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The Economic Impacts and the Regulation of AI: The State of the Art and Open Questions

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Abstract

This review investigates how Artificial Intelligence (AI) affects the economy and how the technology has been regulated, relying on academic and policy sources through early 2024. We find that: (i) theoretical research agrees that AI will affect most occupations and transform growth, but empirical estimates of these effects are inconclusive; (ii) regulation has focused primarily on topics not explored by the academic literature; (iii) across countries, regulations differ widely in scope and approaches and face difficult trade-offs. More and updated data on AI's effect on task- and sector-level productivity would be helpful as well as investigating the impact of regulation on firms and labor agreements.

[1] We thank Petia Topalova (IMF) for comments and suggestions on this note.

Introduction and motivation

This piece and the related paper investigate how Artificial Intelligence (AI) affects the economy and how the technology has been regulated, drawing on academic and policy sources through mid-May 2024.[2] We start by reviewing the theoretical literature on AI's labor market, productivity and growth effects and the available empirical evidence. We then examine the regulatory actions undertaken in different regions, detailing their rationales, approaches, and areas of coverage. Given the rapid evolution of AI technologies and related literature, the paper aims to provide a structure to organize the latest contributions for the use of policymakers, economists, researchers, and industry stakeholders.

Insights on employment and wage effects, productivity, and economic growth

Most studies on the economic effects of AI adopt—implicitly or explicitly—the idea that AI, similar to automation, would be able to substitute to some degree human labor, building on the task frameworks of Acemoglu and Restrepo (2018). This framework models output as a bundle of tasks carried out by either workers or robots (AI), where an improvement in automating technology has two main countervailing effects. The first, direct, effect is the transfer of some tasks from humans to automated capital for those tasks where robots are more efficient. The second, indirect, effect is an increase in human productivity in those tasks where workers are not substituted by robots. Automation therefore both lowers demand for labor through a displacement effect and raises demand through a productivity effect. Under the lens of the task framework, the net impact of AI will be determined by these two countervailing effects and a potential direct productivity effect in some tasks that stand to be complemented by AI. To reach a quantitative assessment of AI effects in the task framework, four main "ingredients" are required: (i) the number of tasks that may be profitably automated by AI; (ii) the associated cost savings, to determine task-level productivity gains; (iii) the potential for complementarity in tasks that are not displaced by AI; (iv) the response of other factors of production to AI substitution. While point (iv) has not yet been tackled, we review the rapidly growing literature that attempts to estimate (i) to (iii), as well as the limitations that prevent it from reaching a conclusive assessment of the impact of AI.

Partially responding to point (i), much of the literature has so far focused on computing "task exposures"–the share of tasks that can be carried out by AI (e.g., Elondou et al., 2023). However, as we discuss, most studies do not indicate which tasks will be displaced or complemented, and when this is the case, they generally do not provide an assessment of the profitability of substitution and associated cost savings, nor do they quantify the gains from complementarity. To reach some estimates of (ii) and (iii), we discuss empirical and experimental studies measuring the productivity gains from AI adoption. In this realm, the dispersion of the estimates of productivity effects estimated in firm-level studies is substantial: adopting firms see sales per worker increase between 0 and 6.8%. Moreover, most estimates are based on technologies pre-dating the latest wave of generative AI (adopting firms see sales per worker increase between 0 and 6.8%). When it comes to generative AI, due to the novelty of the technology and its still-limited adoption, we instead only have experimental studies highlighting sizable productivity gains in specific contexts. For example, Brynjolfsson et al. (2023) finds a 14% productivity increase in call-center workers. Given the limited empirical and experimental evidence on AI's labor market and productivity effects, we have to rely mostly on theoretical studies to get a sense of AI's potential growth effects. Researchers seeking to quantify the general equilibrium effects of AI are currently forced to make

[2] Additionally, we updated the EU regulation to the latest version of the AI law, as published in July 2024.

assumptions on several important points guided by the still scant evidence, such as how AI task "exposure" translates into substitution or what are the implied cost savings. As a result, the range of estimates is very large: private sector estimates imply an increase of GDP of up to 15% (taking place gradually over 10 years), while Acemoglu (2024) puts the number at just 0.7%.

Regulatory actions undertaken in different regions

Most recently the discussion on the challenges of AI has included how regulation should be shaped, if at all, to mitigate risks stemming from AI adoption while maximizing productivity gains. The landscape of regulation and the related provisions are very much evolving, but in general the debate has covered 3 aspects: if and what to regulate, the speed of regulation, and how to do so. Rules are also hard to set because AI is rapidly evolving, and in general there is no common definition of AI. Due to these rapid developments, the OECD maintains a continuously updated definition of "AI system", but it is a long road to build a consensus.

The main rationales for AI regulation and regulatory action to date cover mostly market competition; privacy concerns; intellectual property protection; military uses and national security; ethical issues and algorithmic bias; and financial stability risks. We look at the specific cases of how the European Union (the EU), the United States (the US), and China have so far regulated AI and incorporated the various rationales, notwithstanding substantial ambiguity in the definition of AI for regulatory purposes.

The majority of the cases considered regulate AI on the grounds of monopoly considerations, ethical, and privacy risks. Financial stability provisions are used less frequently as a regulation rationale. Current regulations are not clear yet on the copyright of AI-generated (or co-generated) material, and in some cases (US, China) they defer the decision to apply existing copyright laws to lower courts. The US stands out as it covers national security explicitly, while other entities like the EU have been more ambiguous. We summarize country cases and rationales in Table 1, and we provide deeper details on the more "economic" rationales in the paragraphs below.

- **Market competition.** There are different sources of market power that may entail current or future risks of monopolization. Though high barriers to entry, access to computing power and model training represent moderate risks, due to the presence of several countervailing factors (open-source AI models are already available, and so are samples of datasets so-called "synthetic datasets" that can reduce the amount of data needed to train AI models). Conversely, the markets for chip and semiconductor design and production, as well as raw materials, are already concentrated, posing a potentially higher risk. There is also an increased concentration in sectors "producing" technology, as current digital market leaders have dominant stakes in AI as well (see Google, Microsoft, etc.). Another concern relates to the ability of AI to allow firms in other sectors that use AI products to learn more about consumers, which would improve their capacity to price-discriminate, but could also allow them to manipulate consumers using subconscious biases that algorithms can learn but consumers are unaware of.

- **Financial stability**. AI can help banks in risk management and operational purposes (chatbots, fraud detection, and credit scoring). But some risks can arise by the potential for creating new sources and transmission channels of systemic risk (Shabsigh and Boukherouaa, 2023), amplifying procyclicality and herding behavior. AI algorithms may adopt similar strategies in different firms, lack of model transparency may challenge the effectiveness of emergency measures in times of stress, a scarce pool of financial data

may be used by AI, providing unreliable financial advice, and ultimately AI applied to financial tools can augment embedded bias, lead to privacy concerns, and bring unique cyber-threats. Only a few countries considered have covered financial stability aspects in their AI regulation. The US only covers cyber-attacks in its Executive Order, and the EU AI Act refers to competent authorities on the matter.

Overall, countries have taken very different approaches to AI regulation. The EU and Brazil have proposed an ex-ante risk-based approach to regulation.[3] According to the EU AI Act, AI models are assessed based on their potential risks, with stricter rules for "General-purpose AI" (especially for "high risk" or systemic), with penalties for violation. Support for innovation is covered, albeit very briefly. The EU AI Act also creates a new specific EU governance framework with the AI Office (within the EU Commission) and the AI Board with countries' representatives.

A decentralized approach based on guidelines for agencies and departments is taking shape instead in the US at the federal level. This is based on the "Executive Order (EO) on Safe, Secure, and Trustworthy Artificial Intelligence" of October 2023. According to the order, companies developing large AI models need to notify the Federal Government, as well as share results of safety tests. The order includes measures to estimate potential impacts (e.g., on the labor market) and support workers, to attract AI talent and foster innovation and cross-institutional cooperation.

Lastly, China has focused on algorithm recommendation and ethical reviews in its "Interim Measures for the Management of Generative Artificial Intelligence Service" of August 2023. The regulation covers only public usages of gen-AI and it is applied to both domestic and foreign individuals and entities involved in AI services and research in (mainland) China. This document includes provisions on algorithms design and training data and requires providers to carry out security assessments. One important aspect is that gen-AI should respect ethics and morality (including "Core Socialist Values"). Penalties for non-compliance include warnings, ordering rectifications/corrections, and suspension of services.

Ultimately, all regulators face important trade-offs as they need to balance first-mover advantages from AI innovation and development with potential risks.[4]

Main takeaways and gaps

Our review uncovers significant gaps in the current literature on the economic impacts of AI, but also points to future avenues for research and policy. Our main takeaways are as follows. First, there is no consensus in the academic literature on the effects of AI, which we attribute primarily to the lack of adequate and timely data, and the constantly evolving nature of AI. Second, there is a disconnect between policy and research. More research is needed to inform areas and actions of interest to regulators. Third, regulations adopted in various countries differ widely in their approach and scope, and face difficult trade-offs. More and updated data, especially on task-level and sector-level productivity gains from AI, would be helpful as well as investigating the impact of regulation on firms and labor agreements.

[3] The EU AI Act has been approved by the EU Parliament on 13 March 2024, with corrigenda approved on 22 April and EU Council approved the final text on 21 May. It has been published in the EU's Official Journal as Regulation (EU) 2024/1689, with date of effect August 1, 2024 and with its gradual application in 2 years. See the full text here

[4] Among other cases, the UK espoused a context-based view in recent a white paper; finally, Japan and India maintain a largely deregulated and flexible view on AI for the time being.

Table 1: AI-Specific Regulations in the EU, US, and China [5]

Country	AI regulation	Approach	Coverage	Competition	Privacy	Copyright	Military	Ethical	Fin. Stability
EU	EU AI Act (August 1, 2024)	Based on ex-ante risk assessment	AI applications, 'general purpose' AI models (incl. high risk and systemic) also integrated into AI systems.	GN	✓	✓/GN	X	✓	✓/GN
US	Executive Order (EO) on Safe, Secure, and Trustworthy Artificial Intelligence (October 2023)	Decentralized based on guidelines, principles and priorities	AI and AI models, incl. "dual use" foundation models	✓	✓	✓	✓	✓	GN (but incl. cybersecurity)
China	Interim Measures for the Management of Generative Artificial Intelligence Services (August 2023)	Ethical model design and content, ex-post liability	Only on public usages of gen-AI	✓	✓	GN	X/GN (but incl. National security)	✓	GN

Note: This table covers AI-specific regulations, while we signal with "GN" (as per "general") when other regulations/laws include these issues in a general context. We do not consider national laws for the EU nor State-specific regulations for the US. The EU AI Act is now an official EU Law as Regulation (EU) 2024/1689, with the date of effect: August 1, 2024. For China, the source is an unofficial English translation of the Interim Measures document. For the US, some aspects are also covered in the "Blueprint for an AI Bill of Rights" (October 2022) by the White House Office of Science and Technology Policy (OSTP) aimed to set a roadmap for the responsible use of AI especially on potential human rights.

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[5] The "'general purpose' AI model" is defined in the EU AI Act as (Article 3) "(63) '*general-purpose AI model' means an AI model, including where such an AI model is trained with a large amount of data using self-supervision at scale, that displays significant generality and is capable of competently performing a wide range of distinct tasks regardless of the way the model is placed on the market and that can be integrated into a variety of downstream systems or applications, except AI models that are used for research, development or prototyping activities before they are placed on the market; "[…] "(66) "general-purpose AI system' means an AI system which is based on a general-purpose AI model and which has the capability to serve a variety of purposes, both for direct use as well as for integration in other AI systems;[…]" The "dual-use model" in the US EO is defined as "AI model that is trained on broad data; generally, uses self-supervision; contains at least tens of billions of parameters; is applicable across a wide range of contexts; and that exhibits, or could be easily modified to exhibit, high levels of performance* at tasks that pose a serious risk to security, national economic security, national public health or safety, or any combination of those matters […]"

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