose m_i in order to make all the $x_i(15)$ equal and as large as possible?

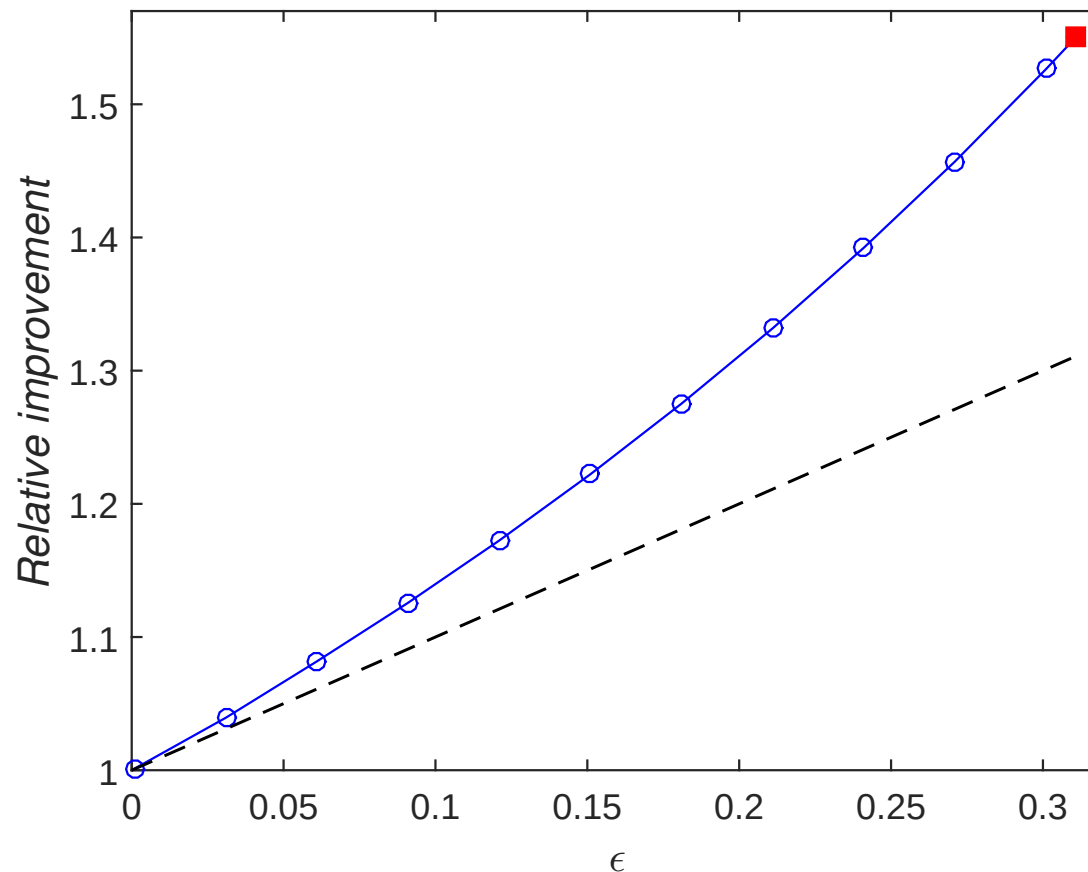


The relative direct effort required in order to produce optimal, and equal progress.

Optimising the direct effort 2/2



Question: how should we choose m_i in order to make all the $x_i(15)$ equal and as large as possible?



Level of progress achieved (on every Goal) by the optimal allocation, as the network coupling ϵ increases.

Conclusions

- SDGs are a complicated network of directed edges
- Try to identify key influences and their directions – not at all exhaustive.
- We can refine the statement that progress on poverty eradication (SDG 1) is ‘central to all other Goals’. The ICSU Report implies that SDG 1 is far ‘downstream’ and progress on many other Goals will improve progress on it.
- Goals 1. Poverty, 2. Hunger and 3. Health are most likely to be achieved.
- Goals 14. Oceans and 15. Ecosystems are least likely to be achieved.
- With re-distributed direct effort, all Goals can be achieved, and the level of progress increases nonlinearly with coupling strength ε .
- Gender Equality (SDG 5) is mutually reinforced by Peace (SDG 16).
- Gender Equality demands specific investment of time and resources because it lies ‘upstream’ of the majority of the other SDGs.
- Next steps: other models, check against data (monitoring programme), country-specific case studies.