Efficient while Risk-taking
How does AI affect international economic policy-making?

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Abstract

This paper provides a broad vision of the role played by AI in the policy-making realm, especially in economic policies. We explore the impact of AI on the means and efficiency of international political and economic policy-making. We employ methods that include the comparison of multiple types of references and form models therefrom, proving feasibility through real-world examples. The main construction of our report is the logic line of background-effect(pros and cons)-limitations, enriched by analyses and examples. Through policy categorisation and data collection, the paper comprehensively analyses the effect of AI in international economic policy-making, and the advantages and characteristics demonstrated thereby. At the same time, this study will tackle the risks of AI use in formulating international economic policies from an ethical perspective, filling a gap in previous research. This study aims to achieve the integration of technology and humanities, algorithms and ethics, which we believe to constitute novel contributions to the field.

Keywords: artificial intelligence, policy-making process, economic policy, policy design and implementation, AI ethics

1 Background

In recent years, artificial intelligence technology has advanced rapidly, with AI becoming a symbol of global scientific and technological innovation. The exceptional capabilities of AI have aroused significant academic interest and discussion. And, undoubtedly, the rise of sophisticated AI systems has already begun to have noticeable impacts on many operating patterns traditional to humanity [10].

AI leverages its powerful capabilities in data processing within economic policy-making and revolutionises the research in that field. By analysing, say, the key data-points, regional distribution, and current status of supply chains, it has profoundly influenced the formulation of international economic policies [7]. Based on input from national governments, Figure 1 displays the number of policy initiatives targeting economies.

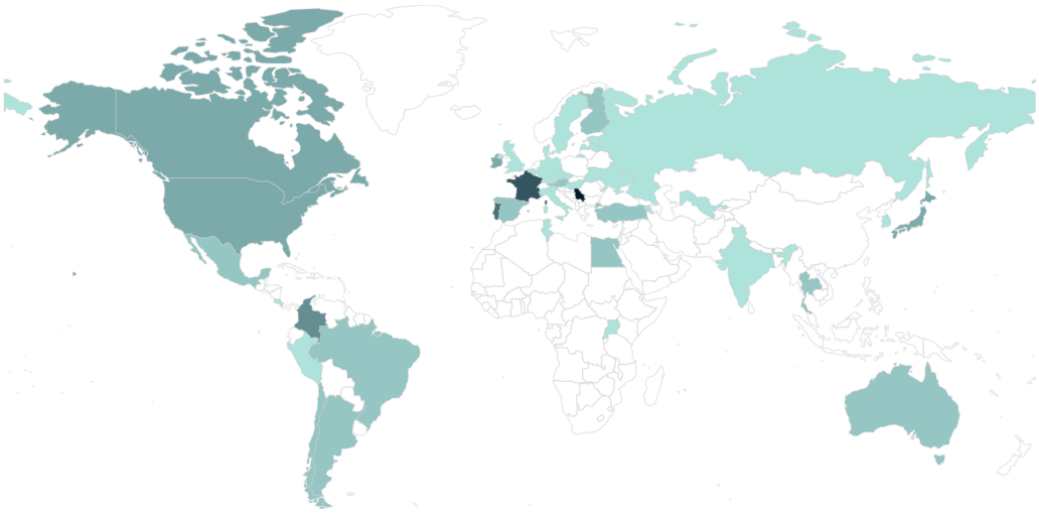

Figure 1: Number of AI policy initiatives in economic governance. The scale ranges from light green (fewer initiatives) to dark green (more initiatives) [7].

Figure 2 illustrates the top 10 countries producing research related to AI and economies in time, based on data from Microsoft Academic Graph.

In terms of research content, previous literature in this field has focussed primarily on a single perspective and typically in a singular context, such as the relationship between AI and international economic policy-making in the context of the China-US trade war [14], and without paying integrating other disciplines. In terms of research methods, previous studies lacked quantitative analysis. To fill these gaps, our group chose several related materials and case studies in order to begin building a pertinent model. We summarise

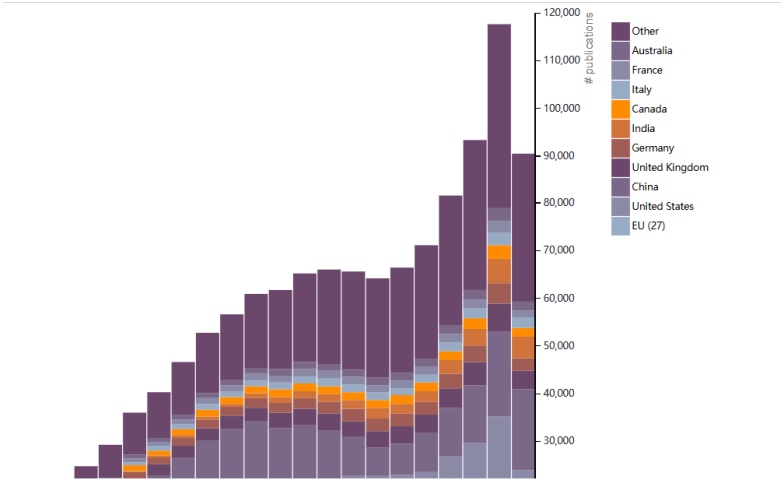

Figure 2: The stacked bar chart shows the top 10 countries producing research related to AI and Economy over time, based on data from oecd.ai reproduced in Microsoft Academic Graph [7].

the achievements of studies across several disciplines, supplementing our own interdisciplinary analysis. From a position of realism, we express concerns about a hot issue in social research: How to strike a balance between technology and humanism.

2 Challenges

During our research, a large number of ethical and epistemological questions arose to hinder progress. We encountered the fatal dilemma of considering whether we should take AI as simply a further advancement of simple, though many, algorithms or a decision-maker that is, to some extent, intelligent to make judgements. Finally, we overturned the conception of treating AI as a mass of data itself, and shifted our position toward taking AI as an algorithm-based reaction machine. We treated AI as a *limited thinker*.

The next question that blocked our way was the obscure concept of *international*——What does *international* mean? We chose to use a regression-like methodology, and put forward a series of questions based on the results:

- What is the scope of our topic? Is it a comparison among countries, among organisations, or just the international policies within one country? We debated whether "international policy" refers to the policy of supranational organisations like the European Union, or if it refers to the policy of one country towards another country.

- What are the factors that affect the relationship between AI and international economic policy-making? This question concerns the mechanisms in relationship between AI and international economic policy-making. We intend to find factors that have mediating or moderating effects on that relationship.

- What are the indicators that denote policy effect? How can they be measured? Only using economic policy indicators, like employment rate, GDP, or GNP, is a likely partial since real happiness and other qualitative outcomes can not be measured by economic indicators alone.

3 Contributions and Limitations

3.1 Contributions

Our study is inspired by a background of rapid advances in information technology. Based on the materials assessed herein and our own reflection, we reached a consensus that AI's present function in economic policy-making is a double-edged sword. That is to say, it can boost efficiency but its rapid adoption also entails risk.

3.1.1 The model of AI in Policy Making

Concerning the definition of AI, the narrow form is now embedded in many daily economic devices and processes, including voice recognition in smartphones and speakers, content moderation, facial recognition and biometric identification systems, online customer service chat-bots, search functions in online shopping and streaming services, credit scoring, language translation services, diagnosis and monitoring of healthcare patients, and the management of warehouses, shipping, and logistics. We can conclude that AI is a powerful tool in view of the following.

AI offers many benefits to policy-making and policy implementation through efficiency enhancements, public service quality improvements as well as time savings on administrative tasks.

AI can be used as a tool to improve communication and engagement with stakeholders.

AI can help generate high-value inputs and create more meaningful impacts for society in each stage of the policy cycle.

The foundations of policy-making —— specifically, the ability to sense patterns of need, develop evidence-based programs, forecast outcomes, and evaluate effectiveness —— fall squarely in AI's sweet spot. We can state that although governments want to use evidence to inform their policy decisions, that evidence is often incomplete, partially understood, or poorly integrated into decision-making and policy-making. AI can enable both understanding and integration [12]. According to the AI's functioning mechanism, we here use a model to display how AI is playing multiple roles during the procedure of policy-making as listed below [8], and its visualisation is found on page 3.

1. **Identification**: AI tools can rapidly synthesise large amounts of data and detect patterns. Al can support policymakers in determining the most critical challenges affecting their constituents, through analyses of large datasets and crowdsourced data. The patterns revealed by such Al analyses could guide and inform policymakers in setting agenda priorities.

2. **Decision-making**: AI can generate data insights by processing data sources and then performing scenario analysis. Armed with insights from the previous stage, policymakers will be better equipped to make more informed decisions in different policy scenarios.

   Governments routinely try to forecast the projected costs, benefits, and outcomes of policy options. At this stage, AI's capability of prediction is so useful and powerful that it can help not only to project the costs and benefits of different options but also to estimate the likely impacts of policy options.

   AI can play an important role in ensuring procedural democracy. It is helpful to formulate relevant laws and regulations under the existing policy-making system, allowing people to participate more in the policy-making process [9].

3. **Implementation**: A policy is only as good as its implementation. AI tools can help get policies implemented more efficiently through automation and near real-time analysis of feedback from the field. Policymakers can benefit from advanced AI systems and hardware in executing policies. Through automation, quick data processing, and real-time analysis, the use of AI can lead to improvements in the quality, speed, and efficiency of the delivery and implementation of policies.

4. **Evaluation**: AI tools can speed up the assessment of things that need to change by identifying where a policy could be falling short or subject to fraud. What can be clear is that balancing competing political

forces during policy-making will never be tidy, but data is the raw material and AI is the tool that can allow policymakers to generate more effective, targeted, and cost-conscious policies that actually improve people's lives [4].

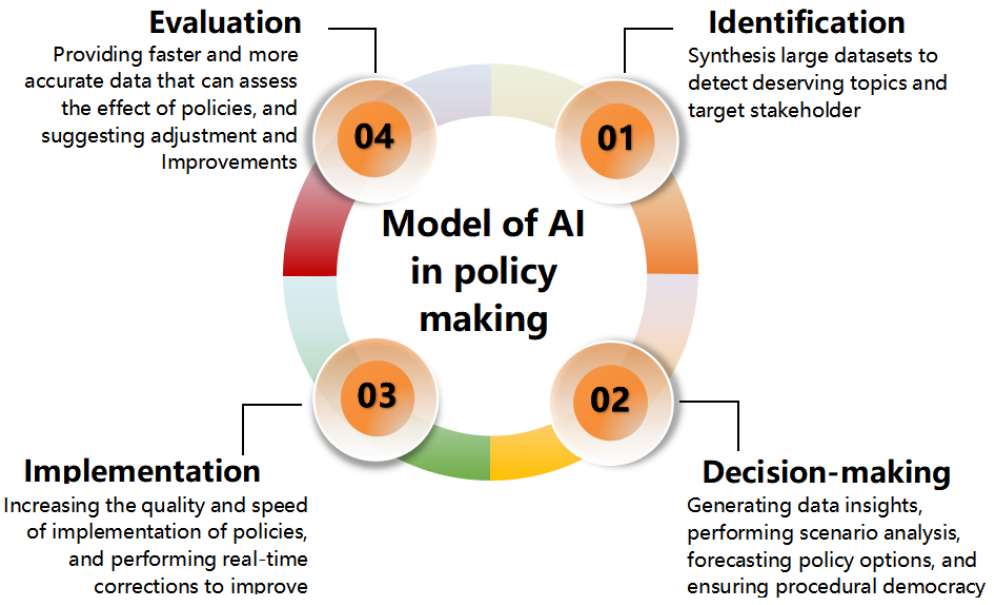

Figure 3: AI's role in policy making.

Figure 3 depicts a vivid image of AI's affordances for efficacious policy-making. A rigorous, quicker, and more adaptive method can thus be achieved in the short term [15]. More broadly, artificial intelligence can deliver on the promises of future governments, making them more responsible and leaving no one behind. In order to give a detailed and applied analysis, we measured two cases as follows.

3.1.2 Case Study: Taxation

Taxation is an area where current policies are badly performed. Tax policy provides governments with an important tool to reduce inequality, supporting the redistribution of wealth through public services and welfare. While improving equality, taxes can also discourage people from working, leading to lower productivity. So, finding the optimal tax policy is challenging

but essential. The involvement of AI makes it possible. The following parts introduce how AI works in taxation.

Identification It is well-acknowledged that current tax policies are imperfect. But a recent study has conducted a simulation of the future development of economies in terms of current tax policy using AI and found that economies would be worse for both equality and productivity [17]. It is high time to explore a new system of tax policy for sustainable growth in economies. This is how AI identifies the topic and task we should take. Moreover, it is also significant to identify the individuals who deserve special treatment in taxation, and this becomes feasible with the help of AI given its powerful capabilities of data collection, analysis, and simulation.

Decision Making In order to facilitate analysis, we compare economic outcomes under the "AI Economist" with the free market (no taxation or redistribution), a simulated US Federal tax schedule, and the tax policy that results from the Saez [16] framework, a standard model of taxation in economics.

Among them, the non-taxable experiment is to illustrate the social results that taxation may help correct and some of the challenges faced in designing the best tax plan. Saez formula is the design of a tax system that maximizes a social welfare function subject to a set of economic constraints, creating a trade-off between equality and productivity. Progress in optimal taxation theory has also come through a growing empirical and experimental literature. But it is usually hard to experiment with real-world tax policies. In the place of experimentation, economic theory such as Saez theory, often relies on simplifying assumptions that are hard to validate, for example about people's sensitivity to taxes.

However, with Stephen Zhang et al.'s AI Economist [17], a two-level deep reinforcement learning framework to train social planners, we can make use of a deep neural network to learn behaviours within the simulated world and including responses to tax policy. Zhang et al.'s model learns dynamic tax policies in regular economic simulation and learns a tax schedule, which is able to observe all public information about the world, including the position of, income, and resources held by agents.

For all four treatments, reinforcement learning to optimise the behavior of the economic agents is used. The results [17] are shown as Figure 4 and Figure 5 on page 8 and page 9.

The spectrum of tax policies has two extremes, one of them is the free market, which only considers productivity and does not raise any taxes. So

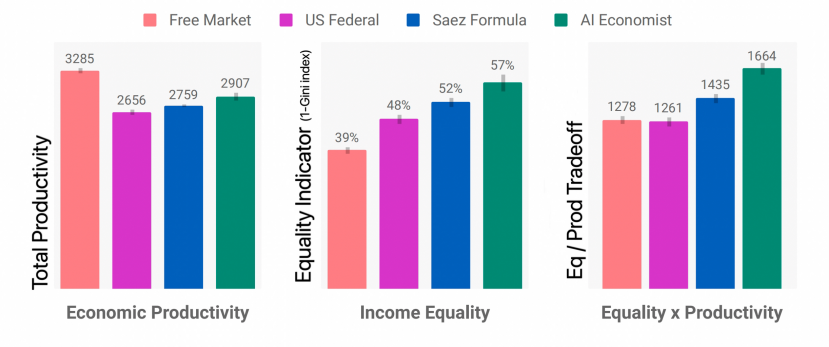

Figure 4: Comparison of overall economic outcomes [17].

this is why productivity simulates higher under a free market than the policies generated by the AI Economist. Productivity measures the total amount of income generated within a given period (analogous to GDP). Taxation always results in a decrease in productivity when compared with the free market, but the loss in productivity is the smallest under the AI Economist. As is clearly depicted in Figure 4, AI has the highest income equality of 57%. Income equality, which is defined as *1 - Gini coefficient* and computed at the end of a given period (a higher Gini coefficient means incomes are less equal), is highest under the AI Economist. The product of equality and productivity measures the balance between equality and productivity. The AI Economist achieves a 16% gain improvement over the next best model, which is the Saez model. The AI Economist also improves equality by 47% compared to the free market, at only an 11% decrease in productivity. Therefore, in the balanced relationship between equality and productivity, AI can provide the greatest economic and social benefit. Also, compared to the tax policy proposed by Emmanuel Saez, AI could improve on this by fully 16%.

As is shown in Figure 5, taxation can improve equality by transferring income. However, taxation will discourage work and reduce productivity. AI economists try to find a balance between these two problems, and the Pareto boundary is a collection of solutions. The AI Economist is closer to this boundary, which means it achieves significantly better equality-productivity trade-offs.

We believe the intersection of machine learning and economics presents a wide range of exciting research directions and gives ample opportunity for new machine learning advances that will have significant positive social impact.

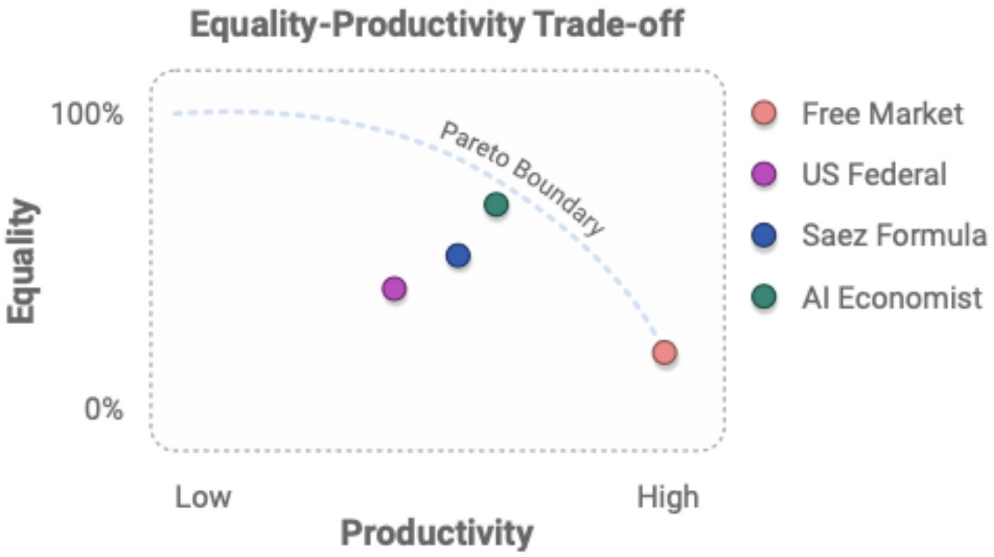

Figure 5: The AI Economist versus existing models in terms of the Pareto boundary [17].

Evaluation Policymakers must ensure that the policies they implement are indeed efficient and effective in achieving their desired objectives. AI could advance the evaluation stage of the policy cycle by providing faster and more accurate data that can assess the impact of policies. To provide a better reference for economic policy-making by the models that are explained and compared above, we have also explored whether AI-learned tax policies improve social outcomes in economic simulations with human participants who earn real money. In the end, we find that the AI Economist achieves equality-productivity trade-offs and higher income-weighted social welfare [17].

The specific mechanism is as follows. First of all, AI simulations capture the trade-off between equality and productivity to help policy formulation better adapt to real markets. Also, AI simulations yield emergent strategic behaviors. In conclusion, The AI Economist can capture features of real-world economies to work well in the face of adaptive strategic behavior and make adjustments flexibly to successfully optimise for distinctive objectives.

3.1.3 Case Study: the Barcelona Superblock

Barcelona is today ranked among the most polluted cities in Europe. To tackle environmental degradation, the government leverage AI's powerful capacities for data collection and analysis. Large accessible urban form data and processing tools with AI not only increase the accuracy and granularity of urban form analysis but also contribute to unveiling latent knowledge of urban morphology. We analyse the Superblock initiative in Barcelona, by using the model of AI in policy-making.

Identification To tackle environmental issues, the first step was to accurately identify the most suitable area for replanning, using AI's capabilities of data collection and analysis. Moreover, the identification of stakeholders, which was carried out by researchers and policy-makers through quantitative health impact assessment with the help of AI, was also a critical part of urban planning. Public involvement in the planning process was achieved through apps and the people's voice was extracted by AI, ensuring procedural democracy. Based on previous analyses, deserving topics were chosen as follows: (a) life expectation, (b) transport-related physical activity, (c) air pollution, (d) road traffic noise, (e) green space, and (f) reduction of the urban heat island effect through heat reductions [1].

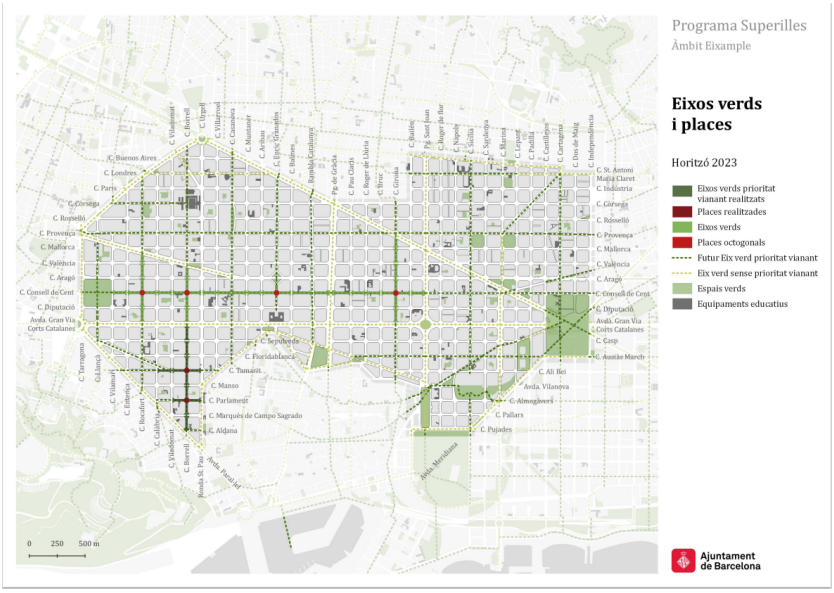

Figure 6: Programme superlines of the case of Barcelona [3].

Decision-making By selecting the appropriate model and constructing the algorithm, AI can estimate the effect of potential policy options [2]. In this context, AI predicts the health impacts related to the potential urban implementation, such as expected changes in life expectation, transport, air pollution, and urban green space (the topic identified in the first step). Urban planners could compare the predicted results of different planning options, and decide which option to implement [1]. This is the reason why the government finally implemented the Superblock initiative. According to the predicted result, the implementation of the Superblock initiative could save 1.7 billion EUR and a 200-day average increase in life expectations due to the improvement of the environment.

Implementation Based on sufficient digital infrastructure for object detection, a computational method has been introduced, for estimating carbon dioxide emissions provoked by the different actors populating the urban space [1]. With the help of AI, carbon emission and air pollutants data of various transport were monitored in real-time for dynamic analysis, enabling the implementation to adjust measures in different regions according to actual air conditions. This function significantly increases the efficiency of urban design for health in the case study.

Evaluation In order to establish a human-centric urban planning model, feedback and evaluation were necessary. Policy makers could adjust and improve the Superblock initiatives according to data and images collected by AI. They selected the most suitable algorithm model according to evaluations of optional algorithms. With the help of AI, changes in air pollutants, and the area of green space were analysed and carbon footprints were calculated. With the implementation of the Superblock initiative, the share of transportation by car was projected to reduce by 19.2% (translated into almost 230,000 car/motorcycle trips/weekday being shifted to public transport, cycling, or walking); green space increased to 19.6%; temperatures reduced by 1°C; and harmful air pollutants reduced by 24.3% [6]. These data indicate the success of the initiatives and the successful use of AI in every process.

3.1.4 Risks

This section will cast light on the risks incurred by introducing AI even while gaining efficiencies. These are examples of what we need to avoid.

Inevitable Nonhumanity While AI can have immense power in data analysis and logic, policy-relevant concepts such as fairness, justice, and equity are inherently human. That's to say:

- AI can not yet replace a judge's compassion or sense of justice since these are inherently subjective.
- AI can not make intuitive sense of human reality. It lacks insight for which humans must provide analogue indices.
- AI algorithms are easily affected by people's biases, prejudices, and experiences.

Cognitive Biases Cognitive biases can be introduced, whether intentional or not, during the crucial phase when policymakers set objectives, data scientists process data, and specialists interpret models. These biases become even more relevant when one considers that the choice of Al model can have different outcomes for various demographic groups even if the same underlying data are used [15]. Figure 7 shows how humans are endeavoring to avoid these side effects [15].

Figure 7: Guidance for the responsible US of AI in policy-making.

Either out of ignorance or malice, bad training data may result in biased policy recommendations, particularly in cases where users will train the tool

using their own data. For instance, the under-representation of communities and segments of the workforce in training data might lead to bias in AI-driven tax models [17]. What is more serious is the possible cut down of innovation in every realm applying AI technology — AI may even partly discourage future innovation by accelerating feckless imitation, which would limit the return on innovation [11].

Privacy Infringement AI's excellent capability in assembling and processing big data has reserved itself a throne in a new era, efficiencies of which, including data analysis, translation services, and model prediction, have been playing an increasingly irreplaceable role in our society. The implementation of AI in policy-making is an improvement in efficiency and productivity, while it is also a kind of dependence, which may still encourage risks. That's to say, what is often neglected is the risk of using AI in economics, policy-making, and perhaps every realm, along with increases in efficiency, which is always partialised in previous research.

One of its byproducts, a more vicious aspect, concerns ethical issues. For example, we are always encountering newly emergent consent clauses the moment we attempt to access online services. Most of the time, we do not care about what is waiting for our personal information when we check the box: "I have carefully read and agree to this clause", and in fact, we do not have a choice. That is the epicenter of the infringement of personal privacy during data collection. That is to say, the tools AI is using (such as facial recognition) can violate privacy protections [8]. As a result, AI could predict personal behavior and preference according to that personal information, and then enable firms to implement price discrimination and to manipulate consumers into making wrong decisions.

As concerns about the ethical impacts of AI have increasingly grown, governments have started to develop cross-cutting regulations that will apply to all AI technologies. However, unfortunately, privacy issues are highly unlikely to be solved in the foreseeable future.

Caged Algorithm We found that the more important issue among those listed is the *discriminatory statistics*, which has yet to be comprehensively tackled in the literature, and we coined a word to describe this phenomenon: a *"caged algorithm"*. To explain in brief, the complementation of AI in economic policy-making is *supposed* to reinforce existing discriminatory practices [8].

The general problem is that AI engines generate insights based on historical data that may have a built-in bias. It shares the same underlying logic

with the Survivorship Bias Theory [13]. Just like the military neglected the possibility that significance falls on the planes that did not come back, we may neglect some data that are supposed to be unnecessary when making decisions. However, it may have a great influence on the data assessment and make a significant difference when it comes to the final output, the result of which is that the AI algorithm, whose designers are humans, also puts these data out of consideration. What can be clearly presaged is that the output and suggestions given by AI will to a large extent influence our decisions to choose the suggested one, this is not hard to predict. And we apply these biased suggestions to make policies, and again input these "imperfect" results into the design of the following AI, thus making a vicious spiral.

Widening Gap Consequences also include the intensification of inequality, widening the alienation between economic development in developing and developed countries, and between large-scale firms and small-scale firms, since the data are precious assets that could lead to monopoly. For example, in the case of Barcelona, privacy protections are violated, and excessive attention to the construction of public space may lead to crowding out of private space. Meanwhile, the collected data about carbon footprint may result in the violation of personal privacy. What's more, it may widen the gap among different classes: Gentrification is a potential risk, which can occur when green and other popular infrastructure in depressed areas are occasionally improved and become attractive to the upper classes, resulting in rising rent and subsequently forced migration.

3.2 Limits

Artificial intelligence technology drives a broader digital economy ecosystem, and the accumulation of large amounts of data is crucial for algorithms. Data flow is an indispensable part of the real-time use of artificial intelligence technology. In order to make artificial intelligence effective and provide accurate predictions that are not easily biased and discriminated against, systems need to be based on high-quality and high-precision data [11]. Moreover, AI and its embedded digital ecosystem need to work seamlessly across international borders. Data are critical for AI. The ability to amass vast datasets is vital to AI innovation, and the operation of AI technologies such as smart devices depends on rapid, real-time, cross-border data flows [4].

That is to say, to foster international trade in AI products and to alleviate the otherwise uneven impacts of AI across diverse populations and national boundaries. Standard-setting is the protection of intellectual property rights;

it is critical but political, and hard to reach consensus thereon. To maintain competition in the AI market, policies to prevent monopolistic control of data are needed since AI exhibits economies of scale associated with the data. In addition, the control of data including international data flow, widens the gap between corporations and nations [5].

However, much less progress has been made in addressing cross-border risks and harms associated with AI, in areas such as competition policy; ethical, transparent, and accountable use of AI; personal data protection; and protections against the exploitative use of algorithms in consumer and labour markets. It may exacerbate economic inequalities, and undermine democracy and human rights. AI policies implemented by one government may be viewed as an unjustified barrier to trade, a threat to national security, or an infringement of fundamental rights by another. Thus, regulations need to be sufficiently flexible to support and respond to technological innovation, and they need to address a range of public policy objectives from promoting innovation to ensuring fair competition, non-discrimination, privacy, and security.

4 Statement

Author Contribution Conceptualisation: All; Article Searching: All; Mechanism Exploring: All; Data Collecting: M.R.C., Z.Y.K.; Algorithm Adjusting: S.R.Z., M.R.C.; Resulting Analyzing: Y.S.Q., S.R.Z.; Case Collecting: Z.X.Y., Y.S.Q., S.R.Z., M.R.C.; Case Analyzing: Z.Y.K., Y.S.Q., S.R.Z., M.R.C. Project Summarising and Report Writing:All. Proofreading and Format Adjustment: Z.Y.K.; All authors have read and agree to the published version of the manuscript.

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Intellectual Property The authors attest that copyright belongs to them, the article has not been published elsewhere, and there is no infringement of any intellectual property rights as far as they are aware.

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