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RESEARCH ARTICLE



Democratization, state capacity and developmental correlates of international artificial intelligence trade

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ABSTRACT

Does acquiring artificial intelligence (AI) technologies from the US or China render countries more authoritarian or technologically less advantageous? In this article, we explore to what extent importing AI/high-tech from the US and/or China goes parallel with importers' (a) democratization or autocratization, (b) state capacity, and (c) technological progress across a decade (2010–2020). Our work demonstrates that not only are Chinese AI/high-tech exports not congruous with importers' democratic backsliding, but autocratization attributed to Chinese AI is also visible in importers of US AI. In addition, for most indicators, we do not observe any significant effect of acquiring AI from the US or China on importers' state capacity or technological progress across the same period. Instead, we find that the story has a global inequality dimension as Chinese exports are clustered around countries with a lower GDP per capita, whereas US high-technology exports are clustered around relatively wealthier states with slightly weaker capacity over territorial control. Overall, the article empirically demonstrates the limitations of some of the prevalent policy discourses surrounding the global diffusion of AI and its contribution to democratization, state capacity, and technological development of importer nations.

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KEYWORDS Artificial intelligence; high-technology trade; United States; China; regime type; state capacity; technological development

1. Introduction: AI, democratization and regime type effects

Do Chinese artificial intelligence (AI) exports render importers “more authoritarian”? One would not be hard-pressed to find expressions of this policy position at the highest levels of decision-making in the US or the EU. In July 2020, a Democratic Staff Report of the US Senate Foreign Relations Committee accused China of “exporting authoritarianism” and warned that countries that are acquiring such technologies from China are in danger of growing more authoritarian.¹ Then, a European Parliament report on digital technologies and repression issued a similar warning that Chinese high-tech exports aid repression and authoritarianism in importer countries, urging those countries to exercise caution when choosing an exporter.² Later in October 2021, President Joe Biden gave a White House memo outlining his China strategy –

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focusing specifically on the spread of authoritarianism through the diffusion of Chinese high-technology exports, accusing China of using AI exports to spread authoritarianism across the world.³ A year later, in September 2022, President of the European Commission Ursula von der Leyen underlined growing Chinese authoritarian technology diffusion as a serious threat to European values and pinpointed the mass export and spread of repressive AI technologies as an EU challenge.⁴ This line of policy reasoning has culminated with the August 2023 executive order by the Biden administration to restrict US investments in a broad range of sectors relevant to China's AI industries.

Over the last decade, the question of whether advanced technologies contribute to the democratization or autocratization of political systems has generated an exciting new conversation in comparative politics and international relations. Proponents of the “democratizing technologies” argument posit that rapid advances in key technologies such as AI, social media, smartphones and other information and communication technologies (ICTs) have increased the volume and quality of information citizens receive about their society and government, and this increased volume and quality of information consumption thus led to an improvement in the quality of democracy worldwide.⁵ The “authoritarian technologies” argument, on the other hand, portrayed a more pessimistic account of the role of information in state-society relations, asserting that rapidly advancing technologies have not only rendered a greater magnitude of political information available to citizens, but also allowed governments to collect and process historically unprecedented volume and granularity about their citizens, enabling more draconian surveillance and repression practices.⁶

This debate is perhaps most vibrant in the field of AI, as new research seeks to explain whether and how greater automatization of decision-making could boost the democratic foundations of nations or contribute to their hidden autocratization through a variety of causal mechanisms, ranging from the very nature of such political regime types, or broader rules and conditions imposed by top exporters. In this article, we dig deeper into this paradigm, and explore whether acquiring AI from China or the US indeed has any distinct effect on importers' democratization or autocratization. We suggest that AI's contribution to importers' state capacity and technological development must be examined closely to paint a more nuanced and layered picture of how acquiring AI from China or the US really affects importer preferences.

This article is structured as follows: it starts with a dissection of the role of emerging technologies on state capacity and countries' technological progress. In doing so, we justify our rationale in selecting our variables and data sources to measure both, in addition to acknowledging their limitations. Then, we move onto our hypotheses that explore the relationship between where importer nations acquire their AI-related technologies and the 10-year change in their political freedoms, state capacity indicators, and technological progress. Third, we explore our methodology, followed by the section where we present our findings. The article ends with a discussion where we try to situate some of our main findings, which are namely:

- (a) there is no statistically significant / robust empirical evidence to support the view that countries that acquire AI from China (or the US) are growing more authoritarian, nor is there any clear trend that suggests that acquiring AI from either power correlates with more pronounced development and technological progress indicators,

- (b) Chinese AI exports cluster around relatively low-to-middle income countries, whereas US AI exports are heavily focused on wealthier countries (measured as GDP per capita),
- (c) there is no robust statistical evidence that validates the axiom that Chinese AI is rendering importers more authoritarian; rather, the overwhelming majority of the countries in the world have witnessed measurable declines in their liberal democracy and polyarchy scores in the last decade. It is not possible to attribute this broader global decline in democracy to Chinese AI as similar declines in democratic indicators are also visible in importers of US AI

2. Literature review: global AI trade, and its effects on democracy, state capacity, and technological development

The previous discussion brings us to the main research question of this article: *is there a relationship between whether a country adopts AI from the US or China and its level of democracy, state capacity, and technological progress?* This question is a crucial consideration not just for importers of AI but also for its exporters. By exporting AI, major powers like the US or China gain technological influence over importers, and similar to the superpower technological competition of the Cold War, they have a strong incentive to export advanced technologies to a broad range of clients. Exporting to a broader range of countries is expected to increase exporters' technological influence globally, as they try to dominate high-technology global trade and render importers dependent on their own infrastructure for the long-term.

From the exporter side, this trade relationship is crucial to build technological "spheres of influence" and capitalize on the technological futures of other nations. Greater powers build spheres of influence through armed, diplomatic, or trade instruments, as well as less coercive methods of influence (or "soft power").⁷ One of the less coercive methods of influence is by controlling technological progress and the supply of its tangible infrastructure (such as hardware), as well as its non-tangible infrastructure (software and know-how) of importers.⁸ For example, the US method of building zones of technological influence over Internet technology has been to situate companies and non-governmental watchdogs at the core,⁹ whereas the Chinese method has mainly been state-driven and centralized, focusing less on freedoms and more on sovereignty and self-sufficiency.¹⁰ One of the most acute flashpoints of this competition has been over 5G Internet infrastructure which influences the data security and transmission protocols of entire web-connected systems of importer countries, bestowing significant long-term influence to exporters over how importers advance in telecommunications technologies.¹¹

The international relations scholarship covers why great powers seek hegemony and spheres of influence relatively well. Technological competition was the hallmark of Cold War superpower geostrategy, whereby both the US and the USSR sought to increase their technological trade footprint globally. Economics and technology went hand in hand in determining geopolitical events as both superpowers sought to demonstrate their ability to boost economic growth and development in their client states. In many cases, such technology trade came with ideological baggage, where the Soviets bolstered anti-capitalist sentiments and its doctrinal influence

through technology trade,¹² whereas Western technological trade did the same by spreading democratization and a free market economy.¹³

In the last few years, the emerging policy discourse on international AI influence situated US-China competition for global technological influence similar to the US-USSR competition that marked the Cold War. In Western discourse, AI trade with China, as well as the broader “Belt and Road Initiative” framework, are said to be bolstering authoritarianism in importer countries, whereas trading with the West (defined as the United States and countries of the European Union) is touted to be bolstering democracy. In the Eastern (largely Chinese and Russian) narrative, on the other hand, trading with the East is said to be bolstering self-sufficiency and independence in importing countries (such as the Belt and Road Initiative), whereas trade with the US or the EU is expected to increase dependency and reinforce colonial power relations.¹⁴ Echoing the USSR export doctrine during the Cold War, China focuses on developing the infrastructure of nations “left behind” by the US or the EU due to a lack of democracy or alliance considerations. Also, the Chinese model of rapid development without democratization is said to be a potential pathway for emerging economies run by governments that find going through the pains of democratization undesirable.¹⁵

However, the importer side of this competition – especially how they choose exporters of high-technology systems and infrastructure – is relatively less studied. After all, importers must gain certain advantages in relative terms by conducting high-technology trade with one great power and not with the other. For OECD, for example, AI is touted to render governments more efficient by increasing their data processing power and bestowing a number of important benefits in terms of national security and public finances – especially on taxation efficiency.¹⁶ For World Bank, both AI in particular and high-technology adoption in general, are expected to bolster a nation’s ability to collect, analyse and disseminate high-quality data on population and economics, rendering it more advantageous compared to others in terms of its ability to maximize the efficiency of national security, as well as its industrial, technological and scientific base.¹⁷ For IMF, emerging technology adoption is a labour-saving trend that can bolster growth, increase nations’ taxation capacities, and broader techno-industrial infrastructure, especially in fragile and developing nations.¹⁸ All three leading international institutions seem to agree that the adoption of new technologies and AI should bring distinct advantages to importers in terms of their state capacity, research-development infrastructure, human capital and industrial capacity. This is why we are adding these additional indicators to our research question, alongside democracy measures.

Although a broader list of benefits of technology adoption can be produced, in this study, we would like to focus on three main recurring themes in the contemporary policy debate on why nations are thought to be adopting AI and newer technologies: democratization, state capacity, and technological development.

2.1. High-technology and AI trade and determinants of democratization

High technology international trade has profound implications for the political trajectory of importer countries, either steering them towards democratization or reinforcing autocratic tendencies. Some scholars suggest that the transfer of high technology can potentially bolster democratization. This is because such technology

often enhances communication and the flow of information, leading to an empowered civil society and creating an environment where individuals can challenge autocratic state behaviour.¹⁹

Historically, the modernization theory along Lipsett's trajectory, argues that economic growth and development pave the way for democratization.²⁰ However, some argue that countries heavily engaged in exporting high-tech goods might employ the ensuing revenues to entrench authoritarian rule, echoing the dynamics of the "resource curse" observed in rentier, resource-rich states.²¹ The issue of dependency is another critical dimension. High technology trade might increase the dependency of less technologically advanced countries on their counterparts, potentially resulting in power imbalances that could undermine national sovereignty. As countries become more reliant on foreign technology, especially within their critical infrastructure, sovereignty concerns can intensify, driving nations to exert greater control over their technology sectors and information flows.

On the other hand, studies that focus specifically on the AI – democracy nexus, pose three main arguments. The first argument derives a lot from the "third wave of democratization" scholarship, underlining that emerging technologies are helping countries democratize by fostering institutional transformation, rendering electoral systems more transparent and increasing the inclusivity of political information.²²

The second line of reasoning suggests that AI's contribution to developing nations' rapid economic development and growth could potentially help transform their industrial and scientific infrastructure, thereby contributing to the eradication of poverty and reduction of economic inequality.²³ Pointing to reduced economic ailments, this line of reasoning suggests that AI could foster democratization by improving nations' industrial and developmental prospects, minimizing their chances of sliding into poverty-related authoritarian practices.

The third argument points to a "technocratic explanation," namely, by increasing reliance on citizen data, automated decision-making systems could make the most cost-effective optimization for societies, generating better governance in contexts traditionally plagued with inefficiency, mismanagement, and corruption.²⁴ By automating data-driven and quantifiable human information, computer systems are expected to produce more effective policy options on the economy, labour management, urbanization, and income inequality that are chronically prone to decision-making or bureaucratic errors in less developed countries.

Against the previous arguments, the "AI authoritarianism" literature points to the following dangers of automation. First, the main critique underlines the importance of not disassociating AI from the quality of the data it works with. In line with the main axiom of machine learning – "garbage in, garbage out" – algorithmic decision-making systems harnessing biased or incomplete data contribute to a greater magnitude of inequality and bias.²⁵ To that end, this line of argumentation urges policymakers not to treat AI as a final product – but as one that is still being developed and undeployable at scale. If such incomplete technologies are used to determine the fates of citizens and nations, this logic asserts, it will contribute to algorithmic repression and greater public polarization.

Second, automated data collection and self-learning algorithmic systems enable greater repression when applied to surveillance mechanisms used for policing, border protection, and other law enforcement purposes.²⁶ Since the AI renders these surveillance practices more cost-efficient, there is greater demand for them in

developing and developed nations. Yet, as cost-effectiveness becomes a more pronounced consideration, algorithmic surveillance systems tend to get more error-prone and rely on lower-quality data, resulting in premature scaling of draconian and flawed repression practices.

Third, AI can be used alongside state propaganda efforts by helping create, curate, and disseminate pro-government narratives and distract populations at scale more efficiently.²⁷ Machine learning can be deployed to produce automated and increasingly more human-like information manipulation efforts, help disseminate these messages while detecting dissent and counter-hegemonic speech more accurately, and suppress the popularization of such opposition narratives in real-time.

This debate renders global AI trade crucial in understanding new global power dynamics emerging through the diffusion of new technologies. The prevailing wisdom in the mainstream Western policy discourse is that AI exports from the West (often defined solely as the US, and sometimes US and EU together) contribute to the democratization and liberalization of importing nations, whereas China (and sometimes Russia) are usually associated with exporting “authoritarian AI” that bolsters surveillance and censorship mechanisms of developing nations.²⁸ Since EU-origin AI exports are relatively lower in volume and are more recent than US-origin ones,²⁹ it has been challenging to assess the long-term effects of European AI trade, compared to US-origin ones that are both higher in volume and duration. This could be an interesting theme to pursue for future studies, as more data becomes available on EU AI exports.

In this article, we aim to contextualize the “regime type argument” empirically and assert that it is equally important to explore whether countries that are importing AI from China or the United States (or both) tend to “do better” in terms of technological and developmental progress. After all, registering individual instances of algorithmic injustice or AI authoritarianism does not necessarily lead to the deterioration of democratic institutions, which is what the democracy scores are measuring. For example, there is not necessarily a relationship between Amazon’s biased algorithms and their harm on American democracy, and many European liberal democracies have companies and start-ups that employ biased algorithms that do not necessarily affect regime type in those countries. To that end, there has to be a more robust argumentation of how similar injustices were created – for example – by Huawei systems and their impact on importers’ level of democracy, and how this impact differs from algorithmic biases created by Western AI systems and their impact on their trade partners. We argue that the *presence* of algorithmic bias in an AI system does not necessarily *cause* a wholesale erosion of the level of democracy in either the origin country or its trade partners.

2.2. State capacity

A major incentive for the adoption of new technologies is their contribution to state capacity: a concept that is connected to the “absolute” and “relative capabilities” debate in international relations. State capacity has been measured through a diverse range of instruments in economics and political science. The most relevant for our purposes is the measurement deployed by Besley and Persson (2009), Prichard and Leonard (2010), and Pomeranz and Vila-Belda (2019) (among many others), which adopts taxation capacity and territorial control of governments as the most important

markers of state capacity.³⁰ *Taxation capacity* is an essential indicator of how much of a country is financially controlled by the central government and to what extent it can uphold complex laws, sustained administration, and reliable enforcement to attain fiscal efficiency. The *tax-to-GDP ratio* is one of the most commonly used instruments to measure state financial capacity, while another commonly used measure for the same purpose is *state fiscal source of revenue* that measures to what extent the government is capable of raising revenues to finance its expenditures.

However, neither of these is a sufficient instrument to measure state capacity. Both can be affected by a broad range of other variables unrelated to state capacity, such as the ideology of the ruling party or the dominant economic model of a country. To that end, additional indicators are necessary, such as “*state authority over territory*,” which demonstrates how much of a country’s territory is contested by another actor (such as militias, revolutionaries, or rebels). If a state remains unable to establish complete control over particular parts of its territory, the percentage of these contested areas can be considered as negative determinants of state capacity, as employed by Thies (2010), Hendrix (2010), and Fjelde and De Soysa (2009).³¹ Incomplete sovereignty, as defined by the weakness of functioning authority over parts of a nation’s territory, leads to organized crime and illegal economic activity, sapping governments of revenue. Therefore, in this article, we are using both “*state authority over territory*” and the national tax-to-GDP ratio to reach a more meaningful proxy combination for state capacity. Similarly, we employ the Fragile States Index’s “*External Intervention Score*” for foreign peacekeeper or military intervention indicators; the presence of such external interventions is frequently used in the literature to measure state weakness and capacity.

2.3. Technological development/Progress

A country’s broader developmental and technological indicators are the second prevalent area where AI and high-technology exports are expected to influence positively. Technological adoption has long been a vital factor driving economic, industrial, and scientific progress due to its ability to render growth more efficient. Fast adopters of emerging technologies have long been identified as increasing their high-technology exports and, therefore, economic development while attaining efficiency in labour productivity. In addition, developmental literature tells us that the robust adoption of new technologies influences the broader innovation and technology investment climate in a country, boosting both its human capital and its research and development infrastructure.

Indeed, there is a highly salient state capacity and development argument that most studies of AI and authoritarianism miss. Regardless of whether AI renders states more or less authoritarian/democratic, its surveillance, detection, decision-making, and autonomy-related attributes and products render automation a significant contribution to state capacity, which all states seek to capitalize on.³² Put simply, should importers care about their democratic backsliding, if AI acquired from China bolster their state capacity, industrial development and boost their export capacity more noticeably than AI acquired from the US or Europe? Or will an importer of US or EU-origin AI value democratization more, if one of its rivals that import AI from China witness a more rapid technological development and state capacity improvement, even if they come at the expense of autocratization?

To that end, in our view AI adoption must also be explained through state capacity maximization and the relative technological/developmental advantage they gain compared to rivals. Countries are expected to choose AI exporters that grant them more visible benefits to state capacity and development, and we argue that regime type considerations are secondary (if any) for importers compared to more pressing relative capability priorities. We thus argue that a central motivation for AI adoption by developing countries is whether it makes them more advanced technologically and capacity-wise, not whether it makes them more or less “free.”

The most frequently mentioned AI-related developmental indicators can be inferred through Hossain et al. (2022), Somjai et al. (2020), Korinek and Stiglitz (2021), and Cho et al. (2021), which focus on (a) changes in importers’ high-value export portfolios – namely how fast their high-technology exports grow, (b) how efficient and productive their labour force becomes, (c) the extent to which their broader innovation ecosystem (human capital, research/development) improves.³³ Thus, in an attempt to assess to what extent AI and high-technology imports demonstrate a similar trend with an importer country’s developmental indicators, we are exploring the extended difference between its high-technology export levels, labour productivity indicators, Global Innovation Index Scores in general, and its human capital and research scores, as well as research and development index score.

3. Hypotheses

This debate leads us to a new question that calls for more “tangible” measures of the predicted effects of AI, namely: *does buying (a) technological products and services broadly defined, and (b) more specifically AI, from the US or China render importer countries more advantageous in terms of their technological progress, state capacity and level of democracy/freedoms?* In other words, do countries that rely on the US or China as an AI trade partner end up “better off” compared to others regarding their technology-related progress and/or “worse off” regarding their democratic progress? This question, we believe, offers a better perspective from which future studies can explore how A.I. importers form their decisions in terms of partnering with the US and/or China and provides a more grounded explanation of how technological diffusion and trade materialize in world politics. Additionally, introduces a much-needed perspective to the debates on the political and regime type effects of AI by linking it to developmental measures and outcomes.

In this vein, our hypotheses are³⁴:

H1: Importers of technological goods and services and AI from China witness a greater decrease in liberal democracy / polyarchy indicators compared to importers from the US

H2: Importers of technological goods and services and AI from the US witness a greater increase in state capacity indicators compared to importers from China.

H3: Importers of technological goods and services and AI from the US witness a greater increase in technological progress and innovation indicators compared to China.

4. Data: sample and variables

Our sample consists of 75 countries, representing all regions of the world. The size of our country sample is constrained by the number of countries engaged in AI trade (ie

how many countries import AI) and how many of those countries' AI trade registers are formally recorded in leading industry-standard trade datasets (ie such as the WITS, UNCOMTRADE or IMF, in which countries openly declare their AI trade data – which could inherently contain a small degree of availability bias). Please see Tables A1 and A2 (both Appendix) for sources and summary statistics of these variables and Table A3 (Appendix) for the country sample, along with data sources and measurements.

4.1. Explanatory (Independent) variables

We have four indicators which are used as our main explanatory variables in all econometric models:

- (i) Two indicator (binary) variables showing if the country is importing AI from the US and/or China.
- (ii) Two variables (percentage) measuring share of imports of technological products and services (broadly defined by the World Bank) from China and US

4.2. Dependent variables

The analyses of our hypotheses require three groups of dependent variables – corresponding to each of our hypotheses.

4.2.1. Group-1, level of democracy and freedoms (H1)

We use two of the most frequently used measures (both constructed by V-Dem) to ensure the robustness of our findings. While there may be a case for using multiple measures and indexes of democracy, recent benchmarking studies converge on V-Dem as a better performing alternative compared to its main competitors.³⁵

- (i) *Liberal Democracy Scores (Varieties of Democracy)*: Based on the expert assessments and multi-variate index construction by V-Dem, combining information on voting rights, the freedom and fairness of elections, freedoms of association and expression, civil liberties, and executive constraints. It ranges from 0 (least democratic) to 1 (most democratic).
- (ii) *Polyarchy Scores (Varieties of Democracy)*: Polyarchies are understood as political systems in which citizens have the right to choose the chief executive and the legislature in multi-party, uncertain elections, and enjoy freedoms of expression, assembly, and association. It ranges from 0 (lowest polyarchy) to 1 (highest polyarchy).

When we look at the global (Figure A1 Appendix) and regional (Figure A2 Appendix) trends in these two indicators between 2010 and 2020, there is a clear (and statistically significant at the global level) decrease in both. This necessitates a deeper analysis of the prevalent “Chinese AI renders countries more authoritarian” argument because these declines in liberal democracy and polyarchy scores are; (a) attributable to a broader global decline in freedoms in the last decade, irrespective of the influence of

AI, (b) whether declines in liberal democracy and polyarchy scores attributed to Chinese AI can also be observed among the importers of US AI

4.2.2. Group-2 – increase or decrease in state capacity (H2)

We use four alternative measures of state capacity to ensure the robustness of our findings and also because each measure is used in the prevalent literature to identify a different aspect of the relationship between the adoption and trade of new technologies, and state capacity. We discuss the changes in these scores both in terms of the size of the effect and, more importantly, in terms of the level of statistical significance of the corresponding changes. We expect the adoption and import of newer technologies such as AI to improve all of the following measures of state capacity.

- i *Fragile States Index (FSI)*: This is an External Intervention Indicator that examines how external players affect a state's ability to function, notably in the areas of security and economy. A state's internal affairs may be threatened by governments, armies, intelligence agencies, identity groups, or other entities that could affect the balance of power (or the outcome of a conflict). On the one hand, external intervention focuses on security aspects of engagement from external actors, both covert and overt, in a state's internal affairs. It is expected that countries that have a lower ranking in FSI, have a lower state capacity as defined by their ability to maintain a government and hold territory; adoption of newer technologies such as AI is expected to improve state capacity, and thus, a country's rankings in this index.
- ii *Tax/GDP Ratio*: Tax-to-GDP ratio is a gauge of a nation's tax revenue relative to the size of its economy as measured by gross domestic product (GDP). Due to the ratio's ability to indicate how much of its aggregate GDP is taxed, it offers a good look at a state's capacity to tax and enforce proper taxation, and is thus used as a proxy for state capacity.
- iii *State Fiscal Source of Revenue*: This is a state capacity proxy measure that explores to what extent the central government of a nation is capable of raising revenues to finance itself. Higher state capacity is associated with a government's ability to finance itself through taxation or revenue generation without the direct involvement of foreign backers or international financiers, and rentierism.
- iv *State Authority Over Territory*: Another state capacity measure that measures to what extent a central government is recognized as the legitimate and sovereign actor in its territories. In areas of state weakening and where challengers rule (such as rebel groups), this indicator is affected negatively. Emerging technologies are expected to improve this indicator – as with others – due to the central government's ability to exert control over its territory.

4.2.3. Group-3 – developmental and technological progress (H3)

We use three alternative indicators, each measuring a different aspect of development and technological progress, in order to capture a more multi-layered picture of both. We expect greater technological adoption and imports, such as AI, to improve all of these indicators.

- (i) *Global Innovation Index (GII)*: ranks the innovation ecosystem performance of countries across 80 indicators related to technological and developmental infrastructure, innovation and research-development capacity.
- (ii) *High-Technology Exports*: are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. We would expect higher adoption of new technologies to improve a country's ability to produce more high-technology products, thereby increasing its high-technology export indicators,
- (iii) *Growth in Labour Productivity*: As a measure of manufacturing and production efficiency (GDP per hour worked), this indicator is a proxy for how efficient an economy becomes over time, largely due to its industrialization and technological progress.

4.3. Control variables

Across all our models, we keep four variables constant. These are country income group (GDP per capita PPP), whether an importer country is within China's Belt and Road Initiative (BRI) framework, whether that country is a diplomatic partner of China (as demonstrated by their UN voting patterns on the Xinjiang and Hong Kong issues), and existing human capital measured in terms of population that have completed tertiary education. These important control variables are intended to address some of the endogeneity and limitations with causality associated with the existing data on global AI diffusion.

4.4. Data limitations

Lack of granularity on AI-specific technology trade and especially the absence of consistent annual time series data on this matter at the time of writing this article, force our analysis into a *correlative* trajectory – rather than a *causal* one. A particular limitation in that regard is the difficulty of creating a “*timing of technology adoption*” dataset, since importing a technology does not necessarily mean adopting it at a national scale. To that end, our study embarks on a cautious path regarding establishing a causal link between these variables and is thus modest in its claims. Although we strengthen the claims of the article by employing a *two-stage instrumental variable methodology* (to consider the endogeneity and simultaneity problems among the dependent and independent variables), our analysis, for now, remains *exploratory*, and our claims are *correlative*. Robust identification of causal relations on the matter can be a subject of further studies in the coming years, as data with wider time-span and for a larger sample pile up, allowing for a more robust time-series inference.

There might be a case for arguing that the *type* of AI being traded must be specified more clearly and disaggregated into more purpose-specific categories such as “surveillance-related” or “smart city-related.” However, disaggregating individual components of AI trade is difficult, as various AI hardware and software components can be used for non-AI tools or systems, and there are definitional limitations regarding what it means for a semiconductor to be bolstering an “authoritarian technology.” The true and precise volume of AI-specific data or the prevalence of subcomponents within that trade is, therefore, very difficult to capture.

For example, some scholars might argue that “surveillance-oriented AI” technologies must be separated and analyzed differently than other classes of AI technologies that might be considered as “democratic AI.” We remain unsure about this point of view, as many AI systems are designed to learn, reason, and make decisions based on data, without being explicitly programmed for specific political purposes. This flexibility allows AI to be applied to diverse domains such as healthcare, transportation, finance, and banking. As a result, AI technologies are not limited to specific components or capabilities, but rather possess a general-purpose nature that enables them to be used for various lines of tasks.

As a further example, field programmable gate arrays (FPGA) used for object detection in autonomous vehicles for traffic monitoring can also be used for surveillance in security systems. Or a chip performance optimizer (CPO) used for public transportation optimization in a smart city context may also have unintended negative consequences on privacy, civil liberties, and social dynamics. Therefore, attempting to classify AI based on specific components or capabilities would be overly simplistic and fail to capture the multifaceted nature of AI. To that end, we remain unconvinced that attempts to classify AI technologies based on their function and purpose fit the purposes of this research, and do not consider the study of such technologies as aggregate general-purpose technologies as more empirically flawed than the attempts to classify them through under-developed categorizations prevalent in the literature. In the future, as better categorizations and export classifications are produced, this could be a possibility. But for now, we stand behind our decision to measure “AI exports” in an aggregated fashion.

The definitions and sources of our dependent, explanatory and control variables can be found in [Table A1](#) Appendix; and their summary statistics can be found in [Table A2](#) Appendix.

5. Methodology

In analysing the relation between our DVs and IVs, the potential problem of endogeneity – in the form of both simultaneity and, more importantly, reverse causality – needs to be carefully tackled. Correctly estimating the causal effects (ie the parameter coefficients) of the IVs in our regression models require treating the following two IVs as endogenous explanatory variables:

- (a) X_1 = China_AI: An indicator variable showing if the country is importing AI technology from China (= 1) or not (= 0)
- (b) X_2 = share of high-technology imports from China in all high-technology imports of the country

Therefore, as opposed to an ordinary least square (OLS) regression model, we need to do our estimations employing a two-stage regression model, including instrumental variables for each of the two endogenous variables and employing maximum likelihood estimators. Accordingly, first, endogenous explanatory variables X_1 and X_2 are estimated in the first-stage with the following auxiliary regressions:

$$X_{1i} = \pi_{10} + \pi_{11}Z_i + v_{1i}$$

$$X_{2i} = \pi_{20} + \pi_{21}Z_i + v_{2i}$$

Since X_1 is a binary variable, the Probit model is used in the corresponding auxiliary (first-stage) regression, whereas for X_2 , ordinary least square estimation is employed for the auxiliary (first-stage) regression. Next, the estimated values of X_1 and X_2 are used in the main regression (second stage), together with the other explanatory and control variables to identify the effects of our IVs on our DVs. For each one of our dependent variables, a separate multiple-equation regression model is run in the following form:

$$Y_i = \alpha_Y + \beta_{x1}X_1i + \beta_{x2}X_2i + \beta_{x3}X_3i + \beta_4X_{4i} + \epsilon_i$$

In the equations for auxiliary regressions, Z is the vector of instrumental variables used for explaining X_1 and X_2 respectively and v_1 and v_2 are the random error terms. In the equation for main regression, X_3 is a vector of exogenous IVs, X_4 is a vector of exogenous control variables (CVs) and finally, ϵ is a random error term. When “correct” instrumental variables are included in the auxiliary stage, using the estimated values of X_1 and X_2 in the main regressions serves to solve the potential endogeneity (ie simultaneity and/or reverse causality) problem. We imply “correct” in the sense that, the included first stage instrumental variables must be successfully explaining the variation in the endogenous IVs, but do not to have a direct effect on the DV.

The instrumental variables (vector Z) included in the auxiliary regressions are GDP per capita (purchasing power parity adjusted) and two indicator variables, first one showing if the country is part of BRI and the second one if it is an ally of China. To ensure the validity of these instrumental variables, it is crucial that they do not have a direct effect on the DVs in the main regression. Hence, to eliminate their potential direct effect on the second stage DVs, three additional variables – which are highly correlated with the instrumental variables – are included in the main regression: (i) a categorical variable indicating the income group, and (ii) the ratio of population with tertiary education, and (iii) a categorical variable indicating the geographic region of the countries are included in the second stage, as part of X_4 . A complete list of DVs, IVs and CVs can be found in Table A1 Appendix, together with detailed descriptions / explanations for each of those variables.

6. Findings

Our models treat AI technology sources (US vs. China) and high-technology imports (in US Dollars) as endogenous variables to remedy potential reverse causality and simultaneity issues. Since our values include the change of respective indicators through 2010–2020, the chronological ordering of explanatory and dependent variables addresses some of the concerns about the direction of causality – although these remedies are not sufficient to broaden the claims of this article beyond correlative. We recognize this limitation but also underline that current fundamental definitional problems of AI sub-components present an unreliable way forward to measure their trade patterns in high granularity, due to the recency and incompleteness of official AI-related trade datasets and registers. This was explained at length in the “Data Limitations” section previously. This problem will likely be resolved in the coming years as better categorization and measurement of AI trade items become available for more countries.

In order to explore the effects of the unobservable factors, which are the potential sources of endogeneity, we also controlled for the correlation between the error terms of the second stage regression with the error terms of the two auxiliary first stage regressions. In all the models presented in Tables 1–3, the estimates of these correlations appear to be insignificant at the conventional levels – confirming that the estimated coefficients of *China_AI* and *ht_im_CHN* in the main regression are robust to the potential problem of endogeneity. While this is still insufficient to offer any causal claim, these checks nonetheless offer reliable controls for endogeneity.

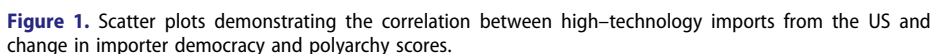


Table 1. Effects of high-tech imports from China on “democracy” variables.

Variables	2nd stage democracy_ch	1st stage		2nd stage polyarchy_ch	1st stage	
		China_AI	ht_im_CHN		China_AI	ht_im_CHN
China_AI	−0.850 (1.394)			−1.188 (1.986)		
USA_AI	0.021 (0.037)			0.005 (0.038)		
both_AI	−0.026 (0.048)			0.004 (0.048)		
ht_im_USA	0.191* (0.112)			0.181* (0.096)		
ht_im_CHN	0.005 (0.010)			0.007 (0.015)		
terti_educ	0.000 (0.001)			0.001 (0.001)		
low_inc	−0.126* (0.072)			−0.136** (0.067)		
low_mid_inc	−0.052 (0.057)			−0.047 (0.055)		
up_mid_inc	−0.082* (0.048)			−0.088** (0.043)		
region_EAP	−0.211 (0.376)	−0.211 (0.178)	12.268* (6.438)	−0.332 (0.537)	−0.211 (0.180)	12.268* (6.439)
region_EUR	−0.039 (0.243)	−0.176 (0.180)	−16.186*** (6.209)	−0.083 (0.334)	−0.173 (0.180)	−16.186*** (6.209)
region_MENA	−0.272 (0.409)	−0.401* (0.216)	−13.632* (7.389)	−0.408 (0.572)	−0.404* (0.223)	−13.633* (7.388)
region_SCA	0.007 (0.116)	0.072 (0.100)	10.196 (7.349)	−0.040 (0.162)	0.075 (0.099)	10.196 (7.350)
region_WHA	−0.130 (0.275)	−0.215 (0.173)	−11.177* (5.820)	−0.180 (0.374)	−0.208 (0.172)	−11.175* (5.824)
democracy2010	−0.203*** (0.068)					
polyarchy2010				−0.238*** (0.067)		
GDPpcppp		−0.001 (0.003)	−0.329*** (0.091)		−0.001 (0.003)	−0.329*** (0.091)
BRI		−0.011 (0.043)	0.459 (3.403)		0.006 (0.028)	0.464 (3.407)
China_ally		0.140 (0.146)	9.246** (4.484)		0.140 (0.151)	9.247** (4.484)
Constant	0.625 (0.971)	0.904*** (0.101)	47.012*** (5.678)	0.883 (1.366)	0.885*** (0.106)	47.007*** (5.707)
Observations	68	68	68	68	68	68

Robust standard errors are in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). F -statistics of the auxiliary (first stage) regressions are significant at the 0.01 level in all models.

This finding suggests that as a country’s GDP per capita markers decline, its chances of acquiring high technology from China increase. This is a stronger determinant of Chinese technology exports compared to whether a country is part of China’s Belt and Road Initiative (BRI), or whether a country can be interpreted as a “Chinese partner,” as defined by its voting behaviour at the UN. The significance of country income group variable suggests that just as the USSR was filling the trade gap with underdeveloped and developing nations during the Cold War, today’s China seems to be filling this same gap now, with a particular high-tech trade focus towards less privileged nations. This result indicates that BRI countries are not necessarily within China’s broader high-technology orbit, as countries can *both* be within the BRI

Table 2. Effects of high-tech imports from China vs. USA on “state capacity” variables.

Variables	2nd stage FSI_x1_ch	1st stage		2nd stage tax_gdp_ch	1st stage		2nd stage stcap_terr_ch	1st stage		2nd stage stcap_fisc_ch	1st stage	
		China_AI	ht_im_CHN		China_AI	ht_im_CHN		China_AI	ht_im_CHN		China_AI	ht_im_CHN
China_AI	-2.333 (10.19)			-13.845 (23.47)			19.315 (34.71)			4.293 (19.77)		
USA_AI	0.423 (0.645)			-2.319* (1.208)			-0.844 (1.199)			-0.085 (0.168)		
both_AI	-0.274 (0.724)			3.375** (1.370)			1.811 (1.119)			-0.280 (0.209)		
ht_im_USA	0.321 (1.049)			4.808 (3.130)			-8.722*** (3.219)			0.891*** (0.336)		
ht_im_CHN	0.022 (0.080)			0.006 (0.160)			-0.266 (0.301)			-0.010 (0.134)		
terti_educ	-0.003 (0.014)			-0.026 (0.037)			-0.126*** (0.046)			0.007 (0.004)		
low_inc	2.195*** (0.676)						-0.595 (2.657)			-0.238 (0.214)		
low_mid_inc	2.208*** (0.675)			-0.109 (1.461)			-1.330 (2.873)			-0.340** (0.162)		
up_mid_inc	1.016** (0.414)			-1.540 (0.963)			-0.660 (1.605)			-0.344*** (0.125)		
FSI_x12010	-0.372*** (0.092)											
tax_gdp2010				-0.042 (0.055)								
stcap_terr2010							-0.315*** (0.117)					
stcap_fisc2010										-0.227*** (0.065)		
GDPpcppp		-0.001 (0.005)	-0.340*** (0.091)		0.002 (0.003)	-0.243** (0.101)		-0.001 (0.003)	-0.345*** (0.092)		-0.002 (0.002)	-0.347*** (0.095)
BRI		-0.033 (0.156)	0.595 (3.518)		0.027 (0.060)	0.201 (3.949)		0.006 (0.069)	0.216 (3.510)		-0.036 (0.173)	0.226 (3.622)
China_ally		0.142 (0.232)	11.215** (4.455)		0.059 (0.216)	9.104* (4.853)		0.153 (0.149)	11.115** (4.456)		0.091 (0.120)	10.978** (4.852)
Constant	1.357 (6.194)	0.929*** (0.226)	46.774*** (5.736)	14.180 (24.329)	0.820*** (0.144)	43.223*** (6.564)	28.583 (22.820)	0.885*** (0.124)	47.203*** (5.784)	-2.999 (11.838)	0.945*** (0.180)	47.225*** (5.878)
Observations	69	69	69	53	53	53	69	69	69	69	69	69

Robust standard errors are in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). F -statistics of the auxiliary (first stage) regressions are significant at the 0.01 level in all models.

Table 3. Effects of high-tech imports from China vs. USA on “technology and innovation” variables.

Variables	2nd stage ht_exp_ch	1st stage		2nd stage lab_prod_gr	1st stage		2nd stage GII_ch	1st stage	
		China_AI	ht_im_CHN		China_AI	ht_im_CHN		China_AI	ht_im_CHN
China_AI	-84.444 (290.781)			1.444 (1.277)			52.171 (113.798)		
USA_AI	-1.772 (4.029)			-0.021 (0.077)			0.687 (2.574)		
both_AI	4.892 (3.908)			0.024 (0.082)			-1.648 (2.686)		
ht_im_CHN	0.525 (2.077)			-0.021 (0.016)			-0.326 (1.293)		
ht_im_USA	0.934 (8.897)			-0.030 (0.163)			2.067 (4.035)		
terti_educ	0.297** (0.120)			0.002 (0.002)			0.099** (0.042)		
low_inc	10.109 (7.160)			-0.035 (0.119)			-5.460*** (2.027)		
low_mid_inc	8.890* (5.259)			0.005 (0.079)			0.783 (1.812)		
up_mid_inc	-0.724 (2.909)			-0.123** (0.057)			-1.209 (1.349)		
region_EAP	-16.036 (72.915)	-0.164 (0.170)	13.870** (6.466)	0.726 (0.472)	-0.245 (0.186)	11.926* (6.850)	2.600 (1.611)		
region_EUR	-6.145 (19.641)	-0.140 (0.186)	-15.985*** (6.123)	0.029 (0.367)	-0.183 (0.178)	-16.297*** (6.189)	2.925** (1.492)		
region_MENA	-21.058 (68.148)	-0.332* (0.188)	-14.662* (7.510)	0.394 (0.399)	-0.415** (0.207)	-13.766* (7.456)	-0.426 (1.843)		
region_SCA	-0.973 (12.127)	0.080 (0.100)	9.781 (7.387)	0.310 (0.208)	0.070 (0.098)	10.020 (7.348)	2.139* (1.259)		
region_WHA	-9.984 (40.234)	-0.213 (0.175)	-10.869* (5.799)	0.170 (0.333)	-0.248 (0.184)	-11.729* (6.079)	-0.850 (1.762)		
ht_exp2010	-0.183** (0.085)								
lab_prod2010				-0.001*** (0.000)					

(Continued)

Table 3. Continued.

Variables	2nd stage ht_exp_ch	1st stage		2nd stage lab_prod_gr	1st stage		2nd stage Gll_ch	1st stage	
		China_AI	ht_im_CHN		China_AI	ht_im_CHN		China_AI	ht_im_CHN
GII2013							−0.062 (0.100)		
GDPpcppp		−0.002 (0.002)	−0.337*** (0.098)		−0.001 (0.003)	−0.334*** (0.098)		−0.004 (0.005)	−0.450*** (0.124)
BRI		−0.028 (0.108)	0.447 (3.569)		−0.011 (0.061)	−0.145 (3.626)		−0.003 (0.129)	5.259 (4.842)
China_ally		0.088 (0.119)	11.472** (4.482)		0.156 (0.108)	9.727** (4.398)		0.045 (0.050)	4.443 (5.340)
Constant	42.014 (172.033)	0.938*** (0.130)	46.869*** (5.868)	−0.077 (0.760)	0.901*** (0.119)	47.609*** (5.942)	−31.385 (42.384)	0.816*** (0.103)	42.376*** (5.593)
Observations	69	69	69	66	66	66	67	67	67

Robust standard errors are in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). F -statistics of the auxiliary (first stage) regressions are significant at the 0.01 level in all models.

framework and vote in a pro-Chinese fashion at the UN, and *not* exclusively trade AI or high-tech with China. Figure 1 shows in turn, that countries like Jamaica, Canada, Mexico, and the United Arab Emirates tend to conform to the prevalent US policy discourse and witness increases in their liberal democracy and polyarchy scores as important US high-technology importers, but countries like Bolivia, Brazil, Argentina, Malaysia, South Korea, India and Turkey do not conform to this trend and have very different regime types despite acquiring similar shares of US high-tech exports as part of their aggregate high-tech imports.

As Chinese foreign policy doesn't have a formal alliance designation similar to clear demarcations in US foreign policy, testing the relationship between alliance considerations and AI import patterns becomes more difficult. As proxy measures for this, we chose to explore countries that have supported China's "Hong Kong Security Law" at the United Nations. These countries almost entirely overlap with those that support China's Xinjiang policy at the United Nations, forming a doubly checked proxy of the "China allies or partners" country group. This turned out to be an empirically valid choice, as we found that China's AI and/or high-technology exports are significantly clustered around countries that, in our categorization, listed as "Chinese allies," which validates previous works that indicate that high-technology trade flows better within alliances and diplomatic partnership regimes.

For our H2 (*importers of AI from China witness an increase in state capacity indicators*), we find an equally nuanced picture (see Table 2 and Figure 2). Greater high technology imports from the US (not solely AI) are correlated with two of our state capacity measures (weaker territorial control but higher taxation ability). While it

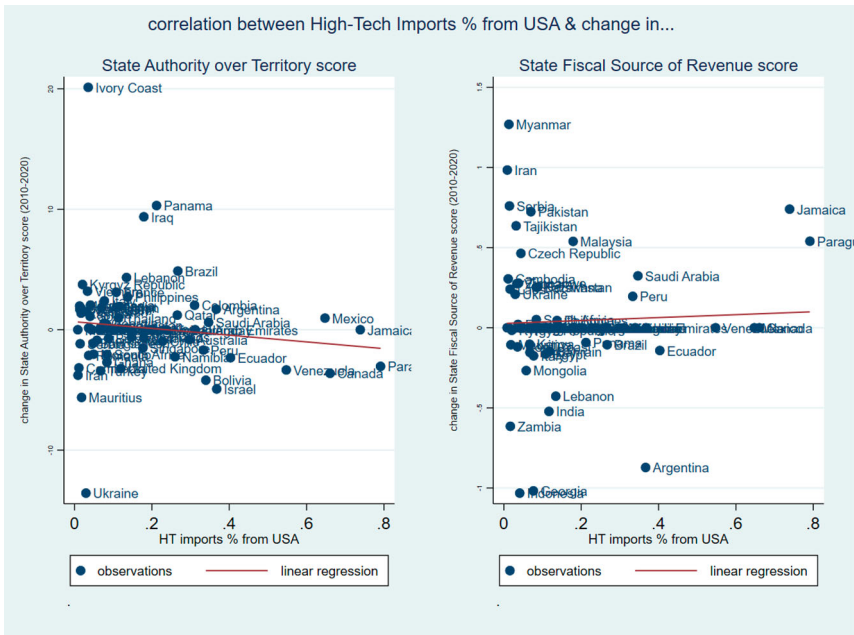


Figure 2. Scatter plots demonstrating the correlation between high-technology imports from the US and change in importer state capacity (territorial control and fiscal source of revenue).

would be speculative to generate a strong inference from these findings alone (especially with regard to the direction of this causality), there seems to be a trend in which US high technology exports are clustered around importers that are struggling with territorial control (such as civil war or counterinsurgency), yet nonetheless can still afford high-technology trade items through domestic revenue generation mechanisms (either through efficient taxation or the control of a natural resource). These countries are more explicitly visible in Figure 2 where countries such as Israel, Bolivia, Ecuador, Venezuela, and Paraguay have visible declines in *state authority over territory* measures, yet have a relatively higher degree of US high technology imports.

In terms of AI-specific effects of trade, we observe that countries that acquire it from both China and the US have a moderately better tax-to-GDP ratio, hinting at a dynamic that is worth exploring in future studies related to importer states' better taxation capacities and trade flexibility with regard to US and Chinese AI. The important nuance here is that this relationship is reversed and becomes less significant for importers that acquire AI technologies *either* from China or the US. This suggests that states that diversify their AI-specific imports between the two great powers tend to do better in terms of taxation capacity compared to states that exclusively trade with one great power. Future studies can explore this relationship between high fiscal capacity and the ability to import from both great powers – instead of just one.

Finally, for our H3 (*importers of AI from China witness an increase in technological progress and innovation indicators*), we observe insignificant results (see Table 3 and Figure 3). We do not see any notable trend between importers preferring AI or high-technology items from China or the US (or both) and their labour productivity

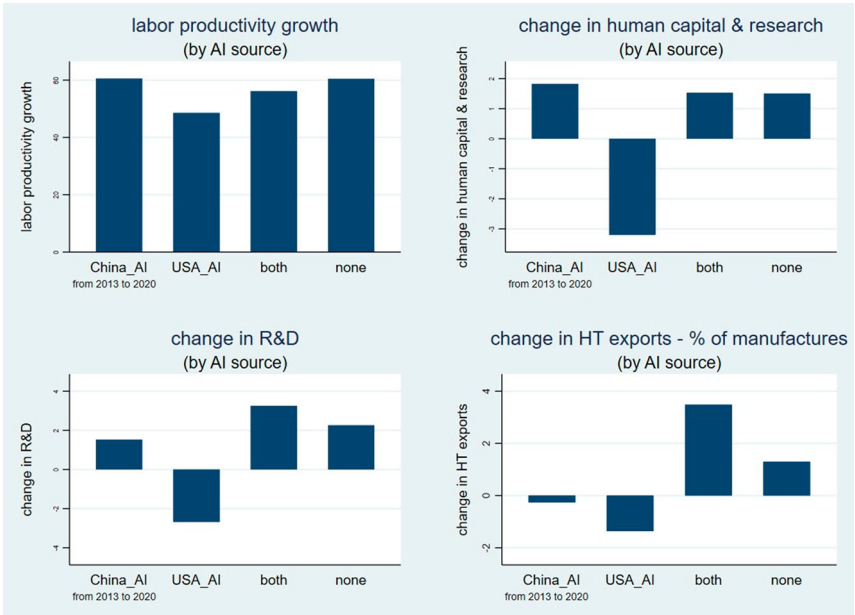


Figure 3. Importer countries by AI source and their labour productivity, human capital/research, research, and development, and change in high-technology export indicators.

growth or change either in their high-technology exports or Global Innovation Index indicators. When we control for research and development progress, as well as increases in human capital indicators, this insignificance continues (not shown; available upon request).

However, when visualized through bar graphs, we observe two trends that aren't visible in the regression results. The first is that countries that acquire AI from the US *only* tended to record a decline in human capital and research indicators between 2013 and 2020, meaning that AI trade with the US is not quite associated with greater human capital accumulation. AI trade with China or *both* US and China, however, slightly correlates with an increase in human capital indicators. A similar trend is seen with the change in research and development indicators: AI trade with China or *both* US and China correlate with higher R&D performance, whereas importers from the US alone see a major decline over an extended (ten-year) period. In tandem with previous hypotheses, we once again validate that importers that acquire AI from both great powers tend to witness the greatest increase in the percentage of high technology exports as part of their aggregate export volumes.

7. Discussion

The results of this study warrant caution towards a number of assertions and narratives prevalent among the Western policy community on AI trade and its effects on democratization and technological development. Although a rapidly emerging scholarship similarly questions the mainstream policy discourse on the subject at the micro scale, ours aimed to be the first one that comparatively tests these political and technological effects in a temporal fashion, through a larger country dataset. In addition to finding inconclusive evidence on the claim “acquiring AI from China renders countries more authoritarian” or “authoritarian countries tend to acquire AI from China,” we also found similarly inconclusive results on the stated positive effects of acquiring AI from the US. An additional observation to be underlined is the strong relationship between AI importer countries' national income – rather than their regime type – and whether they acquire AI or high-technology products from the US. This reinforces our view that Chinese high technology exports are filling the trade gap, which emerges due to US export preferences towards richer nations.

In terms of alliance determinants of AI trade, we ran two proxy tests: whether there is any relationship between an importer's AI acquisition trends and whether it is (a) a BRI country, (b) voted in favour of China on the Xinjiang and Hong Kong rulings. We find that Chinese AI exports are not clustered among Belt and Road Initiative countries but rather among countries that have voted in favour of China's Hong Kong security law and its Xinjiang policy at the UN. Whether an importer is among “China supporter countries” or not is positively correlated with whether it acquires higher AI and high technology from China.

Our second research question on state capacity effects of AI trade yields further nuanced trends. Broader high-technology trade with the US (not specific to AI) is clustered among importer countries that are struggling with territorial control (such as civil war, conflict, and rebellion) yet are doing relatively well in terms of financial control indicators (taxation or natural resource-based domestic revenue-generating mechanism). This yields an interesting importer portfolio for US high-technology exports, clustered around countries that are wealthy enough to acquire these items

from the US but are facing difficulties with security-related domestic territorial control problems necessitating expensive high-technology solutions. There are no significant effects of Chinese AI or high-technology exports in importer countries on state capacity in either direction; in short, China exports high-technology to a broader range of regime types and income groups. Further supporting our findings on this topic, countries that have a higher state capacity in terms of their ability to tax a higher proportion of their national output tend to acquire technologies from both great powers. In short, there is some limited evidence that merits pursuing the advantages of acquiring AI from both great powers, and whether this could be a model for developing countries. Future studies can explore this relationship between high fiscal capacity and the ability to import from both great powers – instead of just one.

Finally, we observe no significant relationship between acquiring AI or high-technology exports from the US or China and an importer's technological innovation and progress indicators. The source of advanced technologies appears to have no significant bearing on an importer's technological advancement. However, when the data is represented visually, we observe that AI trade with the US is associated with lower human capital and research/development indicators. While the US-origin technology trade appears to be associated with an extended decline, China-origin technology trade has slightly improved the fortunes of importers in both human capital and R&D areas. However, countries that import from both US and China tend to benefit from improved technological progress indicators.

We hope this study serves as a benchmark for future work that seeks to explore the political and developmental effects of high-technology diffusion across the world. As the European Union, Israel, Japan, and South Korea have gradually grown into important AI exporters in recent years, further studies will find more reliable data available in the near future, which can be used to explore the effects of acquiring AI from those countries in importer nations. An interesting research avenue in this regard would be to explore how “AI export alliances” form, where multiple nations join their export forces together to claw for more market share in certain geographical regions. Another interesting puzzle would be to dissect the impact of “second-tier AI exporters,” namely advanced economies that adopt either (or both) from the US and China and create their own AI export portfolio that provides advantages to importers in a unique fashion. Ultimately, the long-term effects of AI trade will have far-reaching consequences on how future technologies are adopted globally and what forms of alliances or partnership systems will emerge from that diffusion.

Notes

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34. Please refer to the Table-A1 (Appendix) for a more detailed breakdown of IVs, DVs and CVs that are associated with each hypothesis.
35. Vaccaro, "Comparing Measures of Democracy: Statistical Properties, Convergence, and Interchangeability"; Boswell and Corbett, "Democracy, Interpretation, and the 'Problem' of Conceptual Ambiguity: Reflections on the V-Dem Project's Struggles with Operationalizing Deliberative Democracy."
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Appendix

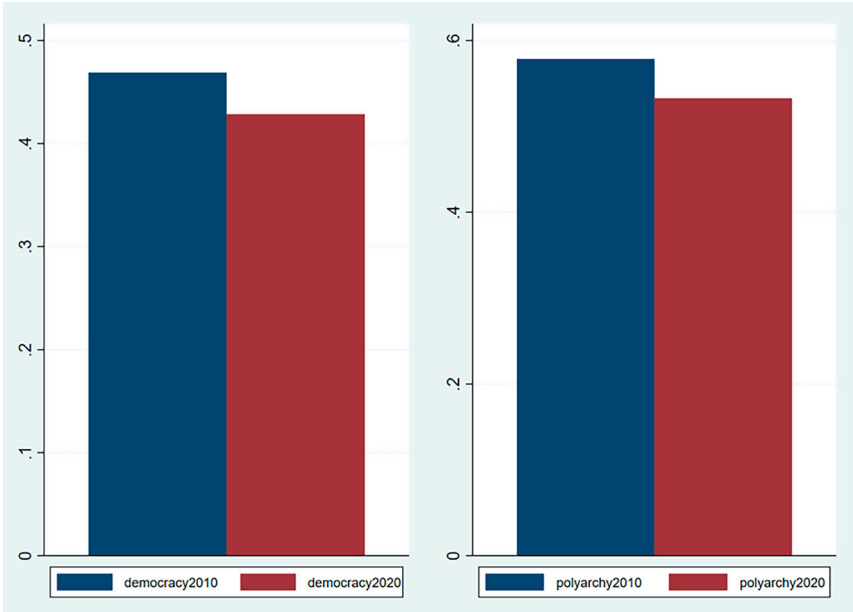


Figure A1. Global trends in liberal democracy and polyarchy scores between 2010 and 2020. Note: Changes in the mean values of both variables are significant at 0.001 level.

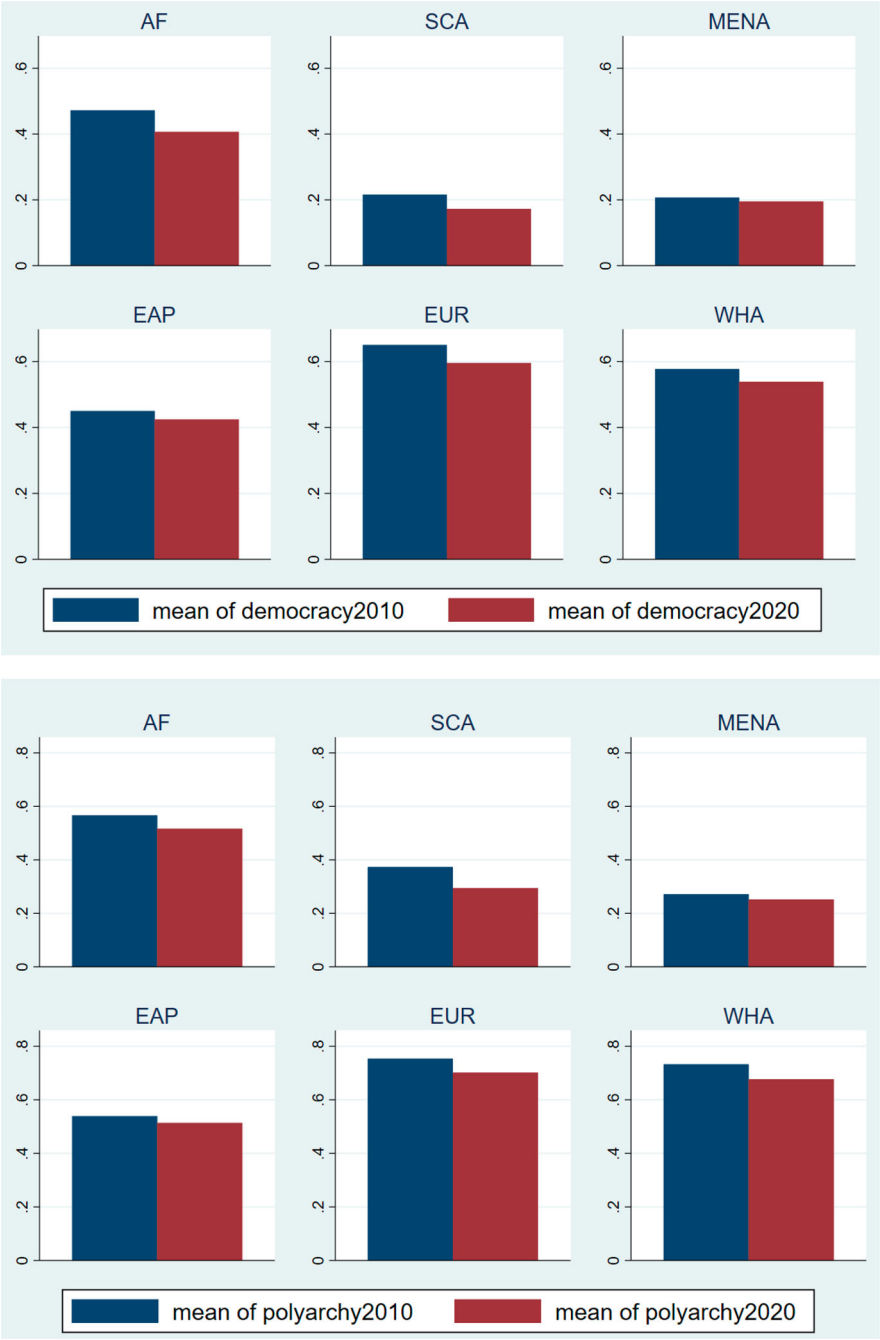


Figure A2. Regional trends in liberal democracy and polyarchy scores between 2010 and 2020.

Table A1. Short descriptions & data sources of variables.

Variable category	Related hypothesis	Variable	Description	Source
Dependent variables	H1	<i>democracy_ch</i>	change in Liberal Democracy Score (between 2010–2019)	Varieties of Democracy Project ³⁶
		<i>polyarchy_ch</i>	change in Polyarchy Score (between 2010–2019)	Varieties of Democracy Project
	H2	<i>tax_GDP_ch</i>	change in Tax Revenue as % of GDP (between 2010–2019)	World Bank
		<i>statecap_terr_ch</i>	change in State Authority Over Territory (between 2010–2020)	Varieties of Democracy Project
		<i>statecap_fisc_ch</i>	change in State Fiscal Source of Revenue (between 2010–2020)	Varieties of Democracy Project
		<i>FSI_x1_ch</i>	change in External Intervention Score (between 2010–2020)	Fragile States Index ³⁷
	H3	<i>GII_ch</i>	change in Global Innovation Index (between 2013–2020)	Global Innovation Index ³⁸
		<i>ht_exp_ch</i>	change in H.T. Exports (between 2010–2019)	The World Bank ³⁹
		<i>lab_prod_gr</i>	growth in Labor Productivity (between 2013–2020)	The Conference Board – Total Economy Database ⁴⁰
Explanatory (Independent) variables	All	<i>China_AI</i>	indicator variable showing if the country imports AI technology from China (=1) or not (=0).	AI Global Surveillance Index ⁴¹ and Stanford HAI Global AI Vibrancy Tool ⁴²
		<i>USA_AI</i>	indicator variable showing if the country is importing AI technology from the USA (=1) or not (=0)	AI Global Surveillance Index ⁴³ and Stanford HAI Global AI Vibrancy Tool ⁴⁴
		<i>ht_im_China</i>	High-Tech Imports from China	UN Comtrade Database
		<i>ht_im_USA</i>	High-Tech Imports from the USA	UN Comtrade Database
		<i>terti_educ</i>	People with Tertiary Education (as % of the population)	Global Innovation Index
Control variables	All	GDPpcppp	GDP per capita (adjusted by purchasing power parity)	World Bank
		BRI	indicator variable for Belt and Road Initiative country (“spheres of influence” argument)	Council on Foreign Relations ⁴⁵
		<i>China_ally</i>	Countries that have supported China’s Hong Kong security law and Xinjiang policy	UN General Assembly ⁴⁶

Table A2. Summary statistics of variables.

Variable	Observations	Mean	Std. Dev.	Min.	Max.
<i>democracy_ch</i>	71	−0.041	0.094	−0.316	0.185
<i>polyarchy_ch</i>	71	−0.046	0.105	−0.364	0.142
<i>tax_gdp_ch</i>	53	0.782	2.496	−3.925	9.729
<i>stcap_terr_ch</i>	72	0.207	3.949	−13.571	20.125
<i>stcap_fisc_ch</i>	72	0.042	0.373	−1.032	1.269
<i>FSL_x1_ch</i>	72	−0.840	1.136	−2.900	2.300
<i>GII_ch</i>	68	−3.121	3.646	−11.200	6.000
<i>ht_exp_ch</i>	72	1.088	9.323	−18.979	63.053
<i>lab_prod_gr</i>	68	58.218	18.235	0	100
<i>China_AI</i>	72	0.750	0.436	0	1
<i>USA_AI</i>	72	0.375	0.488	0	1
<i>both_AI</i>	72	0.306	0.464	0	1
<i>ht_im_China</i>	72	36.953	21.143	2.659	93.361
<i>ht_im_USA</i>	72	0.164	0.178	0.008	0.791
<i>terti_educ</i>	69	32.846	13.920	2.300	63.100
<i>GDPpcppp</i>	71	24.672	20.988	2.583	95.603
<i>BRI</i>	72	0.778	0.419	0	1
<i>China_ally</i>	72	0.236	0.428	0	1

Table A3. Country sample.

AFRICA (AF)	Botswana	East Asia and Pacific (EAP)	Australia	Europe (EUR)	Czech Republic
	Ghana		Cambodia		Denmark
	Ivory Coast		Indonesia		France
	Kenya		Japan		Georgia
	Mauritius		Laos		Germany
	Namibia		Malaysia		Hungary
	South Africa		Mongolia		Italy
	Uganda		Myanmar		Malta
	Zambia		New Zealand		Netherlands
	Zimbabwe		Philippines		Romania
Western Hemisphere and Americas (WHA)	Argentina	Middle East & North Africa (MENA)	Singapore	South & Central Asia (SCA)	Russia
	Bolivia		South Korea		Serbia
	Brazil		Thailand		Spain
	Canada		Vietnam		Switzerland
	Chile		Bahrain		Turkey
	Colombia		Egypt		Ukraine
	Ecuador		Iran		United Kingdom
	Jamaica		Iraq		Bangladesh
	Mexico		Israel		India
	Panama		Lebanon		Kazakhstan
	Paraguay		Morocco		Kyrgyz Republic
	Peru		Qatar		Pakistan
	Uruguay		Saudi Arabia		Tajikistan
	Venezuela		United Arab Emirates		Uzbekistan

Data Sources.