Promoting both vitality and inclusion through innovation policy

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Innovation disparities
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OECD

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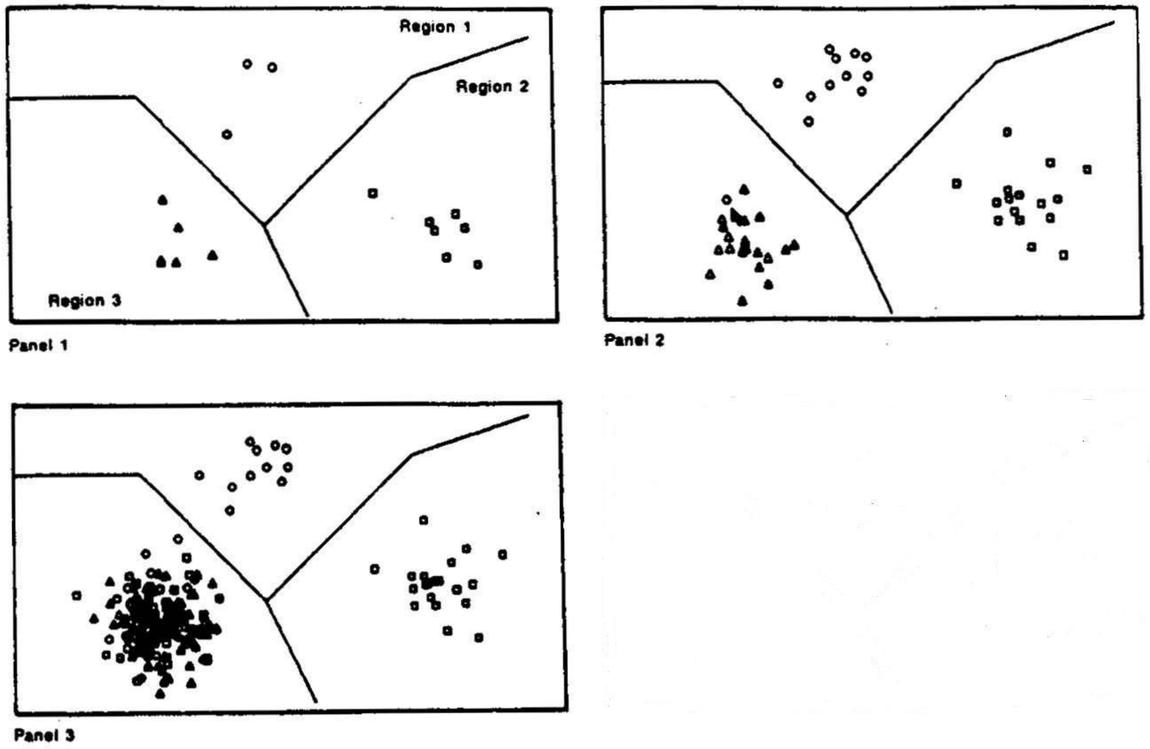
- Driving forces towards disparities are inherently associated to the innovation process
- Finding compatibility zone for growth and inclusive policies
- Policy complexity and the role of institutions

Driving forces towards disparities are inherently associated to the innovation process

- Spatial disparities
  - Indivisibilities at macro-level (R&D infrastructure)
  - Agglomeration externalities
  - Star scientists are disproportionately important in terms of building a strong research agglomeration



Driving forces towards disparities are inherently associated to the innovation process

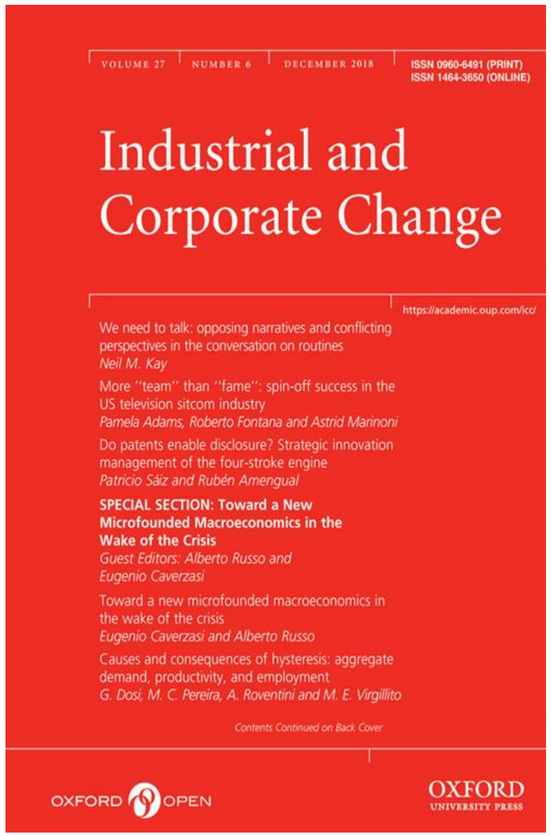
- Firms disparities
- Frontier firms take all
  - Innovation impact relies on network externalities – driving the emergence of a small number of superstar firms
  - Scale, scope and spillovers and R&D productivity have positive feedbacks relationships at firm level
- Interfirm-propagation is difficult
  - While new business processes are rapidly replicated within leading firms (they achieve scale without mass) inter-firm diffusion is problematic
  - Gap between replicability and imitability
  - Knowledge is partially excludable
- Growing gap between «the best and the rest»
- Workers earnings are increasingly tied to firm-level productivity differences

Conflicts among policy objectives

- Growth/dynamism and fairness in distribution of innovation benefits or in the allocation of resources may not always be compatible
  - Cluster/pole of excellence/top science *versus* regional cohesion
  - Patent *versus* consumer surplus
  - Strong innovation performance in machine learning and big data *versus* limiting monopolization
- No simple response to such problems
  - Ex post corrections – (innovation, wealth, tax revenues, inclusion programmes)
  - Ex ante preparation – (provision of equal opportunities to become an inventor)
  - New trade-offs between business and social outcomes

Building policy space where various goals are compatible

- Under what circumstances *addressing disparities* becomes is a *sine qua non* condition for productivity effects of R&D and innovation – neither an *ex ante* condition, nor *ex post* correction nor something frugal, modest, at the bottom of the pyramid or social
- Building **policy space** where different policy goals (growth & inclusion) are compatible – and even better mutually re-inforcing; where there is indeed a rationale for innovation policy (not only for social or cohesion policies) to address disparities
  - Notion that inclusion/addressing disparities should be embedded in the «innovation program – in the structure of the very process to deliver economic impact
  - Not just about innovation diffusion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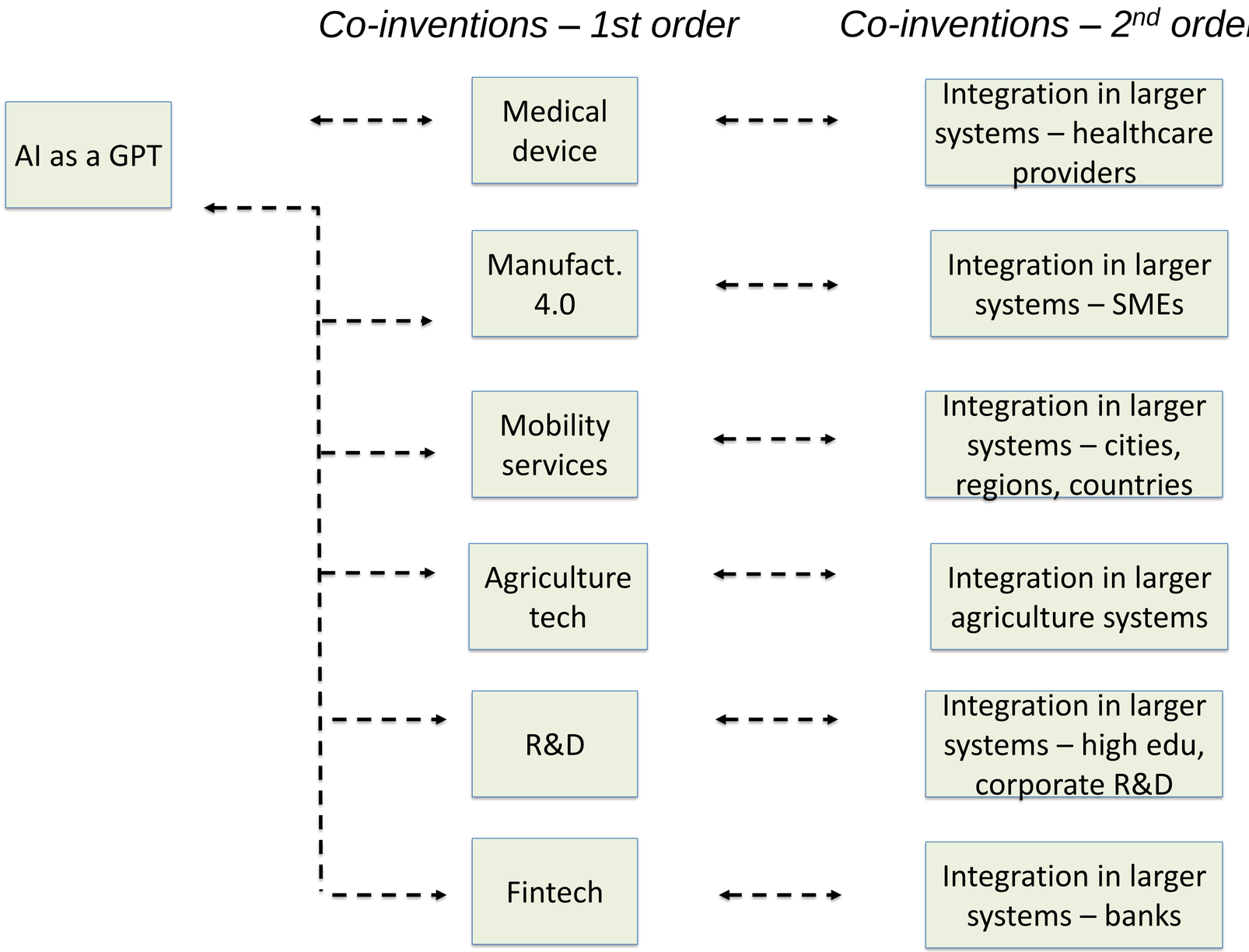
Framework – General purpose technology

- General purpose technology (GPT) – growth engine
- Most often, GPT do not offer the complete innovative outcome, but the recombination of GPTs with complementary technologies enables the creation of new innovative solutions in many application sectors (AS).
  - Vertical improvements in the GPT itself
  - Horizontal propagation in a large range of AS based on innovational complementarities
- Co-invention of applications – «*takes time and resources, including flashes of inventive brilliance*» (Bresnahan)
  - Involves adaptation, adjustment, new knowledge and intangibles
  - Not trivial or simple – implies R&D and organisational innovations in the AS
  - Costs are significant – including sunk costs of R&D, training, organizational changes, experiments and of failed systems
  - Myriads of economically important innovations result from processes of 'co-invention' of applications.
- Unless co-inventions happen broadly, the economic impact of GPT remains weak

Logics of co-invention and externalities - 1



*Externalities are considerable

*Advances in GPT itself creates new opportunities in AS sectors

*Co-inventions of applications increase the size of the market for the GPT, improving the economic return to GPT invention

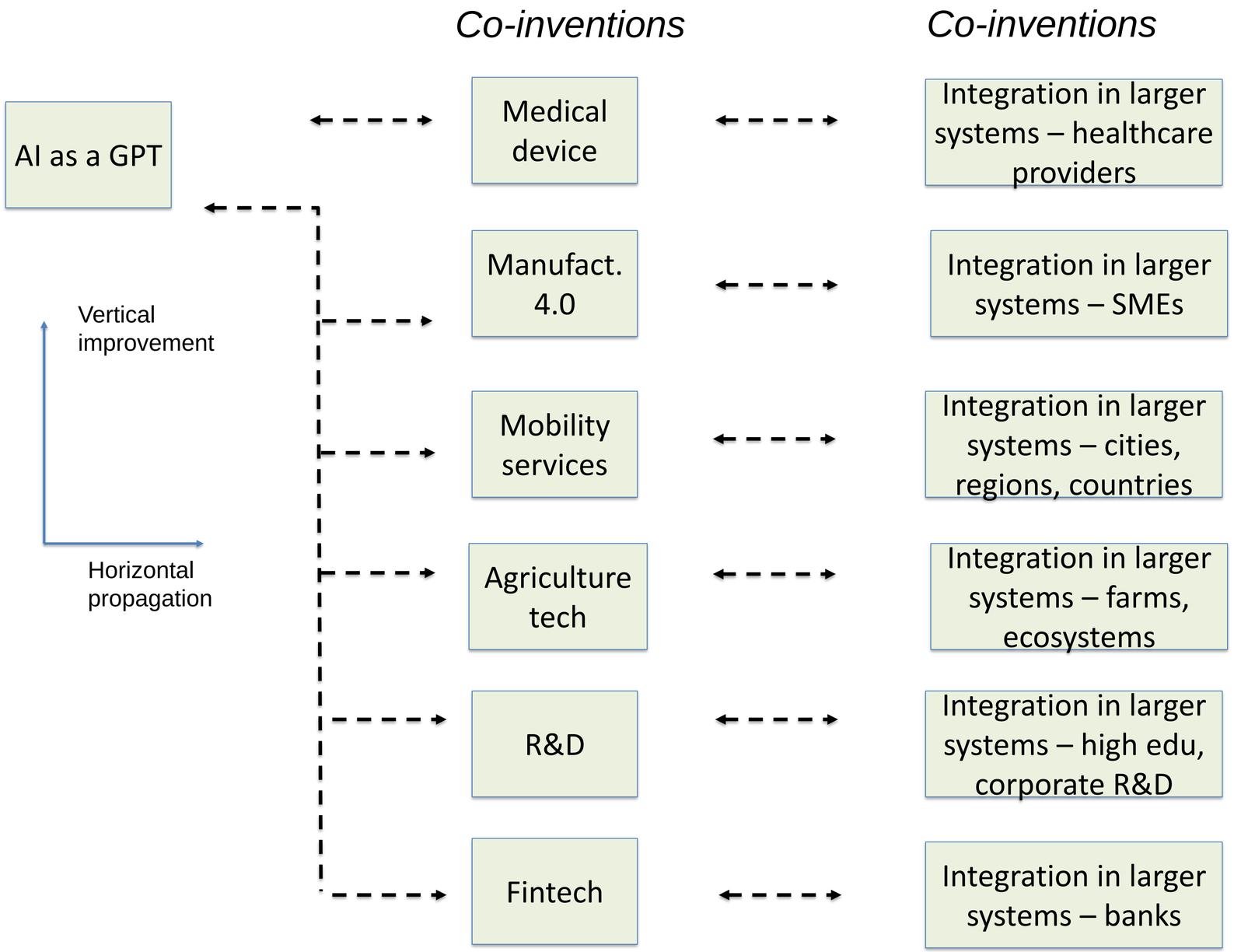
*Dynamic feedback loop

* Early co-inventors provide learning experiences (and more) resulting in decreasing the cost of next co-invention
This happens within and across AS

*All these externalities and feedback make a strong case for inclusion of all potential co-inventors

*Two orders of co-invention - inclusion essentially concerns second order co-invention

Logics of co-invention and externalities - 2

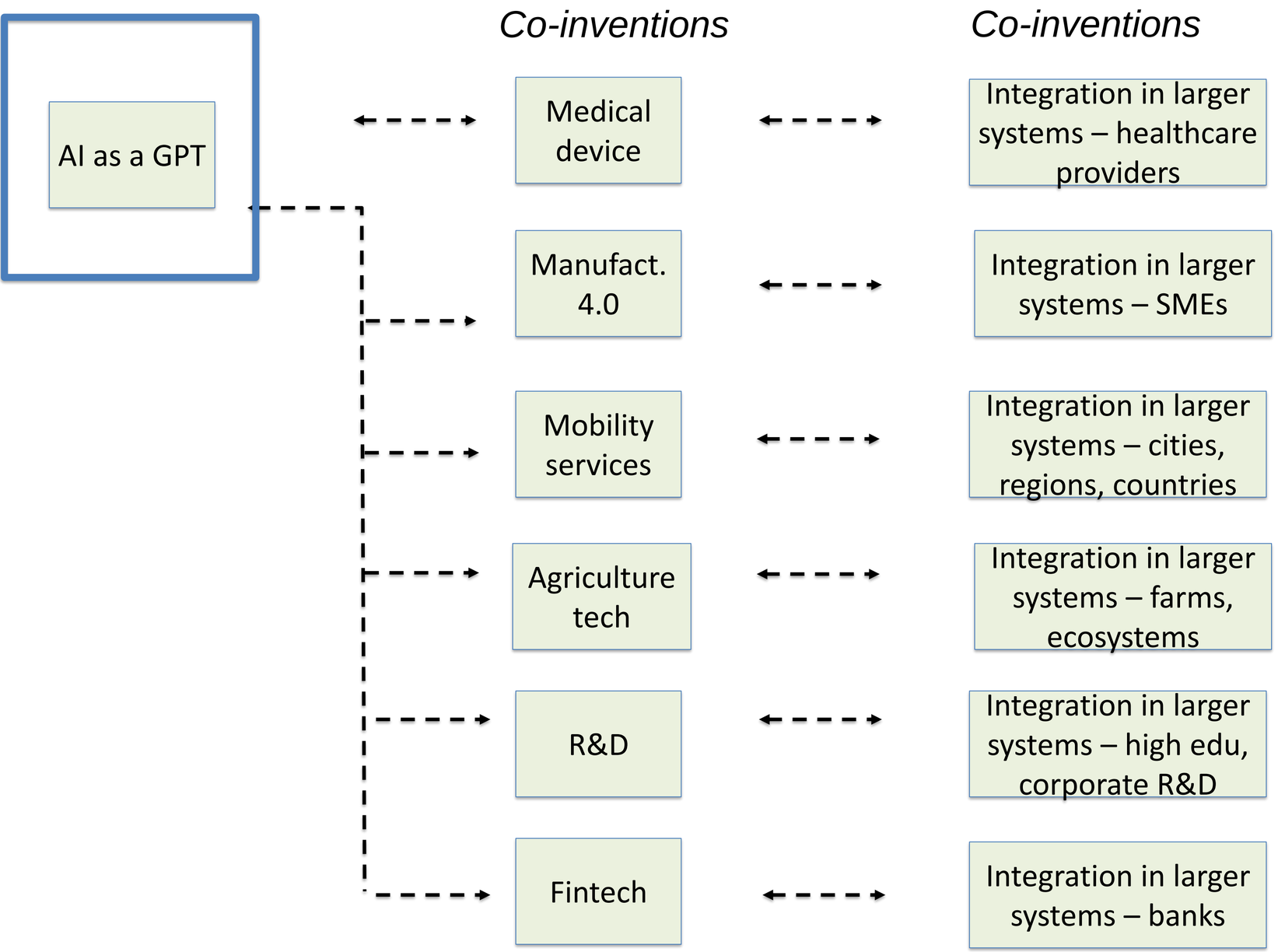


The very nature of GPT makes that full productivity realization implies not only vertical improvements of the GPT itself but also horizontal propagation across AS and progress in AS feeds back into the GPT sector

One can expect a long tem dynamic develops, consisting of large scale investments in research and innovation whose social and private return attain high levels in both GPT and AS

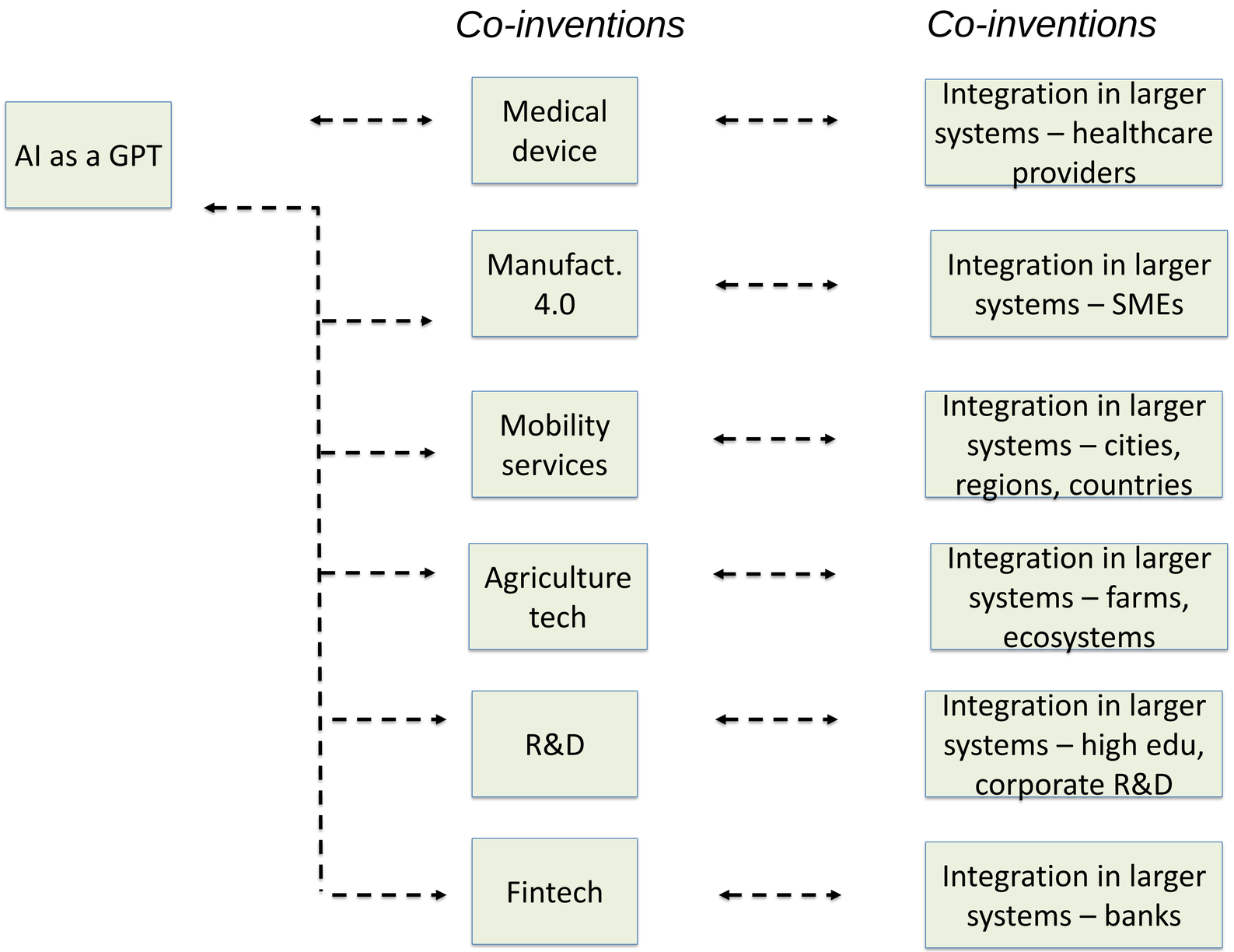
This takes time – productivity paradox

Productivity paradox



- The GPT sector itself is to be bound to be small relative to the economy as a whole - and however fast it innovates and grows in itself, it can never on its own pull the whole economy
- The analogy of the GPT as a «locomotive» pulling the other sectors is misleading
- If the rest of the economy fails to adopt widely the GPT, or fails to make complementary innovations in adopting sectors, economy-wide growth just will not materialize
- Remember the productivity paradox at computer age – «*Abysmal rather than admirable* » Gordon
- In this sense a GPT innovation policy must be «inclusive»

Easy and difficult markets

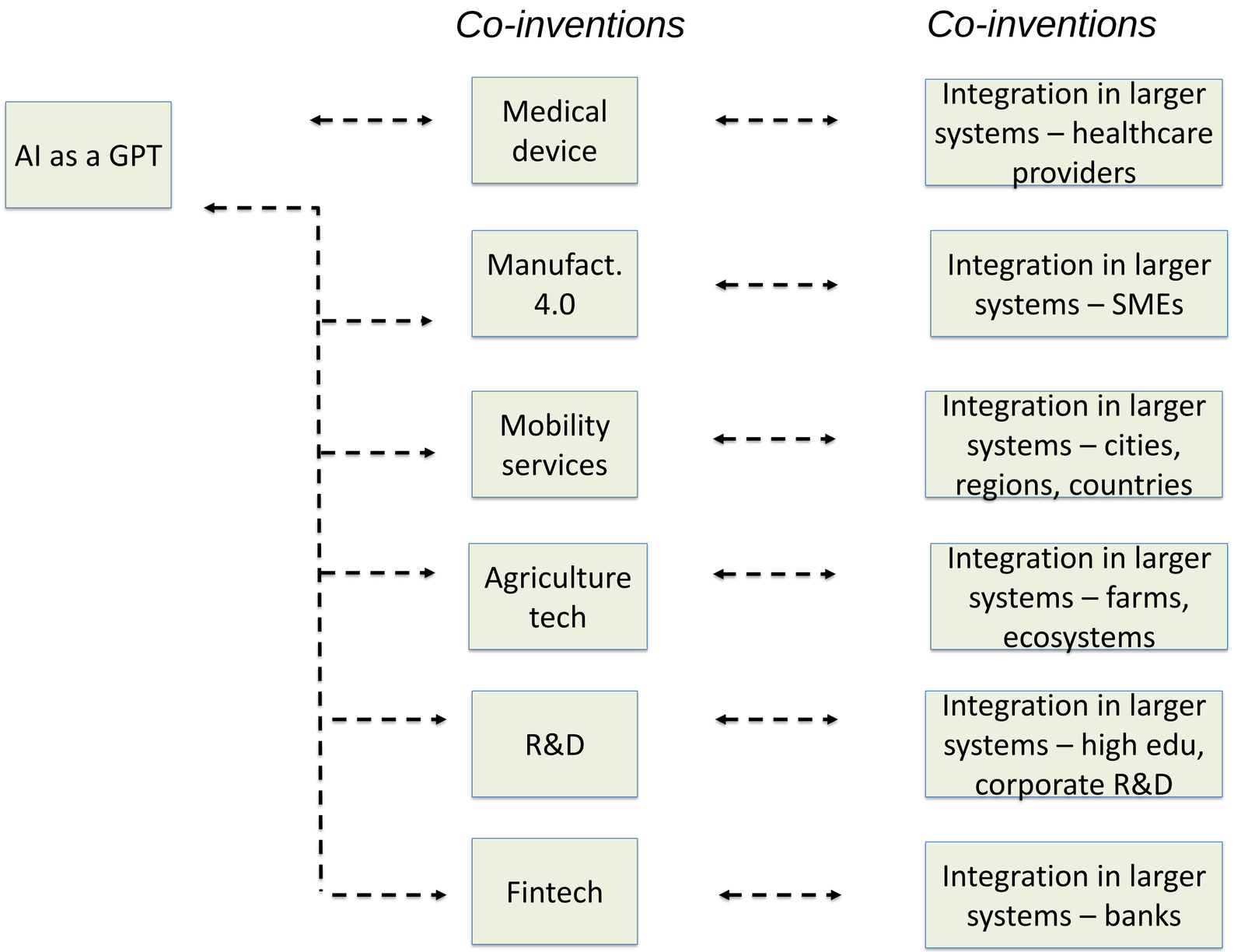


Four factors determine what kind of AS can lead the trend (of adoption) (Helpman & Trajtenberg):

- aggregate demand (wtp x market size) in an application sector,
- the immediate benefit of the GPT relative to the technologies in use in the application sector,
- the development costs in the application sector per needed additional innovation and
- the number of complementary components which would need to be innovated in the application sector.

GPT early adoption is driven by the existence of a few AS in which all four factors are very favorable. The laggard sectors are strongly determined by the number (scope and complexity) of complementary innovations which would be needed to incorporate the new GPT.

Not only one game in town

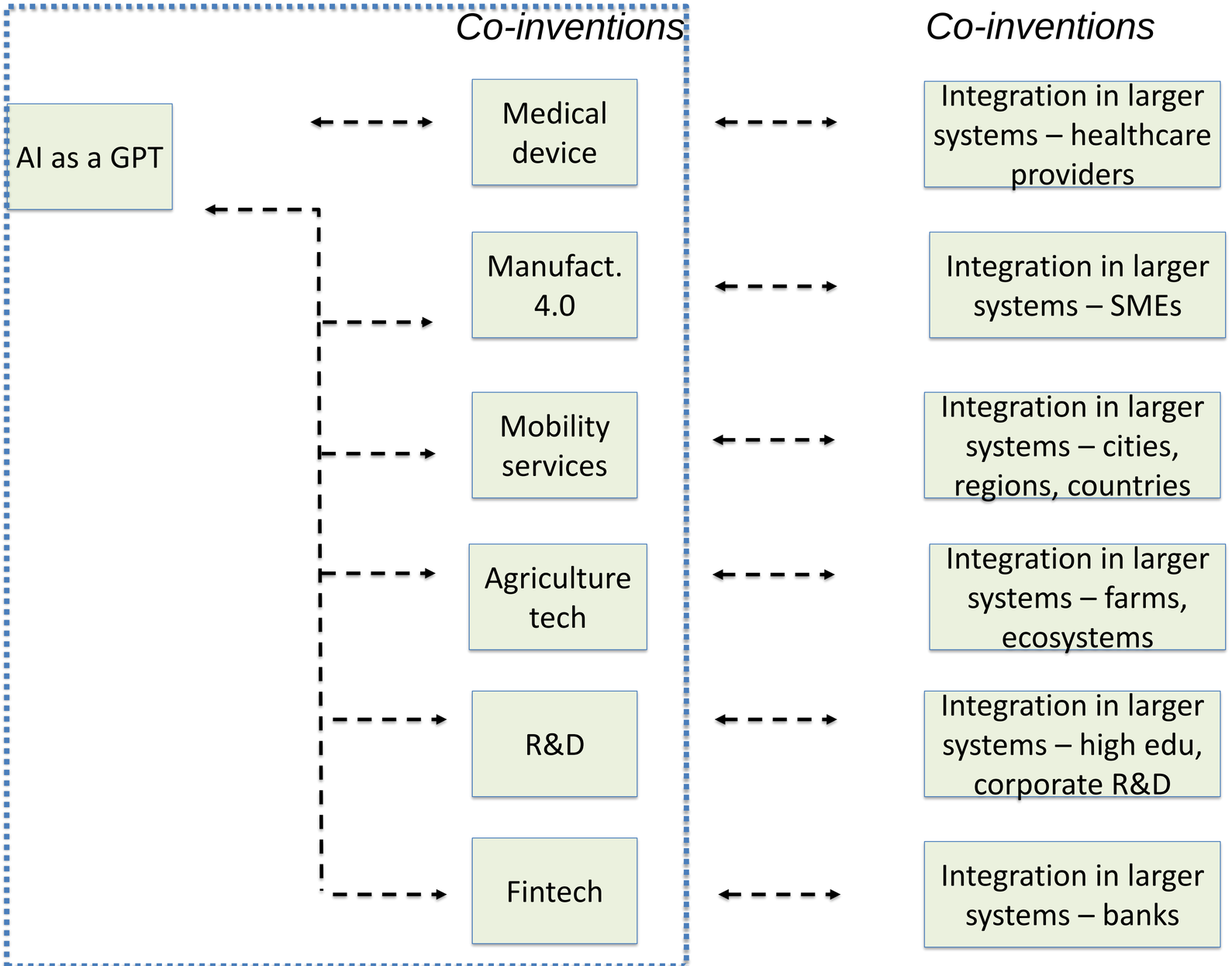


- Innovation is widely distributed over the whole spectrum of sectors (not just high tech) and invention processes (not only formal R&D).
- In many cases, "*the point is not inventing at the frontier but rather generating innovation complementarities in existing sectors. These types of complementarities mays well be less 'flashy', less overtly 'innovative', and yet these ultimately constitute the key to economy-wide growth in regional or national economies*".
- A GPT policy needs to recognize the multiplicity of innovation targets and "styles" – involving skills, management, adoption – in particular as second order co-invention is concerned

Framework – *cont.*

- The GPT cycle creates two bodies of knowledge, one about the GPT, another about the applications of GPT - this means that even traditional sectors and even secondary regions should be included in the knowledge economy
- The dynamics of a GPT may be spatially distributed : While a few leading regions can invest in the invention of a GPT, *follower regions and laggards* are often better advised to invest in the '*co-invention of applications*' i.e. the development of the applications of a GPT in one or several important domains of the regional economy.
  - The essence of RIS3

Is this time different? AI is a *disruptive* GPT



*Considerable externalities among co-inventors and between co-inventors and inventors. Because all of these externalities are not internalized by contract, the economy is far from a socially optimal rate of innovation

*Attempts to internalize these externalities have been wildly successful on some occasions and a big problem to overcome on others - examples

*The development of the AI/GPT is highly disruptive – supporting agressive entry of AI giants towards application sectors

*A way to internalize externalities

*But who decides the direction of inventions in application sectors?

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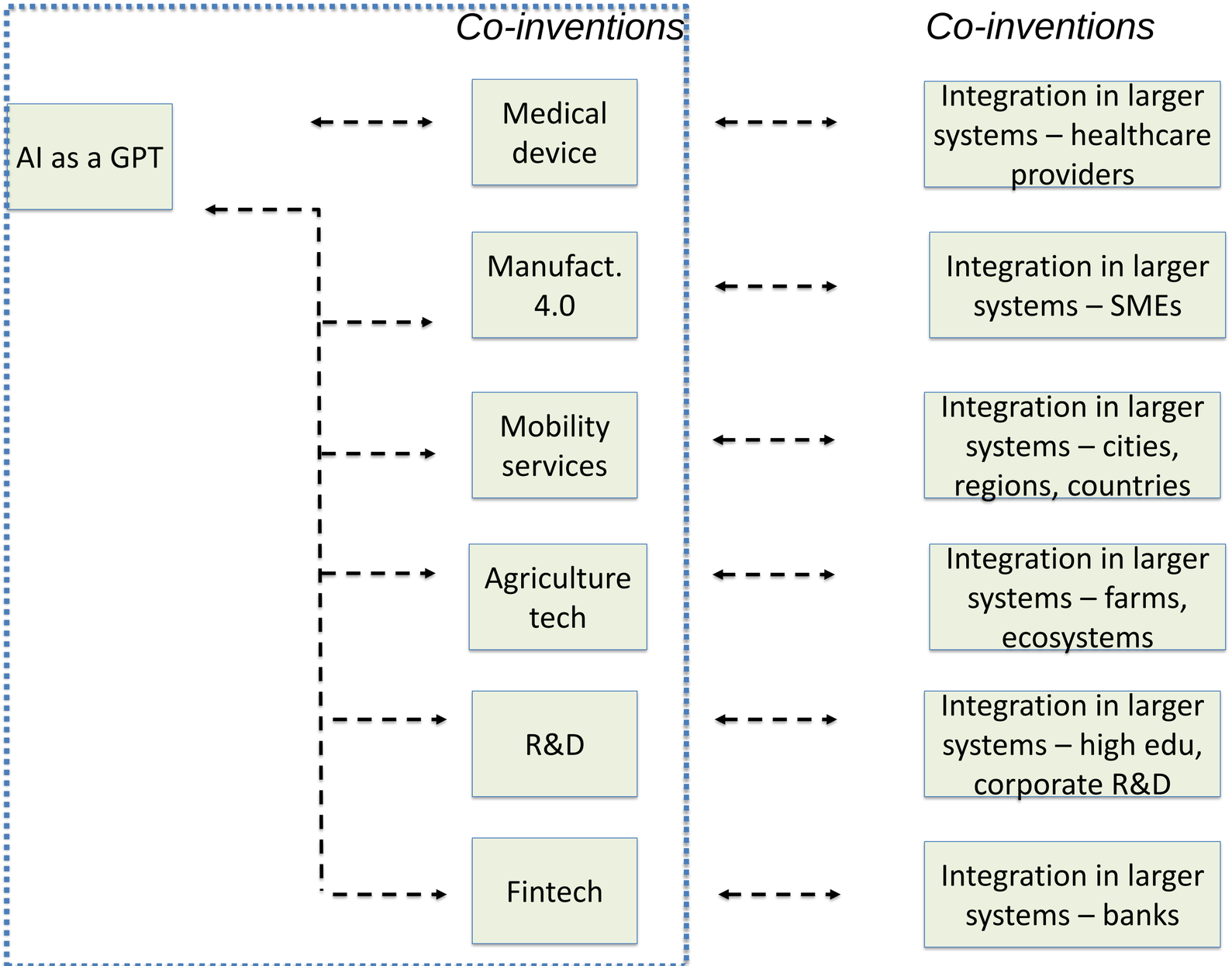
Full deployment of a GPT: productivity, wages, less disparities?



*Full deployment includes traditional sectors and secondary regions

*Issues in relationships between innovation, productivity and wages

*a key condition – accessing to and acquiring GP Technological Knowledge

*A complex social problem

- Driving forces towards disparities are inherently associated to the innovation process
- Finding compatibility zone for growth and inclusive policies
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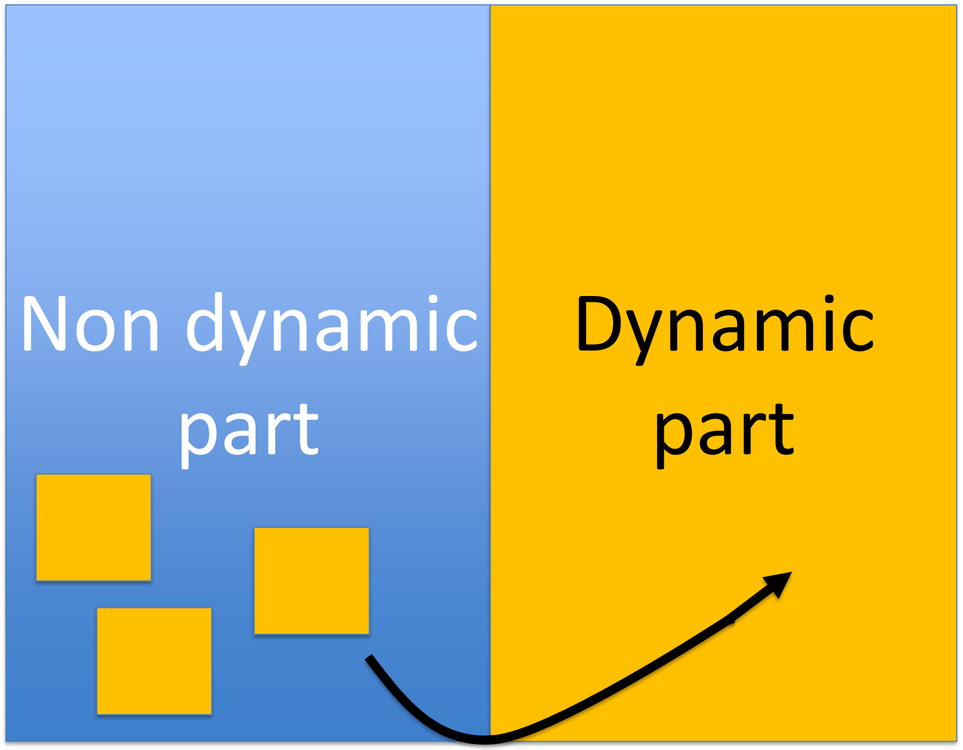
Pushing more R&D
and finance resources

even based on « neutral » instruments



S3 = Pulling existing resources into the dynamic part

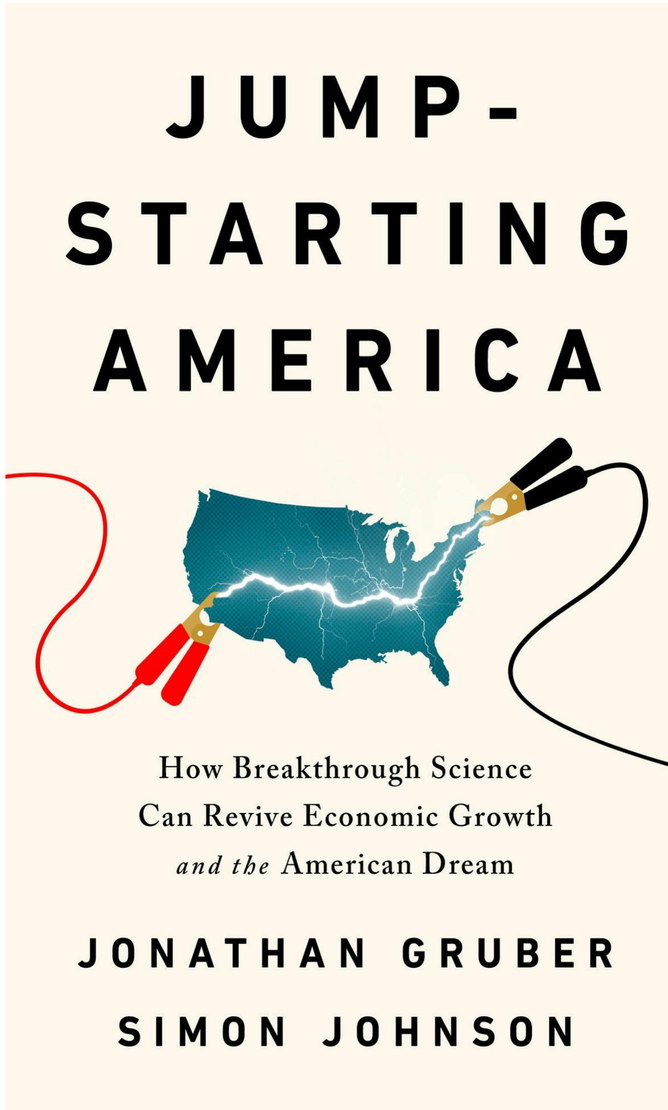
Phelps mechanism

A policy to promote both dynamism and inclusion is not a policy that would support ***pushing*** more R&D related resources into the economy, because these resources will ultimately be largely captured by the top science/high tech ecosystem but instead it aims at ***pulling*** some existing resources (of the traditional sectors) into innovation activities.

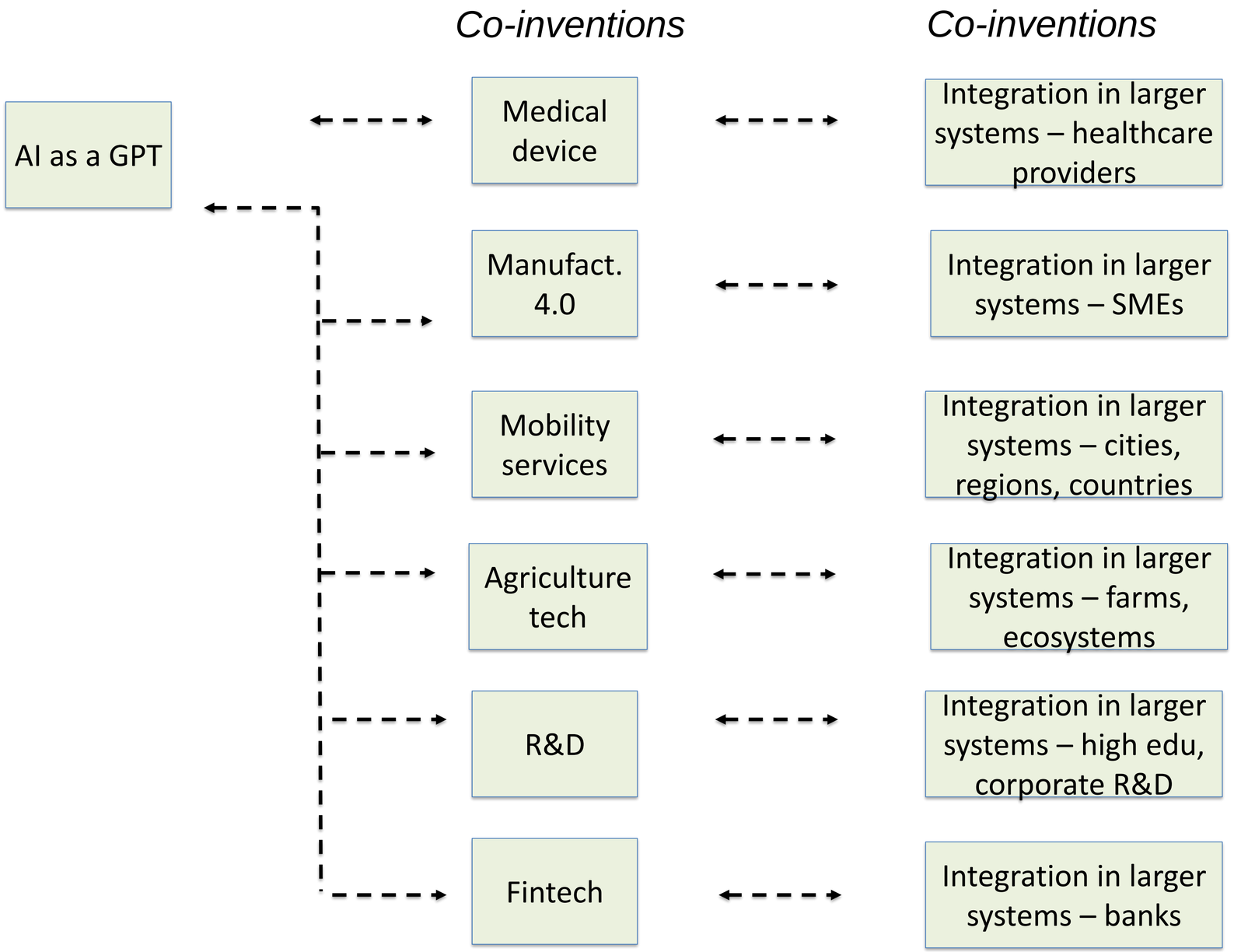
A GPT policy involves not only a pushing mechanism but also a pulling one

Jump-starting America – quite pushy!

- Starting point – great regional disparities in terms of innovation driving significant inequalities and social issues
- Policy : spreading research-related dollars wider than the existing superstar cities to which they flow today
- THIS is an index to select 102 places as potential new innovation hubs and recommend pushing much more resources in these places through basic research, R&D infrastructures, financing, technical and scientific educations
- Problem with this policy?



An enormous complexity



"Understanding the basic problems of coordination is not enough. One is led to a new but not simpler set of questions: what activites in what firms are complementary and need to be coordinated in what way? An appropriate choice of policy tools requires a detailed understanding of the externalities and the innovative complementarities involved" - Matsuyama,1997

**"The public inputs that innovators require tend to be highly specific in the area in question.*

The idea that the government can disengage from specific policies and just focus on general framework conditions in a sector neutral way is an illusion based on the disregard for the specificity and complexity of the requisite publicly provided inputs and capabilities.'
Haussman and Rodrik, 2006

Tinbergen assignment theorem

- Did we forget something to do? Or are we doing too much?
- How many instruments?
- Tinbergen rule – number of instruments = number of externalities – provide a first-order guidance on these questions
- Knowledge externalities (fundamental research)
- Co-invention externalities (from application to core invention)
- Adoption externalities (among adopters)
- Training externalities (labour market)
- More market/coordination failures to be fixed

GPT/growth policy – national level

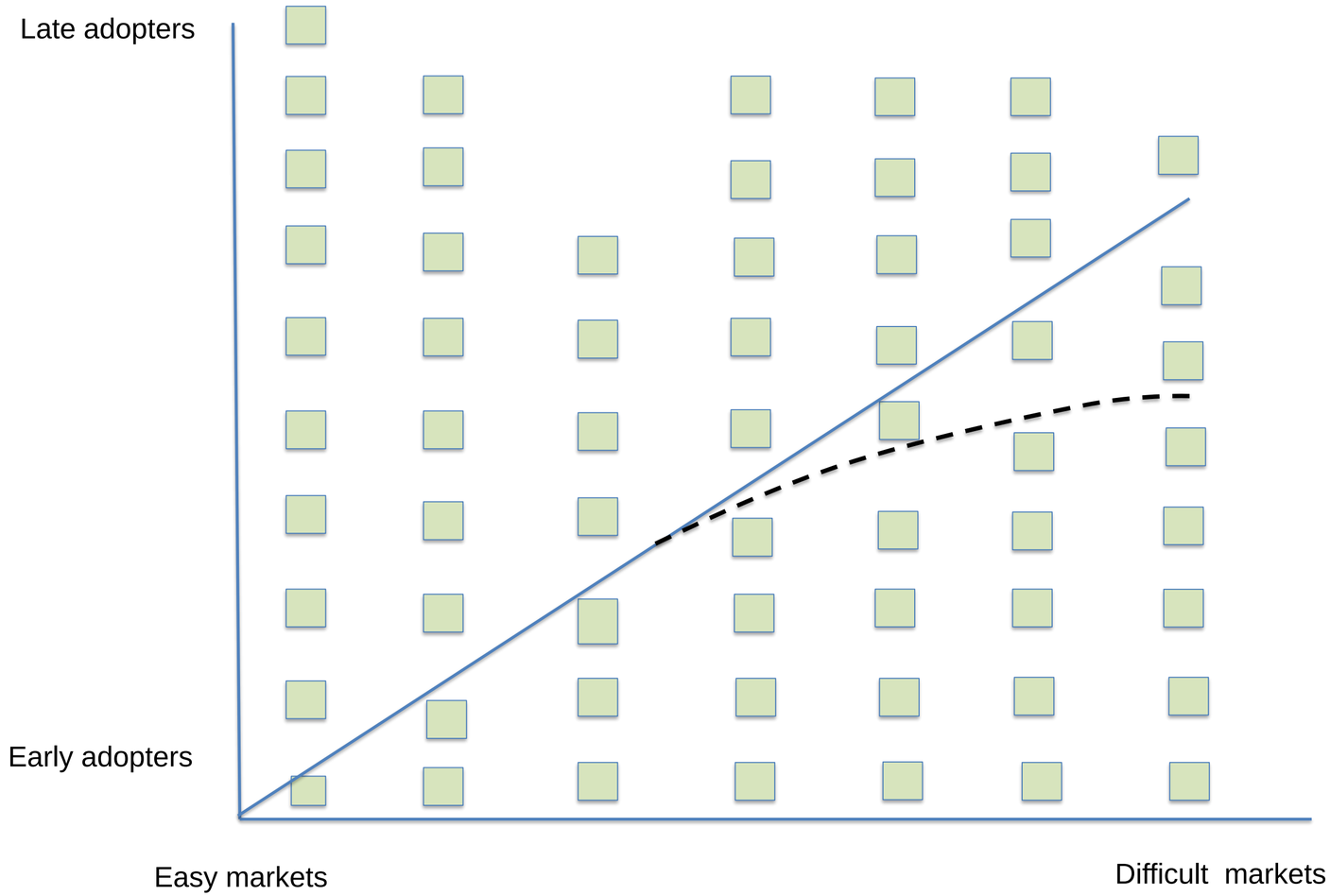
- Considering the two axes – innovation in the GPT, horizontal propagation (which involves a multi-sector approach) and all externalities – this implies:
- Going from the most favourable markets for early stage GPT to the more difficult markets
- Targeting specifically traditional sectors in which the scope and complexity of innovational complementarities are the greatest and the provision of industry specific public inputs (skills, management, adoption) raises strong challenges
- Targeting early co-inventors in application sectors – those firms which potentially generate massive spillovers (towards the GPT inventors and towards late adopters) – fixing two market failures in the same time
- Fine-tuning instruments according to the logics of co-inventions
- Developing a regional/spatial strategy of a GPT deployment

Designing programmes to support co-inventions

- Rationale for co-invention support programmes
  - There is room to consider supporting early adopters at higher rate than late adopters and early adopters in difficult markets at higher rate than early adopters in easy markets
  - While the policy rationale for knowledge production never weakens, the policy rationale for innovation adoption is weakening as adoption progress – meaning a need for a dynamic policy
  - Standard adoption policies don't recognize the fact that the very rationale of the policy (adoption externalities) is weakening itself as the adoption is progressing – needs for a dynamic policy
- Providing sector-specific public inputs
  - Hausman and Rodrik – *doomed to choose*

The co-invention externalities curve

Early adopters are weakening the rationale for subsidizing further adopters in any sector

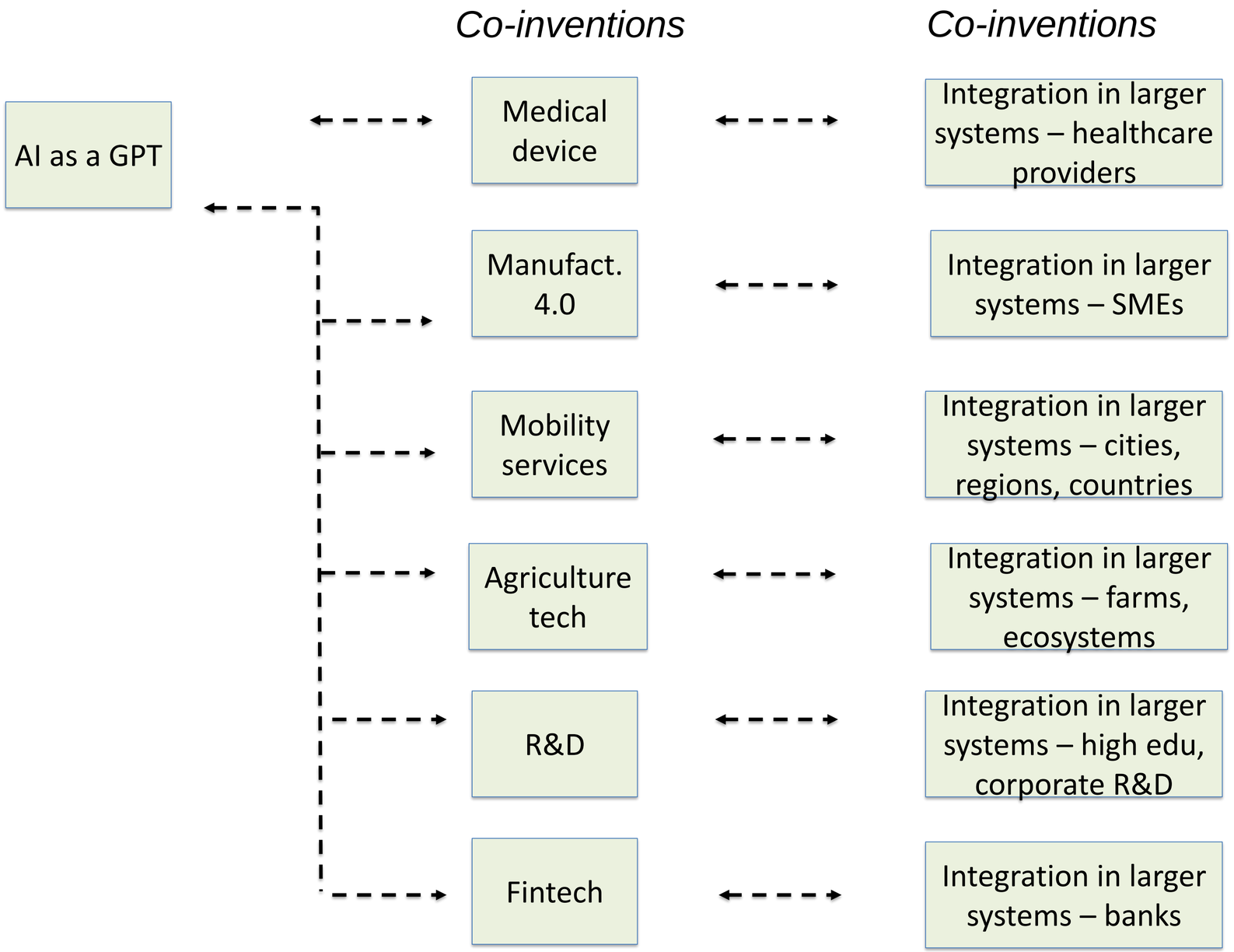


Early adopters in difficult markets make these markets easier for the next adopters

Subsidizing early adopters
For easy markets
the first 10% of firms receive a subsidies

For difficult markets the first 50% of firms receive a subsidies

Centrality of institutions



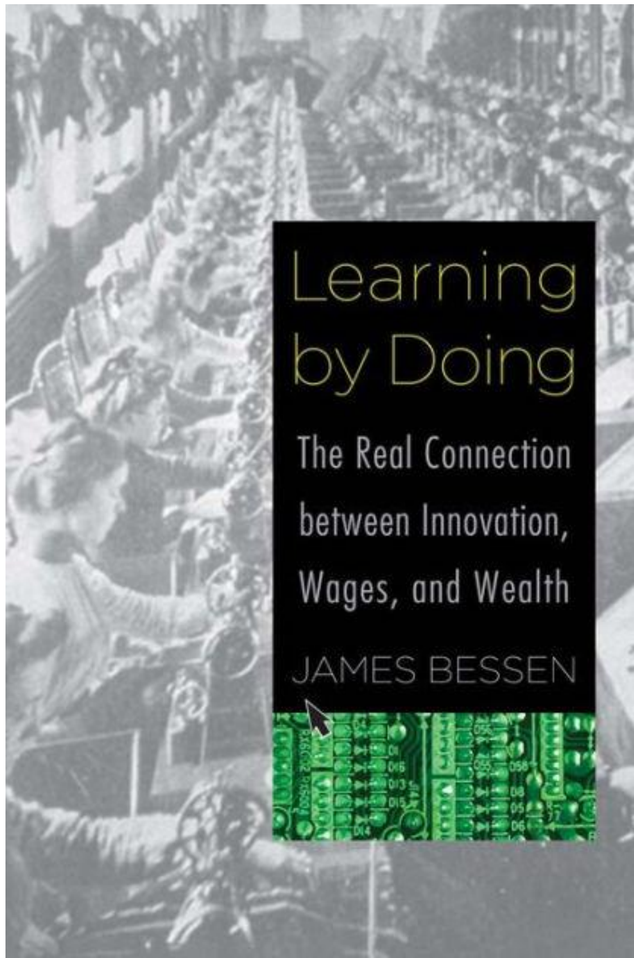
Strong institutions can decrease the cost and scope of policy

Training and new skill acquisition.
Developing the knowledge and skills needed to implement and deploy a GPT on a large scale is a difficult social problem – especially during the early stages

Transfer of GP Technical Knowledge to firms

Institutions - 1

- Developing the knowledge and skills needed to implement and deploy a GPT on a large scale is a difficult social problem – especially during the early stages. Early technical knowledge is typically too fragmentary, uncertain, and constantly changing to be standardized
- Prior to standardization, classroom education is difficult and labor markets may not reliably reward workers who invest in their training.
- Need for robust markets and training institutions – which will reduce the number (the scope) of programs in a GPT policy



Institutions - 2

- SMEs and the access to GP Technological Knowledge
- Coordination between various orders of co-invention (research and SMEs) raises considerable problems and there are many reasons to fail
- Innovative models of cooperation and transfer are needed (e.g. Inspire)

Conclusion

- Finding a policy space where both goals of growth/innovation and adressing disparities are compatible and even mutually beneficial
- GPT framework
  - Recognizing a multiplicity of targets, goals and innovation styles
  - Taking care of innovational complementarities and co-inventions of applications
  - Targeting lead adopters in AS
  - Including the less favourable markets at the early stage
  - Developing a regional strategy of GPT deployment
- There is indeed a rationale for innovation policy (not only for social or cohesion policies) to address disparities
- This can lead to a very complex (costly) policy
- Strong institutions to support acquisition of and access to GP*TK* (VET, platforms for partnerships) can decrease policy complexity


Merci