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Research Paper

Artificial Intelligence: An Analysis of Macroeconomic and Microeconomic Effects with Recommendations

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I. Introduction:

2023 was the year of blitzscale-like propulsion in the usage of and awareness regarding artificial intelligence models, with OpenAI's ChatGPT (Chat Generative Pre-Trained Transformer) spearheading the same. This has major ramifications on global economic prospects including but not limited to labor market dynamics along with effect on GDP and economic output.

Macroeconomic Changes brought by AI

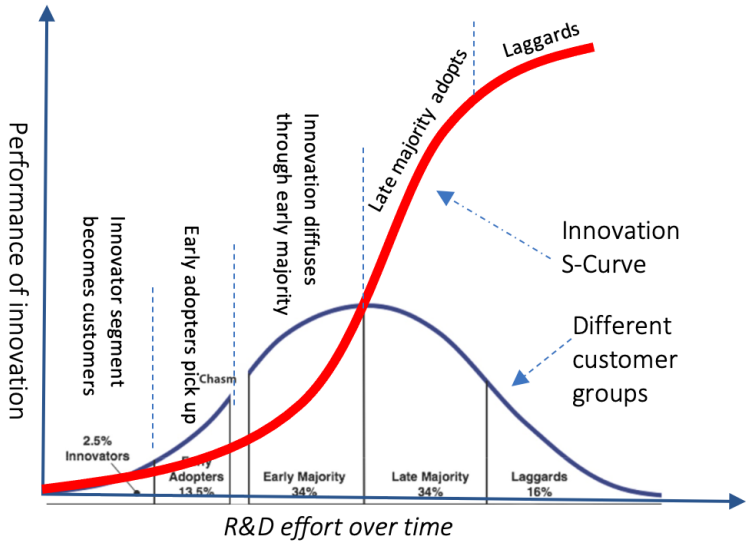

Figure 1: S-shaped curve representing adoption of AI (Zaman 2022)

The adoption of AI by countries and companies can broadly be modeled using the S-shaped curve shown in Figure 1. The ferment stage is the first stage of the s-shaped curve, when the innovation is first created (Zaman 2022). At this point, the main customers are investors. Following this, the 'take off' stage takes place, in which a few early individual customers take interest in and use the emerging technology. Thereafter, the innovators or creators have to cross the 'chasm' or point where a product considered niche has to be taken from early adopters to the masses (Moore, 2002). Thereafter, the technology reaches its maturity stage, wherein it is adopted by the masses.

Analysis of Effect of AI on Economic Inequality

The effect of new and advanced technologies such as AI results in the widening of economic gaps due to income inequality among developed, developing and underdeveloped nations. This is because the concentration of further investment is increasing in developed economies to further the use of AI and similar technologies (IMF, 2020). This also results in an increased Gini Coefficient for poorer nations. In a comparison of the United States and Uruguay, it was found that on average, the highest decile of earners (who have also

seen the highest investment in artificial intelligence), have seen an increase in income of USD 1300, whereas the lowest decile of earners have seen negligible increase in income (Cornelli, Frost, and Mishra 2023). Thus, AI has significantly increased income inequality. Another concern is the fact that automations such as AI are replacing the human labor force at alarming rates. Further, the level of training required for workers to shift from occupations that are likely to be replaced by AI to occupations that are less susceptible to possible replacement has increased considerably, thereby making it exceedingly difficult for working in manual, repetitive occupations in developing countries to switch to higher paying jobs (Qiu and Liu, n.d.).

Changes in the Workforce- **Modern Solow Paradox**

The effect of AI on modern occupations can be described in terms of a modern Solow Paradox. The Solow Paradox refers to a situation in which the labor force productivity decreases as investments in technologies (for instance, computers, machinery automation etc.) are made. Theorized by Economist Robert Solow in 1987 in the context of the early computer age, the Paradox was largely rectified in the United States in the 1990s ("Digital productivity paradox | ILO/Cinterfor", n.d.). However, due to the rapid increase in AI usage across sectors, the Paradox may have returned. A widespread decline in productivity growth rate has been observed across the Organisation for Economic Cooperation and Development (OECD) (Brynjolfsson, Rock, and Syverson, n.d.).

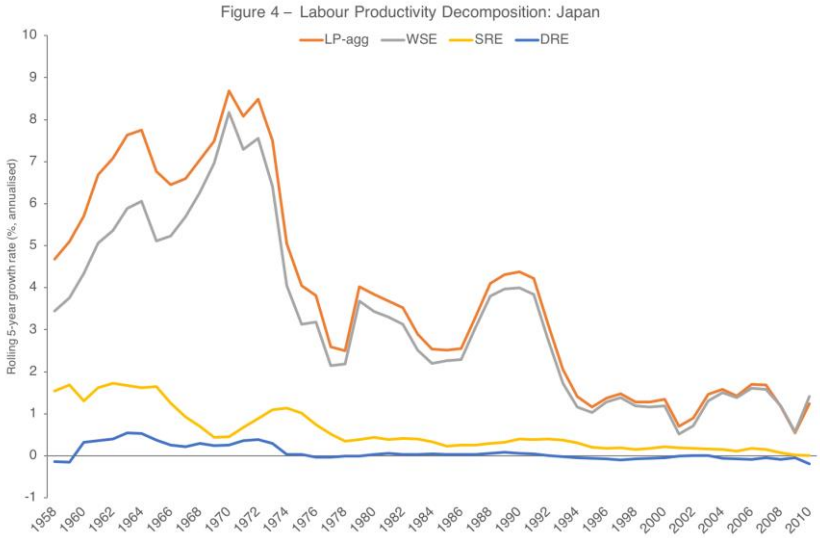

Figure 2: Solow Paradox in Japan, source: ("The Productivity Paradox – A Survey", n.d.)

The rapid adoption and increase in investment in GPT (General Purpose Technologies) has resulted in a notable change in the workforce composition across economies. However, the effect has been different in developed and developing economies. A measure called AI Occupational Exposure (AIOE) helps measure the proclivity of an occupation to be exposed to AI (Felten, Raj, and Seamans, n.d.). From a study of the AIOE of 4 Emerging Economies and 2 Advanced Economies, data on the AIOE of different occupations has shown the results in Figure 4. Potential Complementarity refers to the situation wherein there is a possibility for cross-price elasticity of demand between two or more products or services.

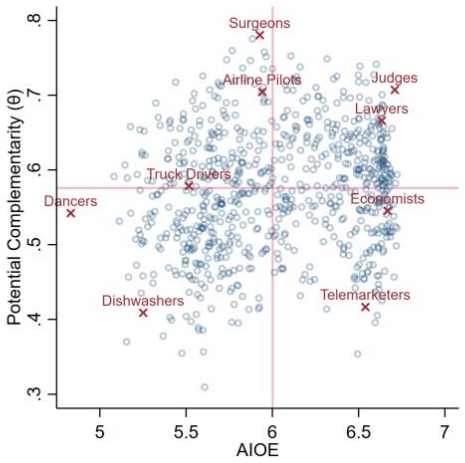

Figure 3: AIOE and Potential Complementarity, (Pizzinelli et al. 2023,)

Effect on Economic Output

It has been estimated that by 2030, the global GDP (at Real Market Price) will be 14% higher due to AI advancements ("Sizing the prize", n.d.). The short to medium term effects of AI on economic output appear positive, with consulting firm PwC estimating that AI could contribute $15.7 trillion to the global economy by 2030. However, the benefits of such growth largely accrue to China (with an estimated 26% growth in GDP by 2030) and North America (with an estimated 14.7% growth in GDP by 2030). Sector-wise analysis of the effect of AI on economic output reveals that in the long term, growth in economic output due to AI and other technologies might be limited by **Baumol's Cost Disease**. Baumol's Cost Disease refers to when sectors like agriculture and industry witness a decline in their share of GDP, whereas sectors like the service sector witness a sharp rise in their share of GDP. Thus, in sectors where there is increase in production of tangible goods, there may not be a commensurate increase in percentage of their contribution to the GDP (Aghion, Jones, and Jones, 2017).

Microeconomic Changes brought by AI

AI has played a pivotal role in the new age cost determination of a variety of goods and services. For instance, it has reduced the costs of 'prediction problems'. The programming of self-driving cars has been reduced to a 'prediction problem', wherein the AI model tries to predict what a good human driver would do ("Mckinsey: The economics of artificial intelligence" 2018). AI is also posited to reduce the cost of sustainability related ventures. This has been already implemented in a limited capacity. Boston Consulting Group redesigned a machine learning based control system for a European Oil and Gas Company to predict CO2 emissions for different machines, thereby assisting in reducing carbon emissions by 3500 to 5500 tons of GHGs per year (Degot et al., 2021). Depending on the usage of the AI, AI can be seen as a positive consumption externality whereby the benefits of its regular usage by some firms can be conferred upon non-adopting firms. For instance, streamlining of supply chains using AI models can confer benefits on producers and consumers alike, irrespective of whether they themselves are adopters of AI in their respective organizations. Likewise, the misuse of AI can be a negative externality for businesses and consumers. For instance, 'submodularity' is an effect wherein a user inadvertently shares a lot of data with AI models (Acemoglu, Makhdoumi, and Malekian, 2021). If this disclosure of data affects the user negatively, AI will be in the role of a negative externality .

Existing Policies:

Various countries have differing policies on the adoption and regulation of AI systems and softwares. For instance, India has a policy of growing AI research and adoption through NITI Aayog's National Program on AI. The Digital India Act has been proposed but not yet implemented (Chauriha 2023). Meanwhile, China is the first nation to have binding regulations on AI. This includes regulations on how AI systems are developed, implemented and what information must be revealed by the developers to the government and users (Sheehan 2023). These policies have been largely scattered and limited only to their own countries. There has been little implementation of international measures that work not only to regulate the misuse of artificial intelligence, but also to mitigate its adverse effects such as those on income inequality, decrease in productivity, unemployment and reduced contribution of agricultural and industrial sectors to the GDP.

Policy Recommendations for Nations to Prepare for Changes brought by AI:

In light of the aspects disclosed and analyzed before, the following policy recommendations are suggested. Firstly, national governments should work on determining standards of additional training and education that should be provided to low skilled workers and those who have occupations with high AIOE levels. This will help prevent relative large scale unemployment as it will be re-skilling members of the labor force. Secondly, international organizations should release guidelines on the widespread usage of AI models. While the UN Resource Guide on Artificial Intelligence Strategies fulfills this to a limited extent, the guidelines must be all-encompassing and made in consultation with the newly formed UN AI Advisory Board. Thirdly, it is imperative that local governments take steps to curtail the effect of Baumol's Cost Disease in rural areas on agriculture and small scale industries, to increase their contribution to the GDP. A few ways in which this can be implemented are by implementing Minimum Support Prices for agricultural goods provided by the government and Price Ceilings on the cost of agricultural inputs such as fertilizers and seeds. Fourth, the government should regulate the negative externalities caused by AI by way of controlling 'submodularity' by the creation of efficient monitoring systems of AI models.

II. Conclusion:

This essay concludes that while there are significant macroeconomic and microeconomic challenges to be faced by nations due to the adoption of AI models, many of them can be mitigated through suitable policy measures.

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