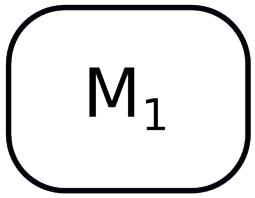
Models on the Move: Migration and Imperialism

Seamus Bradley[⋆] and Karim Thébault[†]

† University of Bristol
⋆ Munich Centre for Mathematical Philosophy

Partially based upon 'Modelling Inequality' with Alexander Reutlinger[⋆] (BJPS, forthcoming)
<philsci-archive.pitt.edu/11624/>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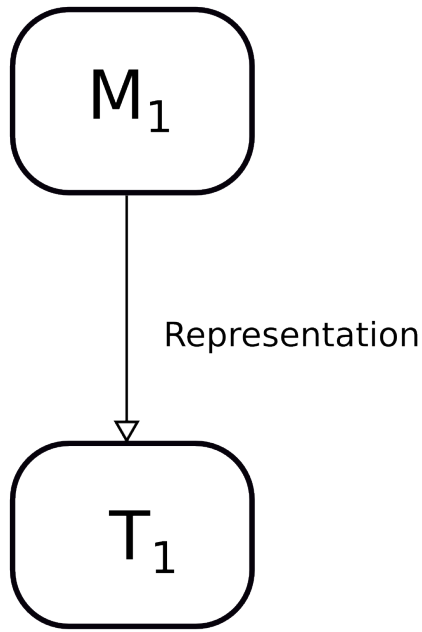
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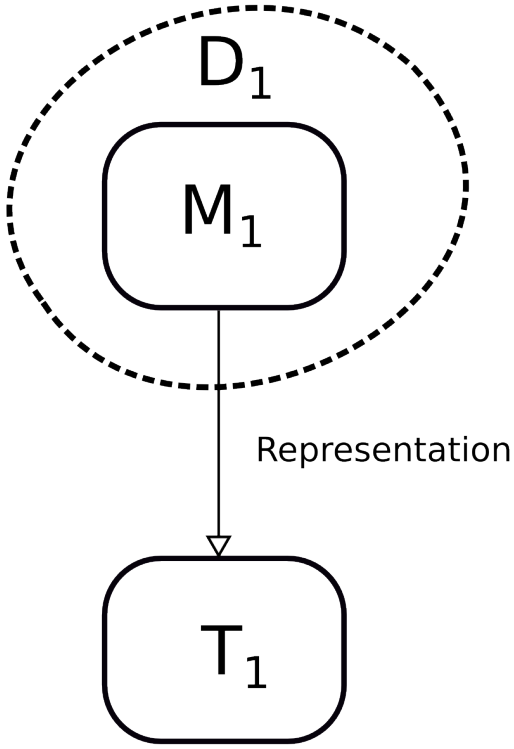
D_1
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Representation
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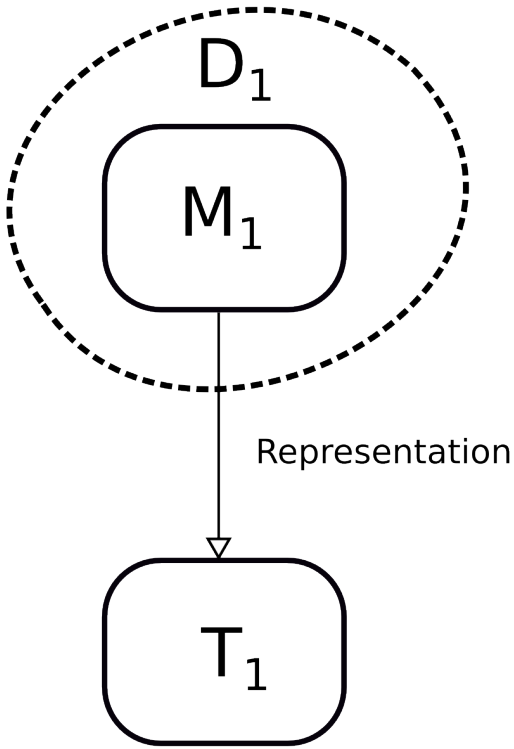
Migration


australia
Build your childrens future!
£10
CAN TAKE YOU TO AUSTRALIA
* YOUNGSTERS UNDER 19 TRAVEL FREE
* AUSTRALIA OFFERS YOU A NEW LIFE
* BIG OPPORTUNITIES WITH SPACE TO LIVE
* HIGHER WAGES, LOWER TAXES
* 40 HOUR, FIVE DAY WEEK * APPLY TO
Australian Migration Office, (Dept. S.P.3)
Norfolk House, Smallbrook, Ringway, Birmingham, 5.

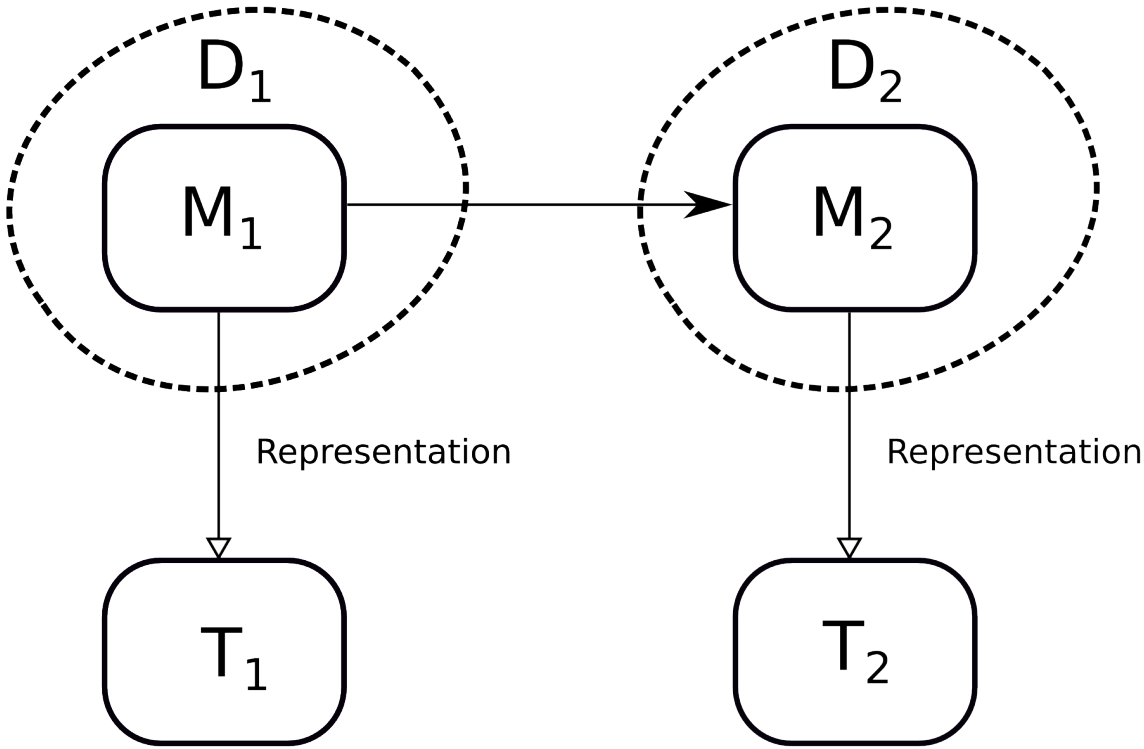
Migration

Models move from one discipline to another via a radical reinterpretation of their representational function.

Migration



Migration



Re-Sanctioning

Re-sanctioning is the process by which the idealisations made in the original context are justified in the new context.

Re-Sanctioning

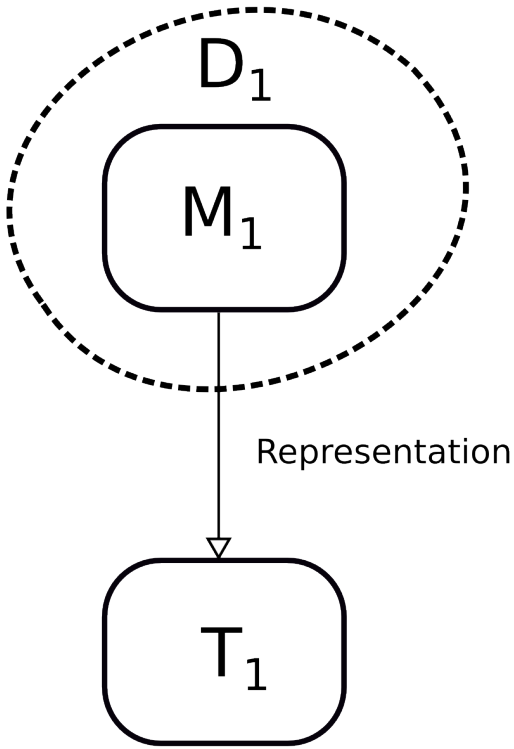
Because the model has been re-interpreted, **very different idealisations** are involved in justifying the domain of validity of the model.

Imperialism

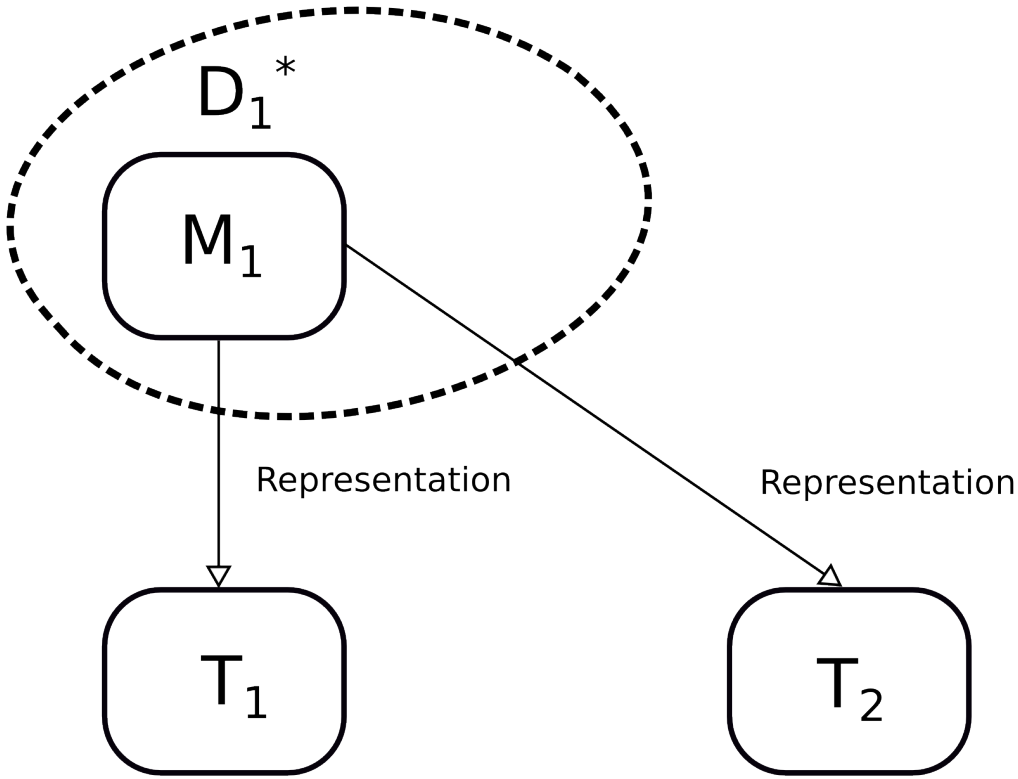
Imperialism

Domain of validity of models in imperialistic discipline extended to include target systems previously described by the models of the colonised discipline.

Imperialism



Imperialism



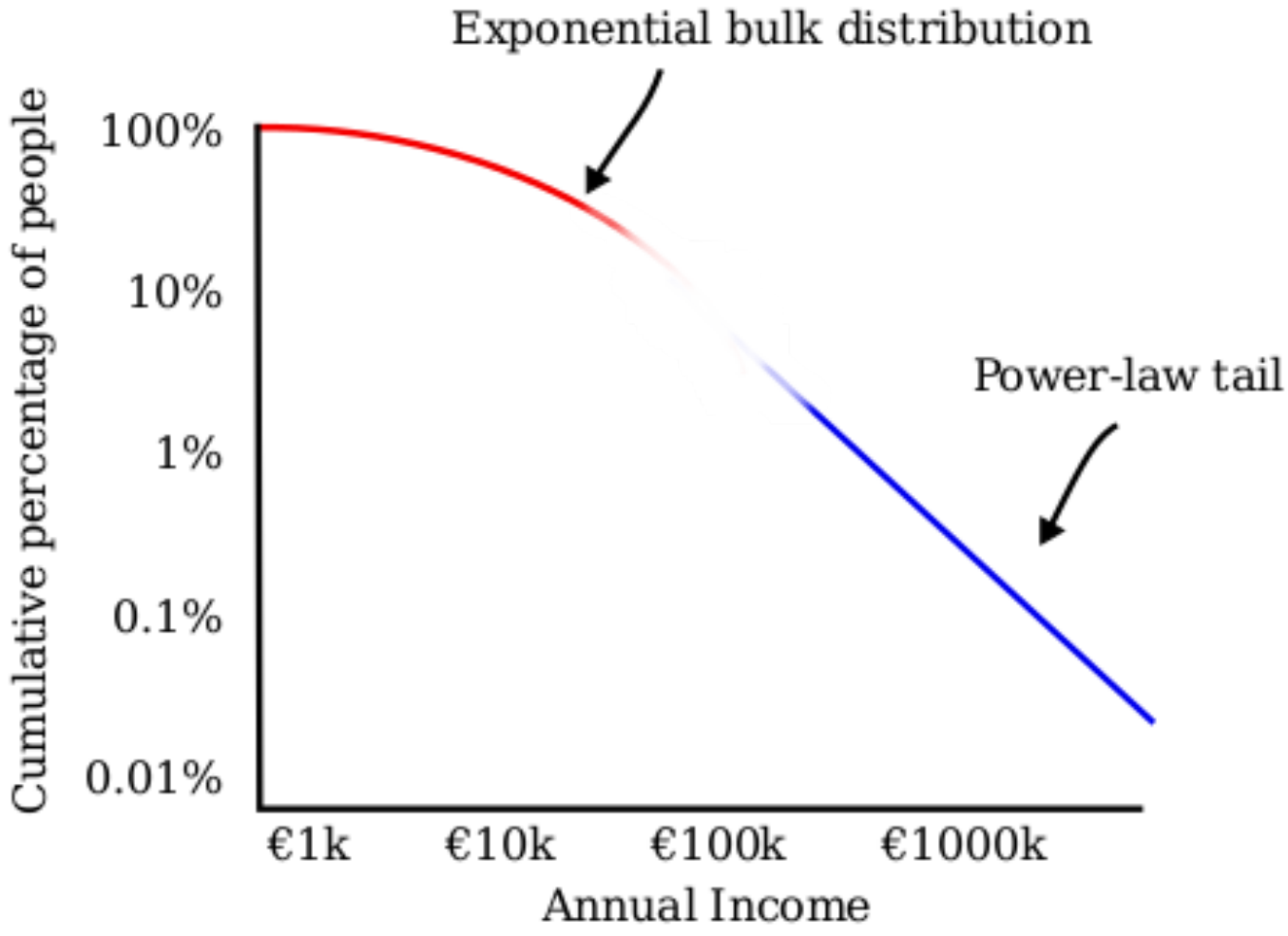
Unification

Unification involves the expansion of the potential target systems of a model to include different types of phenomena.

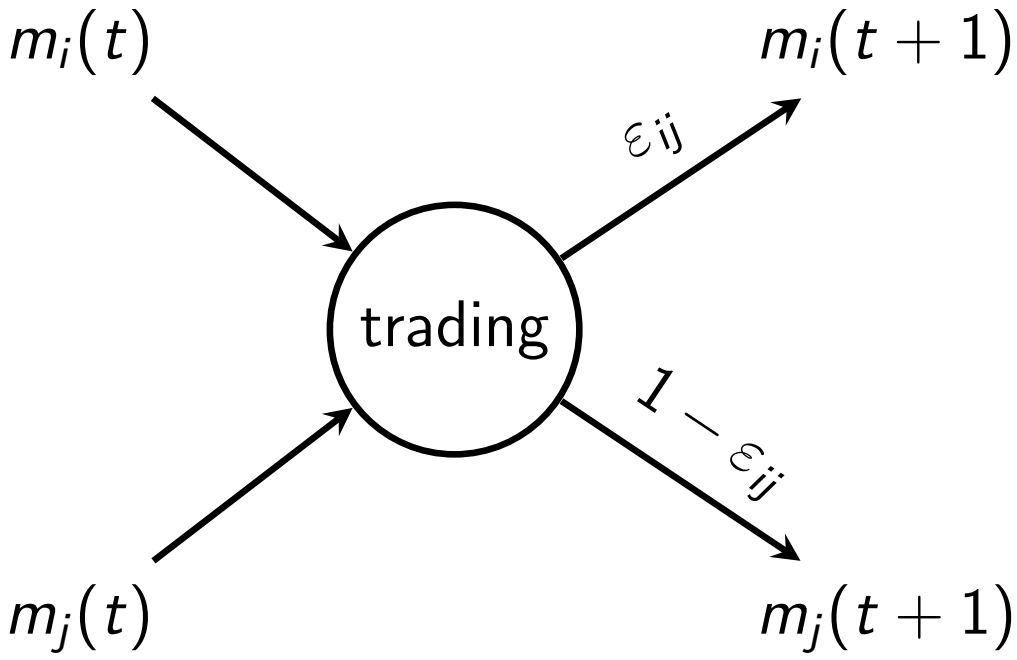
Unification

It relies on **the same idealisations** being justified in a new, and potentially quite different, modelling context.

Income Distributions



Kinetic Exchange Models of Income



Kinetic Exchange Models of Income

Understanding these models as examples ‘migration’, rather than ‘imperialism’, puts our focus on the questions of *re-sanctioning* rather than *unification*.

Migration and Imperialism

Kinetic Exchange Models of Income

Methodological Prospectus

Migration and Imperialism

Kinetic Exchange Models of Income

Methodological Prospectus

Migration and Imperialism

We will consider two controversial models that we take to illustrate migration and imperialism respectively:

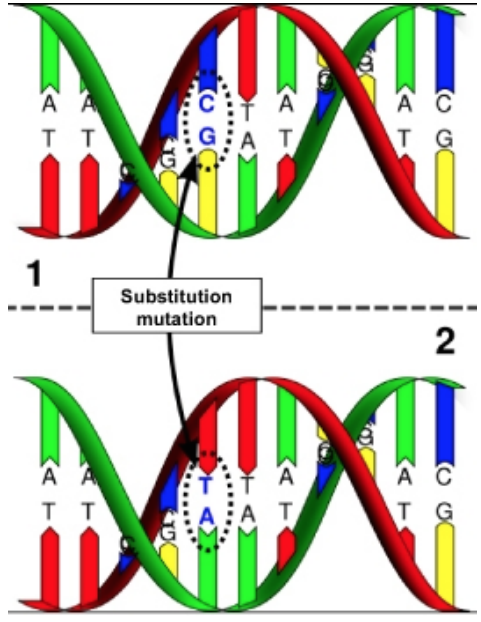
Phylogeographic Linguistics $=$ Migration

Geographical Economics $=$ Imperialism

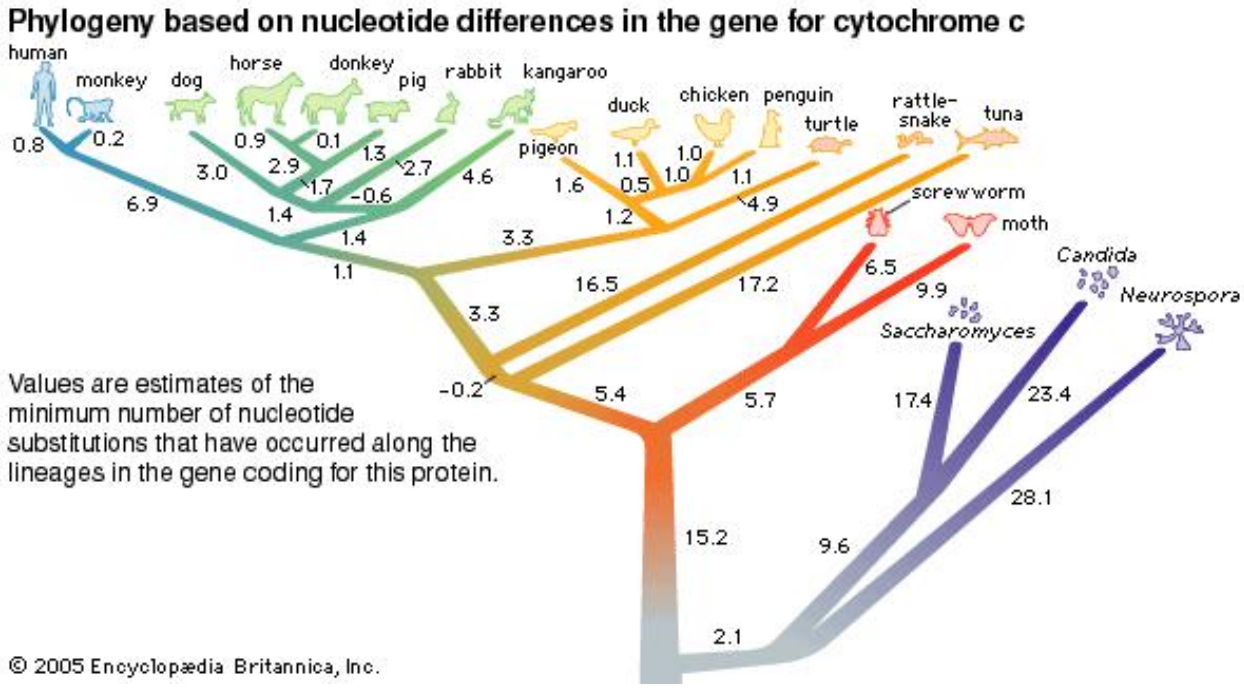
Bayesian Phylogenetics

A phylogenetic model consists of a stochastic model of genetic evolution via nucleotide substitution and a tree with 'branch lengths' representing the number of substitutions expected to occur.

Bayesian Phylogenetics



Bayesian Phylogenetics



Bayesian Phylogenetics

We feed molecular sequence data into the model and get out posterior probabilities for different possible phylogenetic trees.

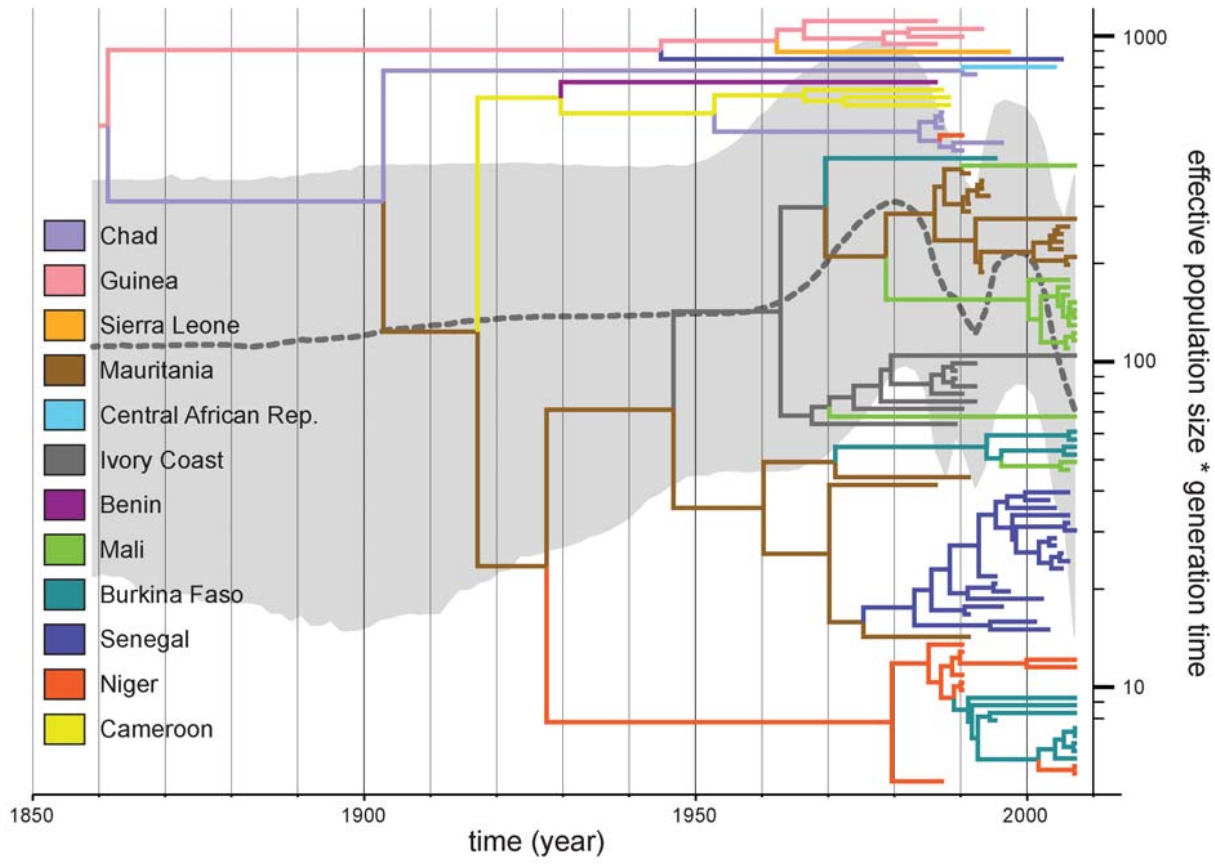
Bayesian Phylogeography

Bayesian phylogeography involves integrated models based on *both* molecular sequence data and spatial location data. Makes use of Continuos Time Markov Chain (CTMC) models for both genetic evolution and spatial dispersion of genes.

Model Migration

Biological Context: Lemey et al. (2009, 2010) design Bayesian phylogeographic model to investigate the origin of virus outbreaks based upon geographic and molecular sequence data on Avian influenza A-H5NA and Rabies in Africa.

Model Migration



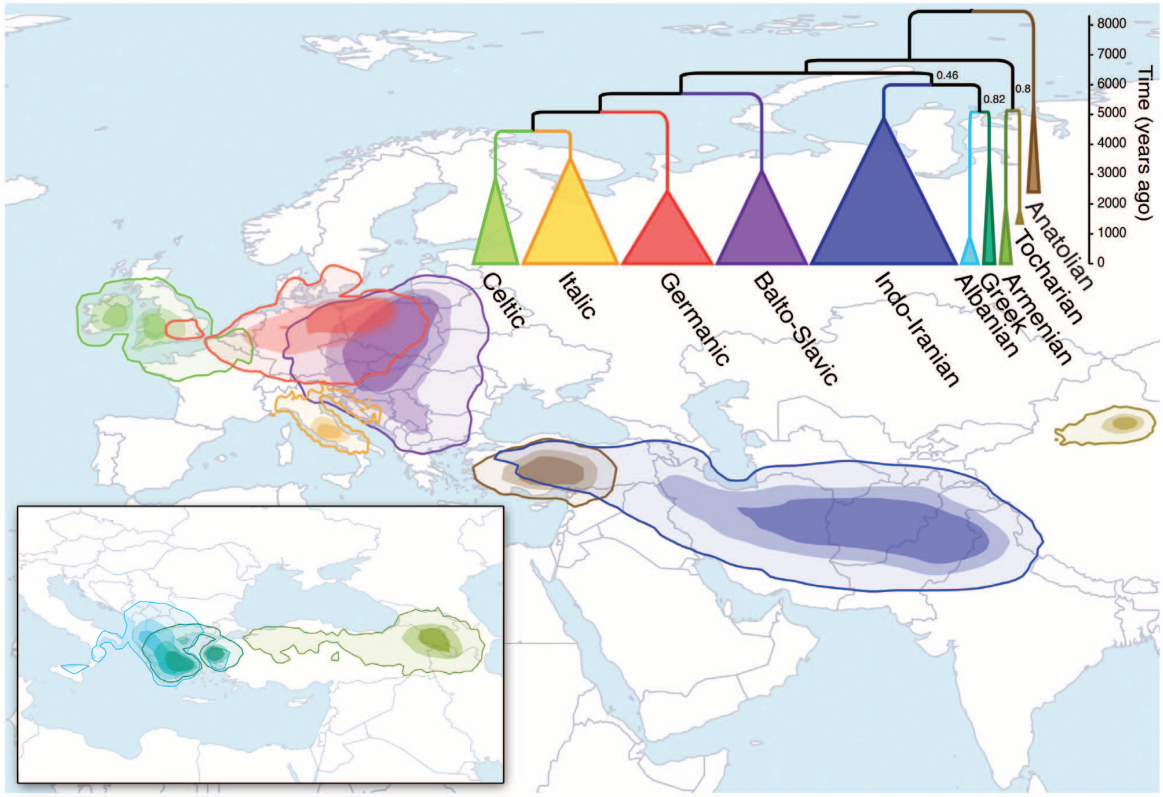
Model Migration

Key Idealisation: Model sequence evolution via (HKY85) CTMC model of nucleotide substitution.

Model Migration

Linguistics Context: Bouckaert et al. (2012) adapt model to investigate spread of languages based upon data of basic vocabulary terms and geographic range assignments for 103 ancient and contemporary Indo-European languages.

Model Migration



Model Migration

Key Idealisation: Model language evolution via CTMC model as the gain and loss of homologous words – i.e. cognates like *night*, *nuit*, *Nacht* – through time.

Re-Sanctioning

Clearly the biological justification for the use of a model of genetic evolution as nucleotide substitution is *totally irrelevant* to the justification for the use of a model of linguistic evolution as gain and loss of cognates, whether or not these models are formalised in the same way via CTMCs.

Re-Sanctioning

Rather the idealisation has to be adequately *re-sanctioning* in the new modelling context based-upon (at least in part) the relevant disciplinary modelling norms.

Re-Sanctioning

In this case, Heggarty (2012) notes that language phylogenies are more reliably established from phonology (sound) and morphology (word structure) rather than just homology: a particular problem is the existence of 'borrowings' (like the French words in English) that could confound a homology based phylogeny.

Phylogeographic Linguistics

Bouckaert et al. (2012) did simulations to show that their analysis is reliable even with low levels of borrowings and thus to (at least partially) re-sanction the key idealisation.

Phylogeographic Linguistics

Such successful re-sanctioning is likely to be in part due to the fact that Bouckaert et al. (2012) are a multi-disciplinary team including practitioners trained in traditional historical linguistics.

Economic Imperialism

...typical imperialists do not merely establish embassies in foreign countries and offer advice to indigenous populations. And similarly, economic imperialists do not merely export a few tentative hypotheses into the fields they invade, but introduce an entire methodology and one that is in many cases almost entirely inappropriate....

— Dupré (2001) p. 128

Economic Imperialism

...Here I mean by 'methodology' two things: first, a set of core assumptions about how to conceive of the phenomenon under investigation, in this case human behaviour; and second, a methodology in the strict sense of a style of scientific argument.

— Dupré (2001) p. 128

Geographical Economics

Geographical economists are interested in the geographical or spatial distribution of various kinds of entities at various scales:

> *industry clusters, core-periphery patterns among countries and regions, cities and systems of cities, patterns of international trade and specialization, and the causes of economic growth and development. (Mäki and Marchionni)*

GeoEcon explains this variety of phenomena by treating the entities as economic actors optimising given constraints of competition and transportation costs.

The Core GeoEcon Insight

People tend to cluster when transportation costs give them an incentive to locate near their suppliers and customers: when increased competition (due to nearby competitors) is outweighed by lower transportation costs.

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This explains why people cluster in cities in terms of a **purely economic** decision: it ignores a number of important explanatory factors studied by human geographers and sociologists.

GeoEcon is Imperialist

GeoEcon is imperialistic because it treats those agents who decide where to establish their business (etc) as agents of the same kind as those studied in other areas of economics: **ontological unification**.

Migration and Imperialism: Contrasts

Both migration and imperialism involve models ‘moving’ from one discipline to another discipline.

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Phylogeographic Linguistics Biology $\rightarrow$ Linguistics

Geographical Economics Economics $\rightarrow$ Geography

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Imperialism seeks *ontological unification*; migration involves only *derivational* or *structural* unification.

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Migration and imperialism are resisted by practitioners because they may lead us to ignore important discipline-specific knowledge.

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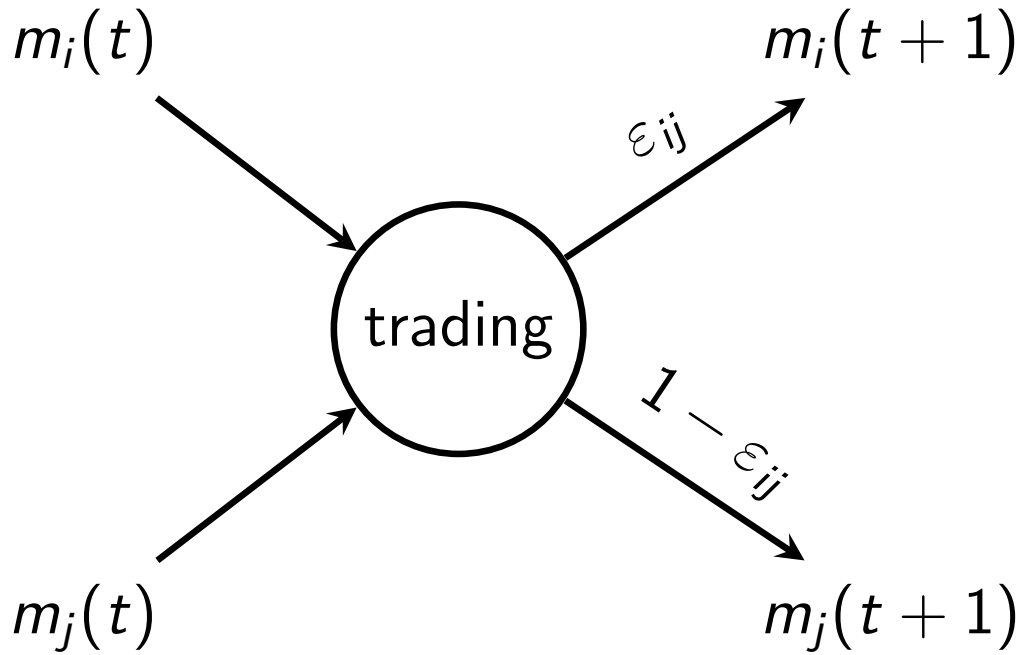
Another similarity: both might yield failed explanations: true how-possibly stories that don't hold in the real world. (Anatolia as unique home of Indo-European languages; Distribution of companies driven by top-down governmental intervention;).

Migration and Imperialism

Kinetic Exchange Models of Income

Methodological Prospectus

The basic idea is that two randomly selected agents, i and j, meet and pool all their wealth. The agent i receives fraction ε_{ij} of the total wealth, and j receives the remainder.



Agents meet randomly and exchange a random amount of their wealth.

$$m_i(t+1) = m_i(t) + \Delta m \qquad m_j(t+1) = m_j(t) - \Delta m$$

where

$$\Delta m = \qquad \varepsilon_{ij} m_j(t) - \qquad (1-\varepsilon_{ij}) m_i(t)$$

This gives us the "DY model".

Here we have assumed that:

i) ε_{ij} is a random variable uniformly distributed between 0 and 1, varying with each discrete time-step, and labelled by the index of the two agents in the interaction (i.e. agents i and j)

ii) The total number of agents, N, and the total amount of money, M, are held fixed.

At each time-step we resample the two agents that are interacting from our population. At late times, $t \to \infty$, the distribution of incomes within the population should be 'well-mixed'.

Let N_k be the number of agents with income between m_k and $m_k + m_\star$, the stable distribution is:

$$P(m_k) = \frac{N_k}{N} = e^{-\frac{(m_k - \mu)}{T}}$$

with $T = \frac{M}{N}$ and $\mu = -T \ln \frac{T}{m_\star}$

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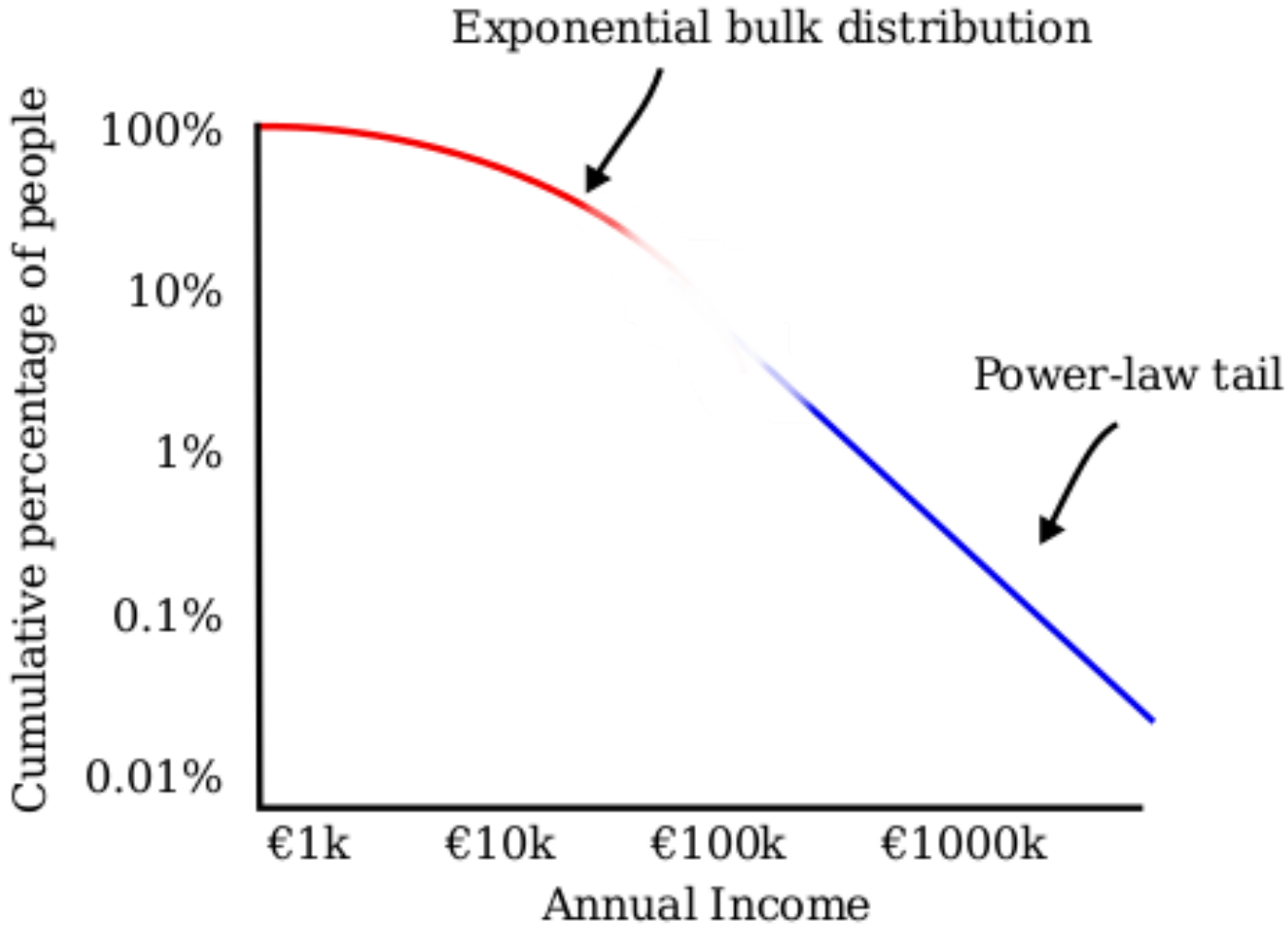
Extending the model to include a 'savings propensity' allows one to recover the power-law tail also.


Exponential bulk distribution
Power-law tail
Cumulative percentage of people
100%
10%
1%
0.1%
0.01%
€1k
€10k
€100k
€1000k
Annual Income

There is a general (and understandable) tendency on the part of econophysicists to develop theoretical models, which are based on the principles of statistical physics. . . [in general] models constructed on these principles ignore absolutely fundamental features of economic reality. Any congruence obtained with the data by such models is therefore spurious. The main problems with translating statistical physics models into economics are

1. *these are essentially exchange-only models of economic and financial processes, which take no account of production,*
2. *they often lead to a confusion of basic concepts, in particular the concepts of transactions and of income.*

(Gallegati et al. 2006, p.4)

The DY model involve a lot of idealisations.

- Conservation of money and of number of agents

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- Conservation of money and of number of agents
- Interactions are binary
- Exchange dynamics

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Nor is the number of economic agents constant.

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Games with three participants are importantly different from games with two agents.

The idealisations involved in the exchange dynamics of the income model seem rather extreme: it is "not like [an] economic exchange process, but more like a burglar process. People randomly meet and one just beats up the other and takes their money" (Hogan 2005).

Each idealisation in the DY model has an analogue in the case of the original Boltzmann model.

Economy	Gas
▶ Conservation of money	

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Economy

- Conservation of money

Gas

- Conservation of energy

Each idealisation in the DY model has an analogue in the case of the original Boltzmann model.

Economy

- Conservation of money
- Binary interactions

Gas

- Conservation of energy

Each idealisation in the DY model has an analogue in the case of the original Boltzmann model.

Economy

- Conservation of money
- Binary interactions

Gas

- Conservation of energy
- Binary collisions

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Economy

- Conservation of money
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- Exchange Dynamics

Gas

- Conservation of energy
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Economy

- ~~Conservation of money~~
- Binary interactions
- ~~Exchange Dynamics~~

Gas

- ~~Conservation of energy~~
- Binary collisions
- ~~Exchange Dynamics~~

Binary Collisions

The legitimate neglect of all but binary encounters in a gas is one of the important simplifications that have enabled the theory of gases to attain its present high development

(Chapman and Cowling 1991, p.3).

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What *legitimates* the binary collision idealisation in the gas case?

Binary Collisions

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As a matter of fact, that is the density regime we are interested in.

Binary Exchanges

We cannot justify binary interactions in the economic case by appeal to contingent facts about some analogue of the “density regime”.

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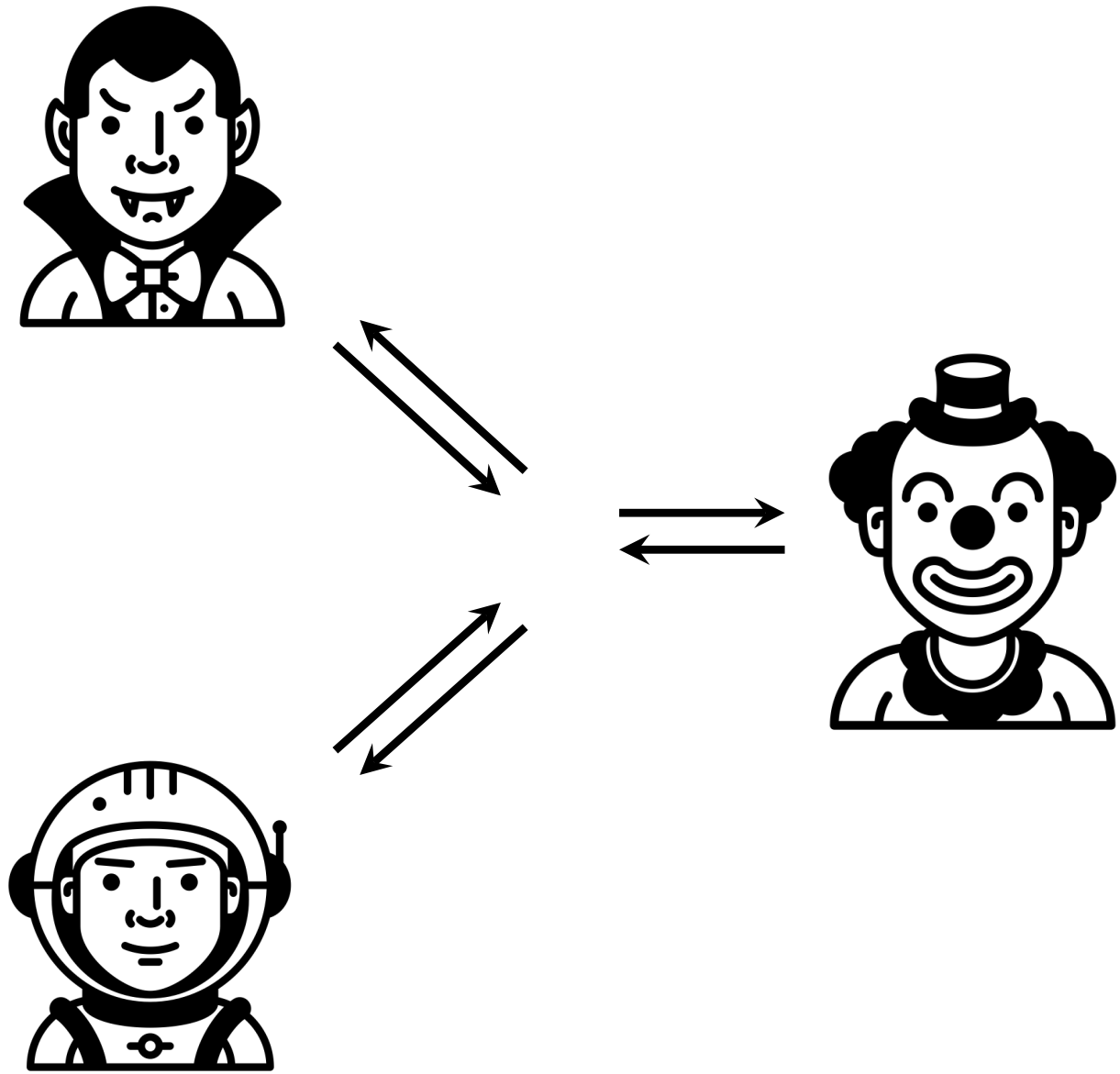
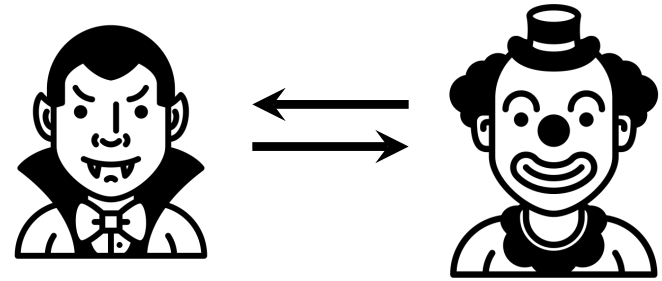
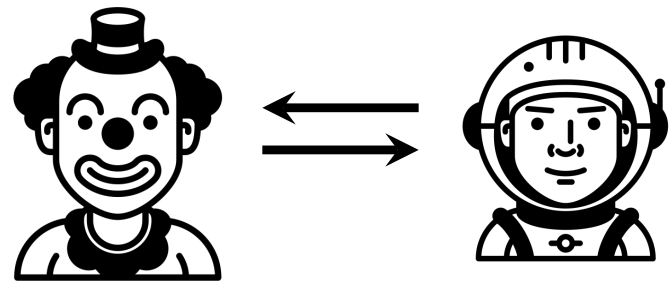
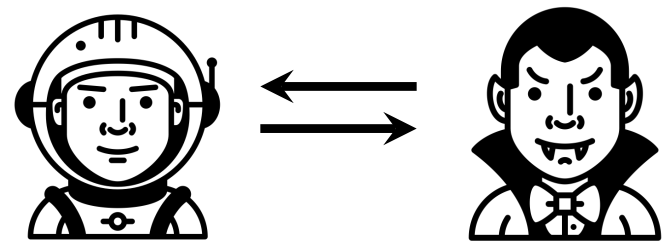
Perhaps three agent economic interactions can be legitimately decomposed into a series of two-agent interactions?



Astronaut, Clown and Vampire by Sergei Demushkin from thenounproject.com







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Binary Exchanges

Whether or not this strategy works, the binary exchanges assumption for the income model for the will require a radically different justification from its gas counterpart.

Binary Exchanges

The binary exchange idealisation is not illegitimate in the new modelling context simply because it cannot be justified in the same way as in the old modelling context, rather it must be re-sanctioned.

Migration and Imperialism

Kinetic Exchange Models of Income

Methodological Prospectus

Imperialism and Econophysics

- The conceptual and rhetorical framework of imperialism is not appropriate to econophysics.
- Clearly in this case no one is genuinely trying to subsume economic systems into the realm of physics!
- Rather by thinking about econophysics models in terms of the framework of migration we focus on the problems of re-sanctioning rather than unification.

Re-Sanctioning

Four general features of re-sanctioning:

1. The justificatory arguments for idealising assumptions can sometimes migrate alongside the relevant models: *re-sanctioning fairly straight forward*.
2. But sometimes new, very different, justifications may be needed in the new context: *re-sanctioning very subtle*.
3. Practitioners trained in the original context often lack awareness of the modelling norms of the new context: *re-sanctioning executed poorly*.
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Re-Sanctioning

- Re-sanctioning should be an important concern whenever models migrate between disciplines.
- Econophysics by definition involves model transfer between physical and social sciences, and illustrates this moral particularly well.
- We believe that there is much valuable work for philosophers of science to do in exploring more cases studies from this perspective
- In particular, we might find a valuable role as *mediators* in disputes between practitioners trained in the old and new modelling contexts.

Re-Sanctioning

- Econophysicsts lack access to economics modelling norms; economists lack access to physics norms.
  Migration/re-sanctioning is made more difficult than it should be.
- Contrast with Phylogeographic Linguistics where collaboration between people trained in both disciplines lead to (arguably) better informed discourse and more effective re-sanctioning.

Thanks!