Who on Earth Is Using Generative AI?*

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Abstract: This paper offers the first comprehensive, global analysis of generative AI adoption and usage, using novel data sources including website traffic and Google Trends. The paper also examines country-level factors driving the uptake and early impacts of generative artificial intelligence on online activities. As of March 2024, the top 40 generative artificial intelligence tools attract nearly 3 billion visits per month from hundreds of millions of users. ChatGPT alone commanded over 80 percent of the traffic, yet its reach remains less than two percent of Google's. Generative artificial intelligence users skew young, highly educated, and male, particularly for video generation tools, with usage patterns strongly indicating productivity-related activities. Generative artificial intelligence has achieved unprecedentedly rapid global diffusion, reaching almost all economies worldwide within 16 months of ChatGPT's release. Strikingly, middle-income economies account for over half of global generative AI traffic, a disproportionately high share relative to their economic size, while low-income economies contribute less than 1 percent. Country level adoption intensity is strongly correlated with the share of youth population, digital infrastructure, English fluency, foreign direct investment inflows, services' share of GDP, and human capital. Finally, the paper also documents disruptions in online traffic patterns and emphasizes the need for targeted investments in digital infrastructure and skills development to fully realize the potential of artificial intelligence.

JEL codes: O30, O31, O14

Key words: Generative AI, Technology Adoption, Geographic Disparities, Digital Divide

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1 Introduction

Generative AI (GenAI) holds the potential to transform economies and societies. Taking traditional AI's predictive power one step further, generative AI is capable of creating new content in all forms of media - text, code, images, audio, video, and more. Generative AI tools like ChatGPT, Co-Pilot, and Midjourney are expected to revolutionize how certain tasks are performed, leading to significant efficiency gains and new opportunities for innovation (Eloundou, Manning, Mishkin, and Rock 2023; Humlum and Vestergaard 2024; Toner-Rodgers 2024). Since the debut of ChatGPT in November 2022, various types of generative AI tools have proliferated and many have amassed a huge user base within record time. The widespread use of generative AI offers the possibility to transform economic development, social structures, and global competitiveness. Despite extensive discussions about the applications and potentials of generative AI on societies (Korinek 2023; Chui, Hazan, Roberts, Singla, and Smaje 2023; Brynjolfsson, Li, and Raymond 2023; Jha, Qian, Weber, and Yang 2024; Kim, Muhn, and Nikolaev 2024), research on the scale of generative AI usage is rare. This paper seeks to unveil the real-time global scale of generative AI usage, including its demographic and country distribution, and to explore the barriers to and impacts of its adoption. As these technologies continue to evolve, understanding their adoption patterns, both in advanced and developing economies, becomes crucial for policymakers, businesses, and researchers.

To measure AI adoption globally, several organizations have been publishing AI indexes and reports, tracking trends in AI development, and focusing on assessing countries' readiness for AI integration. Since 2017, Stanford University has been publishing the AI Index Report (Maslej, Fattorini, Perrault, et al. 2024) annually, providing a comprehensive overview of developments in AI research, investment, technology performance, education, and governance. Tortoise Media also publishes the Global AI Index to benchmark 62 countries' performance on AI innovation, investment, and implementation. The Government AI Readiness Index 2023 by Oxford Insights ranks countries on their readiness to integrate AI into government operations across 193 economies. The IMF's recent report emphasizes AI's transformative potential for labor markets and the need for AI readiness, highlighting the necessity of robust digital infrastructure and skilled workforces in advanced economies, alongside the challenges faced by less developed countries (IMF 2024). Most of these reports and indexes focus on the supply side of AI, offer limited coverage of developing countries, and often lack specific emphasis on generative AI technologies.

Tracking the usage of generative AI tools is a crucial first step in understanding their economic and social implications. Despite progress in connecting more people to the internet, the multi-faceted digital divide is widening both within and between economies, amplifying disparities in productivity and consumer welfare (Sorbe, Gal, Nicoletti, and Timiliotis 2019). Applying innovative data to summarize stylized facts is fundamental. This includes understanding the types of users and economies that are leading in generative AI adoption, those that are lagging, how people are using generative AI tools, and the underlying factors driving these trends. Such insights are essential for policymakers, businesses, and researchers to make informed decisions and foster equitable development in the AI landscape and the broader economy.

However, there is a glaring data gap in monitoring the diffusion and adoption of generative AI, especially in developing countries. Tracking AI adoption is challenging due to several factors. First, conducting comprehensive and representative surveys on AI usage is both time-consuming and expensive, often requiring extensive timelines to gather and analyze data. Many surveys are also one-off and not comparable over time or across countries. For instance, a survey conducted by Humlum and Vestergaard (2024) in Denmark reveals that half of the surveyed workers use ChatGPT. ChatGPT adoption has led to significant time savings in daily tasks, particularly for younger and less experienced workers. Bick, Blandin, and Deming (2024) found that in the United States, 39% of adults aged 18–64 used generative AI as of August 2024. Among workers, nearly a quarter used it at least weekly and 11% relied on it daily, while non-work usage was common but less intensive. Despite these insights, similar detailed data from developing countries are lacking, underscoring a notable gap in our global understanding of generative AI's impact. Additionally, the definition of AI varies widely, encompassing a broad spectrum of technologies from computer vision to robotics and natural language processing, which complicates consistent reporting. Moreover, AI is frequently embedded within products and services, leading to significant under-reporting as respondents may not explicitly recognize or disclose their use of AI. The data gap is even more pronounced in developing countries, which lack the capacity and resources to conduct in-depth surveys. These challenges hinder the collection of accurate, comparable, and up-to-date data on AI adoption, further obscuring the global landscape of AI adoption.

This paper aims to fill this data gap by utilizing novel website traffic data from Semrush.

Semrush collects raw data through clickstream analytics, tracking codes, and server log files. It processes approximately 25 billion URLs daily across a global database that contains over 43 trillion links and 500 TB of raw data. By employing proprietary machine learning algorithms, Semrush analyzes this data to generate estimated metrics such as the number of visits, unique visitors, average session duration, etc. Furthermore, Semrush disaggregates these metrics by economies using users' IP addresses, providing globally comparable data across both advanced and developing economies. For each website, Semrush also infers user profiles based on patterns of online behaviors. This dataset offers a unique opportunity to monitor a selected sample of generative AI websites' traffic globally. Despite the inherent limitations of using website traffic as a proxy, it provides an effective means to monitor generative AI usage from a globally comparable perspective.

Utilizing Semrush data complemented with Google Trends data, this paper offers an in-depth analysis of generative AI usage by individuals across countries, focusing on both temporal trends and geographic disparities. We examine the adoption rates of various generative AI tools, identify key socioeconomic factors influencing usage, and explore the early impact of generative AI tools on traffic to other websites, people's online activities, and broader implications. By highlighting outperforming and underperforming economies and surfacing factors shaping generative AI adoption, this study provides valuable insights into the global diffusion of generative AI technologies and their potential to drive transformative change. The paper is designed to provide descriptive insights that may prompt further questions and exploration. Our analysis seeks not to establish causal relationships but to highlight correlations and trends that could inform subsequent research.

Several key findings have emerged from our analysis:

1. Rapid proliferation of generative AI tools and quick adoption. At least hundreds of generative AI tools exist as of March 2024. The top 40 most visited tools have nearly 3 billion monthly visits. Chatbots dominate the generative AI landscape due to their versatility and wider applicability, accounting for 95% of traffic among the top 40 tools. ChatGPT alone commands 82.5% of total traffic and boasts 500 million users per month, representing 12.5% of the global workforce. Impressively, it took only five months for ChatGPT to reach 500 million monthly unique users. However, traffic and users of several generative AI tools including ChatGPT have plateaued since mid-2023, hinting at market saturation and intensifying competition.

2. Generative AI user demographics skew toward young, educated males. Youth and male

bias is most pronounced for video generation tools, while chatbot users are more highly educated than Google users. Generative AI tools are primarily used as productivity tools, as these tools are predominantly accessed via desktop computers during weekdays.

3. Unprecedented global diffusion and widespread usage in middle-income economies. Just 16 months since ChatGPT's release, it has reached 209 of 218 economies worldwide. As of March 2024, the top five economies for ChatGPT traffic are the US, India, Brazil, the Philippines, and Indonesia. The US share of ChatGPT traffic dropped from 70% to 25% within one month of ChatGPT's debut. Middle-income economies now contribute over 50% of traffic, showing disproportionately high adoption of generative AI relative to their GDP, electricity consumption, and search engine traffic. Low-income economies, however, represent only less than 1% of global ChatGPT traffic.

4. Higher income levels, a higher share of youth population, better digital infrastructure, and stronger human capital are key predictors of higher generative AI uptake. Services' share of GDP and English fluency are strongly associated with higher chatbot usage.

5. Generative AI tools are already disrupting online traffic patterns and altering user habits. Information, language processing, and professional question and answer websites like Wikipedia, Grammarly, Google Translate, and Stack Overflow experienced significant traffic drops immediately after GPT-4 launch, though some recovery has been observed as sites integrate generative AI capabilities. People are increasingly using ChatGPT for information acquisition and aggregation, skill learning, and language processing, while more complex cognitive and analytical tasks have been augmented by ChatGPT.

Existing evidence in advanced countries shows that AI adoption by firms remains very low and is dominated by large firms and young firms. Acemoglu (2024), Babina, Fedyk, He, and Hodson (2024), and Goldfarb, Taska, and Teodoridis (2023) used online job posting data to measure firms' AI adoption and subsequent effects. Miric, Jia, and Huang (2023) and Webb (2019) used patent data as a proxy for AI adoption. Zolas, Kroff, Brynjolfsson, et al. (2021) and McElheran, Li, Brynjolfsson, et al. (2024) used the US Annual Business Survey data to track AI use among businesses. Even though AI development and use has been ongoing for decades, AI usage among US businesses remains very low and highly uneven. Fewer than 6% of firms used any of the AI-related technologies, and adoption is heavily tilted towards very large businesses, businesses owned by more educated and younger owners, and in superstar cities. Bonney, Breaux, Buffington, et al. (2024) provided more current evidence on AI use, which includes generative AI, based on the Business Trends and Outlook Survey (BTOS). They found that the AI use rate rose from 3.7% in September 2023 to 5.4% in February 2024, with an expected rate of 6.6% by early fall 2024. AI users often utilize AI to substitute for work tasks and equipment or software, though few firms report reductions in employment due to AI use yet. IBM Global AI Adoption Index 2023 is among the few studies assessing firms' AI adoption around the world. Globally, 42% of enterprises with more than 1000 employees reported having actively deployed AI in their business. India (59%), the United Arab Emirates (58%), Singapore (53%), and China (50%) are leading the way in AI usage. Companies in the financial services industry, industrial equipment, and telecommunications are most likely to be using AI.

While most firms are still trying to figure out how AI can add value for their businesses, individuals and employees have been embracing the technology much faster. Pew Research Center has conducted two rounds of surveys among US adults to shed light on ChatGPT usage by individuals. By Feburary 2024, 23% of US adults report ever using ChatGPT, up from 18% in July 2023. Users are concentrated in those aged 18-29 and highly educated. Most users use ChatGPT for tasks at work, learning, and entertainment (McClain 2024). The 2024 Work Trend Index Annual Report by Microsoft and LinkedIn highlights that 75% of knowledge workers in 31 surveyed economies use AI at work in 2024. Four out of five AI users bring their own AI tools to work, and this is even more common at small and medium-sized companies. Individuals in administrative and support services, real estate and retail industries report the highest generative AI adoption. Reported generative AI usage is the highest in India, Thailand, Indonesia and China (above 90%).

The contribution of this paper is threefold. First, to the best of our knowledge, this is the first paper that uses website traffic data to offer real-time and granular insights into the usage of various generative AI tools across countries. While there is a growing body of research on AI adoption in advanced countries (Acemoglu 2024; Babina, Fedyk, He, and Hodson 2024; McElheran, Li, Brynjolfsson, et al. 2024; Goldfarb, Taska, and Teodoridis 2023; Humlum and Vestergaard 2024; Bick, Blandin, and Deming 2024), evidence in developing countries remains scarce. Many existing studies only offer a snapshot of AI adoption instead of dynamic trends. There is also a lack of cross-country comparisons of AI adoption. This paper addresses this gap by innovatively leveraging website traffic data obtained from Semrush. This type of data is particularly valuable in a rapidly evolving research domain like AI. By harnessing granular traffic metrics for individual websites and subpages, our study offers rich, timely insights into how emerging technologies are diffused and adopted globally, user characteristics and usage patterns.

Second, this study contributes to a strand of literature on the geography of technology diffusion, deepening the understanding of the country level factors that influence the adoption of generative AI. Previous research has broadly identified economic and infrastructural factors as influencers of technology adoption at the country level (Keller 2004; Comin and Hobijn 2010; Czernich, Falck, Kretschmer, and Woessmann 2011; Delera, Pietrobelli, Calza, and Lavopa 2022), but lacks specific analysis related to generative AI. This paper uses regression analysis to explore how demographics, economic development, industry structure, human capital, and digital infrastructure affect the adoption of various generative AI tools. Our findings highlight the risks of AI exacerbating the already growing digital divide and call for collaborate efforts to ensure the technology is accessible to all.

Finally, by combining website traffic data with Google Trends data, this study also sheds light on early impacts of generative AI tools on individuals' online activities, and discusses the implications for public preferences, digital firms' business model and competition dynamics.

The remainder of the paper is organized as follows. Section 2 introduces the website traffic data. Section 3 identifies a list of the most popular generative AI tools and shows the rapid adoption of generative AI by individuals. Section 4 analyzes user characteristics of different types of generative AI tools and usage patterns. Section 5 demonstrates the geographical disparities in generative AI usage and highlights the record-breaking global diffusion of generative AI. Section 6 delves into the socioeconomic and infrastructural factors that influence these geographic disparities in adoption. Section 7 briefly explores early impacts of generative AI tools on individuals' online activities, and discusses the broader implications. Section 8 concludes and discusses avenues for future research.

2 Website Traffic Data to Monitor Generative AI Usage

Thanks to advancements in digital analytics technologies, we are now able to monitor generative AI usage in real-time through website traffic data. Website traffic data typically include metrics such as number of visits, time spent on site, bounce rates, and user demographics. This data has been widely used by website owners, digital marketers, business analysts, and researchers to gain insights into online behavior and website performance. Common applications include optimizing user experience, improving content strategy, measuring marketing campaign effectiveness, and informing business decisions. Large companies often use this data to refine their digital strategies, while smaller businesses and content creators use it to understand their audience better. Investors and analysts also leverage this data to assess the performance and growth potential of online businesses. As digital presence becomes increasingly important across industries, website traffic data has become a crucial tool for understanding and responding to online user behavior.

Website traffic data offers several unique advantages in monitoring generative AI usage compared to other data sources. First, website traffic data provides near-instantaneous information on user engagement. Unlike survey data which tend to lag behind actual usage trends, traffic data reflects real-time user behavior. Traffic data also directly measures actual usage, eliminating the self-reporting biases that can affect survey responses. Traffic data has comprehensive coverage, capturing a wide range of users from casual experimenters to frequent users across countries. The data is also more granular, metrics are at the website level and can be broken down by geographic location, date and time, device type, visit type and other variables. In addition, even periodic surveys have major time gaps in between, while traffic data provides a continuous stream of information allowing trend analysis and quick identification of changes in user patterns.

For our analysis, we obtained traffic data from Semrush, a leading provider of such data. Semrush collects raw data through clickstream analytics, tracking codes, and server log files. It processes approximately 25 billion URLs daily across a global database that contains over 43 trillion links and 500 TB of raw data. By employing proprietary machine learning algorithms, Semrush analyzes this data to generate estimated metrics such as the number of visits, unique visitors, average session duration, and further disaggregates these metrics by countries using users' IP addresses. For each website, Semrush also infers user profiles based on patterns of online behaviors.

We accessed the monthly traffic data for various tools from January 2022 to March 2024 using the Semrush API. The data includes total visits and unique users per domain from both desktop and mobile devices across geographies. It also encompasses traffic originating from mobile applications. However, it is important to note that this measure of consumer usage does not reflect professional usage through APIs or indirect access via third-party apps. Nonetheless, since most generative AI tools are designed for productivity and work-related tasks for individual usage, our website usage data can serve as a reliable proxy.

To validate data quality, we conduct multiple cross-checks, comparing Semrush traffic data–particularly ChatGPT traffic–with data from other sources. First, in Appendix Figure A1, we compare the website traffic of ChatGPT against its popularity on the internet, as measured by Google Trend index.[1] Semrush's estimates of ChatGPT's monthly website visits closely align with the trends observed in the weekly Google Trends data, a rapid rise following the release of GPT 3.5, a subsequent slowdown after mid-2023, and some short-term fluctuations during holiday seasons.

we validate the Semrush ChatGPT traffic data at the country-month level using country-specific Google Trends data (Appendix Table A4). Regressing ChatGPT traffic and user numbers on Google Trends data for the keyword "ChatGPT," while controlling for country fixed effects, reveals a strong positive correlation. We find an elasticity of 0.64 for traffic and 0.44 for users. As expected, the correlation with Google Trends data for the broader keyword "AI" is substantially weaker for traffic (0.20) and negligible for users (-0.01). This country-level analysis provides further evidence supporting the reliability of the Semrush traffic estimates.

Third, we compare Semrush's monthly mobile traffic data for ChatGPT (which includes both browser and app usage) with independent monthly app download data from Statista.[2] The rapid increase and subsequent stabilization of app downloads after the May 2023 app launch closely aligns with the mobile traffic patterns observed by Semrush after October 2023.

Finally, we conducted a comparison of Semrush data with similar data obtained from other sources, such as SimilarWeb. We found largely consistent traffic patterns for popular websites with over 1 million daily sessions. This strong correlation between Semrush's traffic estimates and data from alternative sources further strengthens our confidence in the reliability of the website traffic data used in this study.

While website traffic data is valuable for tracking individuals' AI usage, it has several limitations. First, individuals' use of VPNs can obscure the actual geographic origin of traffic. This may bias the usage data for economies with small populations, particularly island territories, though the

[1] The Google Trends index reflects global weekly searches for the keyword "ChatGPT" from November 2022 to March 2024. Further details are provided in Section 7.

[2] ChatGPT's monthly mobile app downloads data is obtained from Statista, https://www.statista.com/statistics/1497377/global-chatgpt-vs-gemini-app-downloads/.

impact on larger economies is negligible. Second, most of the traffic analytics tools Semrush relies on only work with Google search engine. While traffic estimates from other search engines like Bing, DuckDuckGo, Yandex, and Baidu can be available, the accuracy is less ideal. Results on Baidu is particularly limited, compromising data quality in China. Third, traffic data can inflate user numbers as the same individual with several digital devices could be counted as different users, leading to overestimation of engagement. Fourth, traffic data does not necessarily reflect the depth or quality of engagement with AI tools, what people are using them for, offline AI usage or enterprise-level AI usage. Fifth, as generative AI is increasingly integrated into various new applications, such as search engines or devices like Siri as announced by Apple, the indirect usage of generative AI websites—such as traffic via APIs—cannot be captured by this dataset.

3 The Rapid Adoption of Generative AI

Artificial Intelligence (AI) broadly refers to systems or machines that mimic human intelligence to perform tasks. Generative AI, a specific subset of AI, involves algorithms that create new content—whether text, code, images, audio, videos, and more—drawing from extensive datasets to generate outputs that were not explicitly programmed. The study of AI has been ongoing for decades, with generative AI also developing over this time, albeit previously in more nascent forms. The transformative capabilities of these technologies, however, truly gained prominence with the emergence of ChatGPT 3.5.

The debut of ChatGPT 3.5 in November 2022 has marked a significant milestone in AI development. Its successor GPT-4, released in March 2023, showcases enhanced conversational abilities and multimodal capabilities. The transformer model, originally proposed by Alphabet in 2017, has revolutionized neural networks and given rise to the large language models (LLMs) and multimodal models that can interpret natural language prompts correctly and generate original text, code, audio, image, and video often indistinguishable from human-made content. The breakthrough has propelled generative AI to the forefront of AI research and commercialization.

Generative AI tools have proliferated and witnessed rapid adoption across various domains. As of June 2024, at least hundreds of new generative AI tools have been developed around the world. In the realm of text generation, ChatGPT, Gemini, Claude, and Microsoft Copilot have profoundly affected writing, editing, language translation, chatbots, search and information aggregation. Image generation tools, such as Midjourney, Stable Diffusion, and Leonardo have democratized digital art creation, enabling both professionals and amateurs to produce high-quality visuals from text descriptions. In the audio domain, AI-powered tools have emerged for music composition, voice synthesis, and podcast creation. Video generation has seen the rise of tools capable of creating short-form content, deepfakes, and even rudimentary animations. Code generation tools such as GitHub Copilot and Devin AI have gained traction in software development, assisting programmers with task automation and bug detection. Additionally, multimodal AI systems that combine text, image, and sometimes audio capabilities have begun to blur the lines between these categories, offering more versatile and powerful creative tools. The proliferation of generative AI tools and quick user adoption has not only transformed some occupations and industries already, but has also raised important questions about copyright, ethics, security, misinformation, labor market and inequality, the future of human creativity and beyond.

We compiled a list of the 40 most popular websites specifically designed for generative AI functions. As technologies continue to evolve and increase in complexity, distinguishing between generative AI and other AI applications, and even non-AI applications, can be challenging. In this paper, we first gathered a longer list from multiple sources and verified each site's functionality. We distinguished between tools exclusively designed for generative AI tasks and those with embedded generative AI functions, such as traditional chatbots, Bing.com and Notion.ai. The latter were excluded from our primary list but considered for comparative analysis. We then selected the top 40 tools with the highest traffic in March 2024 for our analysis. The tools were categorized into three types: chatbot, image, and video. It is worth noting that chatbots increasingly include additional functions such as image and video creation, while some video generation tools can also generate images. Although these features complicated our classification, we attempted to categorize each tool based on its original purpose and most popular functions.

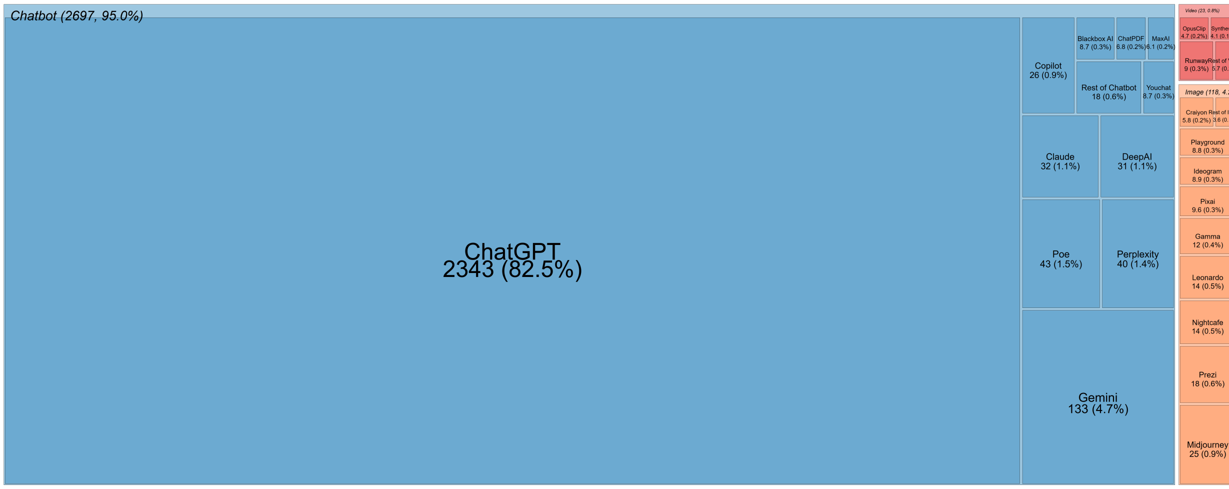


Figure 1: Monthly visits (million) of 40 selected GenAI tools

Figure 1 illustrates the distribution of monthly traffic for each tool in the sample. These tools collected have over 2.8 billion monthly visits.[3] ChatGPT holds a dominant position among all tools, commanding 82.5% of the total traffic. Chatbots occupy the top seven positions and account for 95% of the traffic, underscoring their popularity as the most used type of generative AI tool. Image creation applications account for 4.2% of the traffic, while video generation tools represent less than 1%. This distribution suggests that ChatGPT usage can serve as a good representation of generative AI tools overall, especially considering its multifunctional applications beyond text generation. It is important to note that traffic data for several Chinese generative AI tools is grossly underestimated, as Semrush data cannot accurately track traffic on Baidu, the dominant search engine in China. Ernie bot, the first generative AI chatbot released to the public in China, reportedly surpassed 200 million unique users in April 2024.[4]

[3]Table A1 presents the selected 40 generative AI tools along with their respective monthly traffic data for March 2024.

[4]Baidu says Ernie AI Chatbot now has 200 million users: https://www.wsj.com/tech/baidu-says-ernie-ai-chatbot-now-has-200-million-users-aa7381ee.

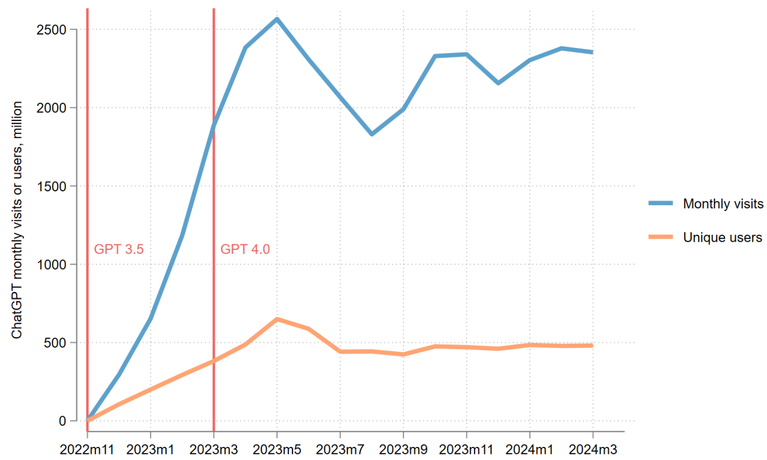


Figure 2: ChatGPT monthly visits and unique users

ChatGPT, a prominent example of generative AI tools, set a record as the fastest-growing consumer software in history, reaching 100 million users in just 64 days after its release. This remarkable achievement surpassed the growth rates of other popular applications like TikTok and Facebook, which took nine months and 4.5 years, respectively, to reach the same milestone. Figure 2 illustrates ChatGPT's meteoric rise and subsequent stabilization. As shown in the figure, monthly visits surged from zero in November 2022 to 2.5 billion in May 2023. After June 2023, the number of visits and unique visitors plateaued at approximately 2 billion visits and 500 million unique users per month, respectively. This indicates that around 6% of the world's population, or 12.5% of global workforce uses ChatGPT monthly, a significant penetration level for such a nascent technology, though the number needs to be taken with a grain of salt due to overestimation. Nevertheless, the stabilization of users and visits since June 2023 indicates potential challenges for future growth. ChatGPT may have reached a significant portion of its potential user base and hit market saturation. The emergence of alternative AI chatbots and integration of AI features into existing platforms may have diversified user choices. Infrastructure, skills, language gaps, data privacy and security concerns may also limit its global reach.

Figure 3 compares ChatGPT's monthly traffic with other leading and related websites. ChatGPT's monthly traffic surpassed the question-and-answer website Quora's traffic within four months following the release of GPT-3.5. As of March 2024, ChatGPT has reached 2.3 billion visits per month, which positions it slightly above 1/3 of Wikipedia's 6.8 billion monthly visits. Despite this impressive figure, ChatGPT's traffic remains modest compared to the leading websites: it is merely 1/50 of YouTube's 110 billion, and 1/70 of Google's 165 billion monthly visits. ChatGPT's monthly traffic stagnation since mid-2023 also indicates that it is still far from dominating the internet usage landscape.

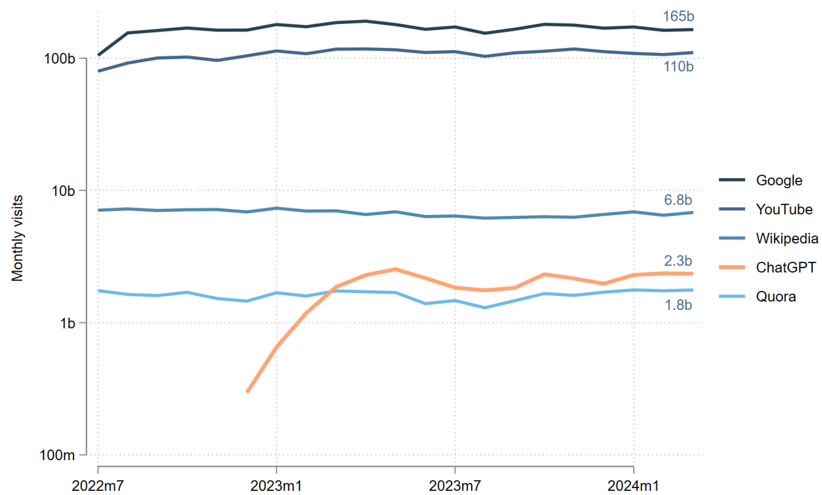


Figure 3: Monthly traffic comparison between ChatGPT and other leading websites

While other generative AI tools have also rapidly amassed significant user bases, their numbers pale in comparison to ChatGPT's dominance (Figure 4). Google's Gemini, launched in early 2024, quickly secured its position as the second most popular chatbot, demonstrating the tech giant's ability to leverage its existing infrastructure and user base. Competitors such as Perplexity and Claude have also seen consistent user growth over recent months, carving out their niches in the AI landscape.

Image generation tools have experienced a more volatile trajectory. Midjourney, for instance, saw a sharp rise in monthly visits until early 2023, after which traffic stabilized at around 20 million visits per month. Newcomers like Gamma and Leonardo AI have also attracted considerable attention, diversifying the field of AI-powered image creation.

Video generative AI tools, including Runway and Synthesia, which predated the 2022 AI boom, witnessed a similar surge in traffic post-mid-2022. However, both image and video generation tools appear to have reached a plateau or peaked earlier than chatbots, suggesting a potential saturation of their initial target markets.

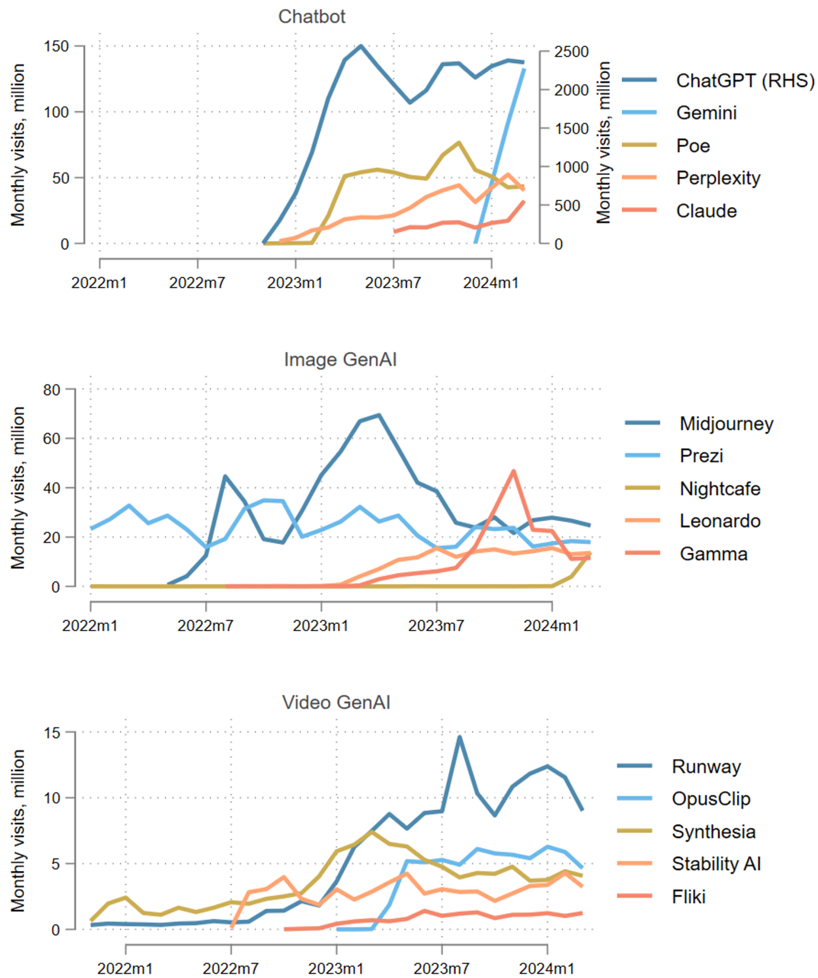


Figure 4: Monthly traffic of GenAI tools by category

This trend may indicate that while many users initially experimented with these tools out of curiosity, sustained demand is concentrated among professionals and dedicated enthusiasts. The plateau in user growth for image and video tools, compared to the continued expansion of chatbot users, might reflect the broader applicability and lower barrier to entry for text-based AI interactions in everyday tasks.

4 Generative AI User Profile and Usage Patterns

This section examines the demographic characteristics and usage patterns of generative AI tool users. Drawing from clickstream data aggregated by Semrush, we analyze key user attributes including age, gender, education, and employment status, alongside usage metrics such as daily traffic fluctuations and device preferences. This analysis offers a nuanced view of who is using generative AI tools and how they're being integrated into daily routines and workflows. By exploring these factors, we aim to illuminate current trends in AI tool adoption across various population segments.

The gender gap in digital tool usage remains a significant aspect of the digital divide, with females representing 48% of global internet users. Figure 5 illustrates the share of female users of five popular generative AI tools across each category, as well as five other widely used websites. Generally, female users are underrepresented in generative AI tools compared to male users, with video generation tools showing the lowest female participation. ChatGPT has a female user share of 33%, lower than Google (48%), Quora (54%), and Wikipedia (52%).[5] Runway, a popular video generation tool, has an even lower female user share at 21%. Midjourney, the most popular image generation tool in our sample, bucks this trend with 52% female users.

[5] The gender disparity in ChatGPT adoption is also found in Humlum and Vestergaard (2024). In their Danish survey, female white-collar workers are 20.6% less likely to use ChatGPT compared to their male counterparts within the same occupation categories.

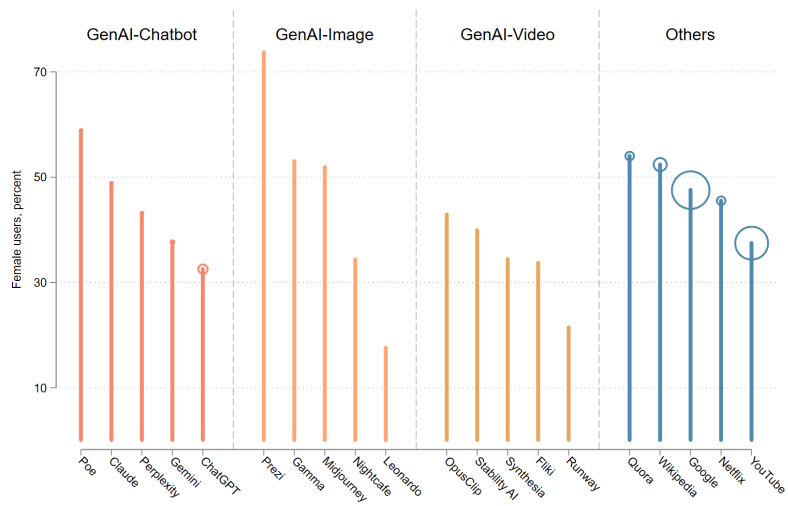


Figure 5: Female user share of GenAI tools and other leading websites

Note: This figure shows the share of female users of top 5 generative AI tools in each category in our sample as well as other five popular websites. Circle size represents the monthly traffic.

This gender gap variation may reflect disparate usage patterns across industries and demographics. The higher female representation in image generation AI could be attributed to greater participation of women in fields like fashion and design. Geographic distribution of users may also play a role. In developing countries, chatbots are more prevalent than image and video generation tools (shown in Figure 11b), and these regions also exhibit a lower proportion of female internet users.

While current data limitations preclude a comprehensive analysis, these findings underscore the need for further research to understand the underlying patterns of the gender gap in generative AI tool usage. Such insights could inform strategies to promote more equitable access and representation across all types of generative AI tools.

Figure 6 further illustrates the cross-distribution of gender and age group. As expected, generative AI tools attract predominantly younger users, with video generation tools showing the most pronounced youth skew. Using Google's user age distribution as a baseline, we compare the age-gender distribution across various generative AI tools. Chatbot users exhibit an age distribution closest to Google's, indicating broad penetration across all age groups. This suggests chatbots have achieved wider acceptance among diverse age demographics, likely due to their versatility in fields such as customer service, business writing, education, and personal assistance.

Image generation tool users skew younger, with nearly 60% under 35 years old. Video generation tools show the most extreme youth bias, with almost half of users under 25 and minimal usage among those over 55. Compared to chatbots and image generation, video generation is still a nascent field with the fewest users and limited options. Several factors could be behind the extreme youth and male bias in video generation tools. Main users of video generation tools include video content creators and influencers, who are primarily young people between 18-34. Young students and professionals may use these tools for school projects, presentations, or to create entertaining content for their peers. The potential barriers such as information, cost, and complexity of text-to-video tools may also deter female and older users.

This demographic variation across generative AI tools highlights their distinct appeal and utility to different age cohorts. The skewed distribution also underscores the potential for expanding these tools' reach to older demographics and diversifying their user base, particularly in video generation.

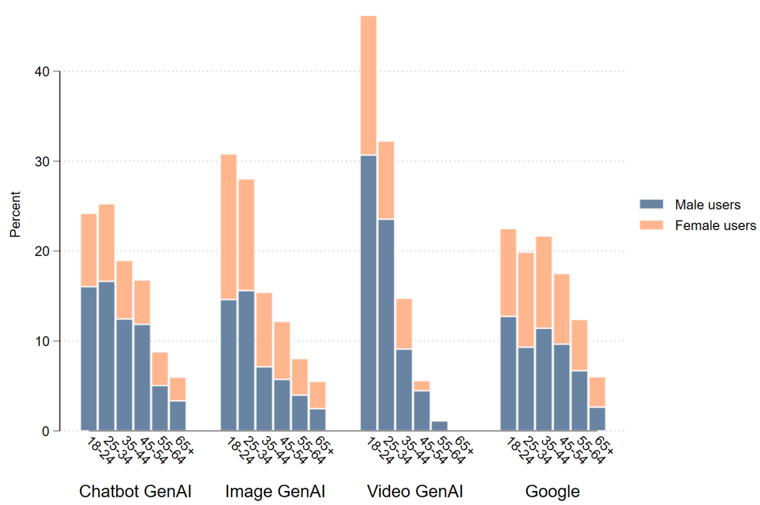


Figure 6: Age-Gender distribution of GenAI tools and Google

Chatbot users tend to have higher educational attainment compared to general internet users. Figure 7 depicts the user distribution by education level for different types of generative AI tools and Google. Nearly half of chatbot users are college graduates, well above the 40% observed for other tools and Google. This educational skew likely correlates with users' occupations, as white-collar professionals with college degrees are more prone to integrate chatbots into their workflows. The applications of chatbots extend beyond typical information searches performed on Google, reflecting their broader and more complex utility in professional and educational settings. In contrast, users of image and video generation tools exhibit educational backgrounds similar to Google users, suggesting their usage may be more experimental or recreational rather than professionally driven. This disparity in educational profiles across different AI tool types highlights the varied adoption patterns and potential use cases for each technology, with chatbots seemingly more entrenched in knowledge-intensive work environments.

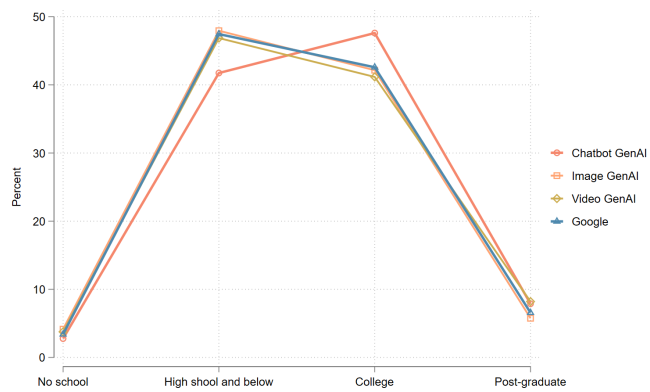
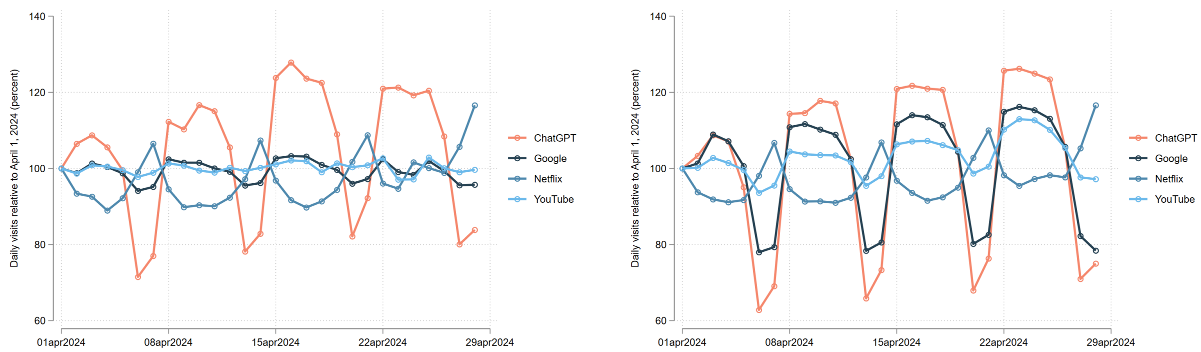


Figure 7: Education distribution of three type of GenAI tools and Google

Note: This figure presents the distribution of website traffic by education groups, with all percentages summing up to 100% for each category.

ChatGPT is primarily a productivity tool, as evidenced by its weekly usage patterns. As shown in Figure 8a, the daily traffic of ChatGPT exhibits a distinct periodic pattern across a week, with traffic dropping approximately 40% on weekends compared to weekdays. Google also shows a similar weekly traffic pattern but with much smaller dips on weekends compared to ChatGPT. Traffic for YouTube remains stable throughout the week. In contrast, Netflix, as an entertainment tool, receives much more traffic during weekends. This pattern is even more pronounced for desktop traffic (Figure 8b), where ChatGPT's weekend traffic is just half of its weekday traffic. These observations suggest that ChatGPT is predominantly used for productivity purposes and employed for tasks related to work or education performed on desktop computers, leading to higher usage during the typical workweek.



(a) Total traffic (relative to April 1, 2024) (b) Desktop traffic (relative to April 1, 2024)

Figure 8: Daily traffic of ChatGPT and other leading websites

Mobile internet has dramatically accelerated the adoption of digital tools by enhancing accessibility and convenience. Figure 9 reveals a strong correlation between mobile usage share and total traffic across different websites, highlighting the pivotal role of mobile internet in driving user engagement. Leading digital platforms like Google and YouTube see over 80% of their traffic originating from mobile devices.

In contrast, generative AI tools like ChatGPT are predominantly accessed via desktop computers. Less than half of ChatGPT's total traffic comes from mobile devices. Kimi chatbot, a popular chatbot in China, receives only 15% of its traffic from mobile devices. Image generation tools such as Midjourney, Leonardo, and Meta Image similarly show low mobile usage, with only around 30% of traffic from mobile devices. This pattern reinforces our finding that generative AI tools are primarily used as productivity tools, with significant traffic originating from desktop computers in professional settings.

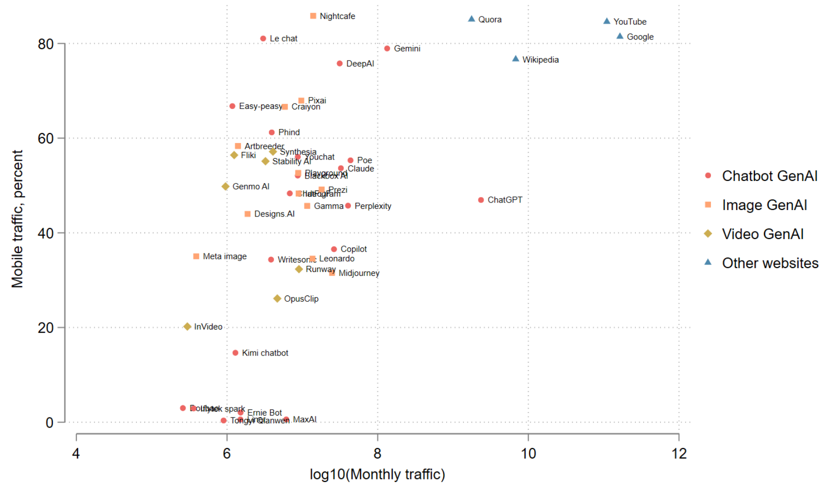


Figure 9: Share of mobile traffic against monthly traffic

However, the landscape is poised for change as generative AI features are increasingly embedded into smartphones and mobile apps. Leading smartphone manufacturers including Apple and Samsung have already begun embedding generative AI capabilities into their products. This shift will expand generative AI's applications beyond productivity tasks, broadening its user base and democratizing access to these advanced technologies. The integration of generative AI into mobile devices and apps promises to extend its reach to a wider, more diverse user base, enable more spontaneous and context-aware AI interactions, foster innovation in mobile-specific AI applications, and bridge the digital divide. In addition, new devices are already emerging for the generative AI age, such as AI-optimized wearables, smart glass, AI-powered AR and VR sets, holographic or projection-based interfaces. We can anticipate significant shifts in usage patterns, as this evolution makes generative AI widely available and reshape how we interact with AI in our daily lives.

5 Geographic Distribution of Traffic and Users

Generative AI has reached nearly every corner of the world. By the end of March 2024, ChatGPT traffic was recorded in 209 of 218 economies worldwide.[6] The nine exceptions were primarily Fragility, Conflict & Violence (FCV) economies where data was unavailable: Cuba, the Islanmic Republic of Iran, the Democratic People's Republic of Korea, Kosovo, Libya, Myanmar, Namibia,

[6]The list of economies is based on the World Bank's 2024 country classification.

Sudan, and the Syrian Arab Republic. Figure 10 visualizes ChatGPT users' geographic distribution on a map. ChatGPT shows impressive penetration across continents. Economies with larger populations generally have higher traffic due to a larger user base. This global reach is not unique to ChatGPT; other generative AI tools, such as Midjourney shown in Appendix Figure A3, demonstrate similar widespread adoption patterns internationally. The first panel of Table 1 provides a detailed breakdown of monthly ChatGPT traffic for the leading economies.

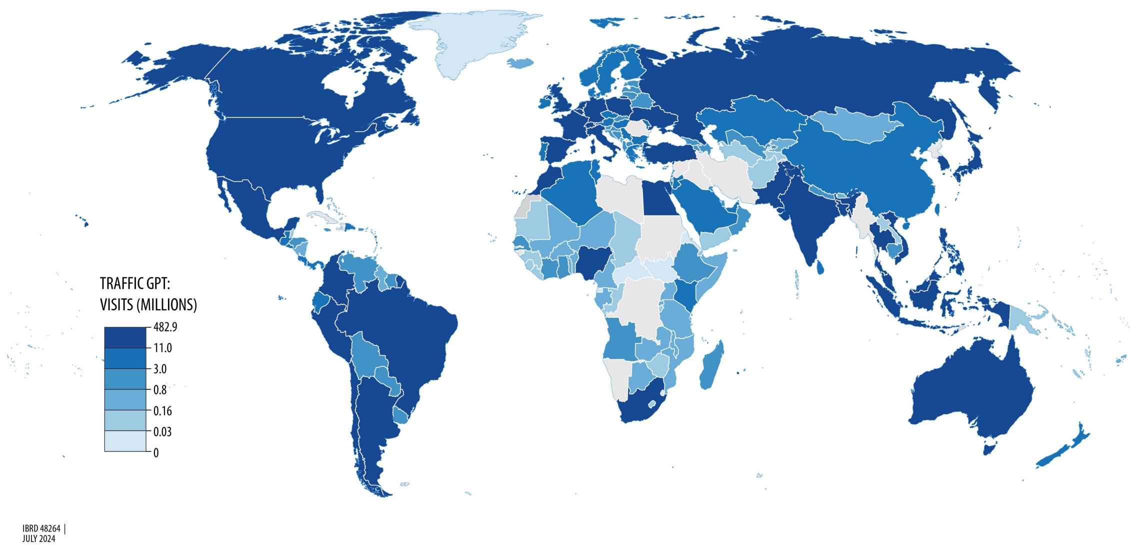


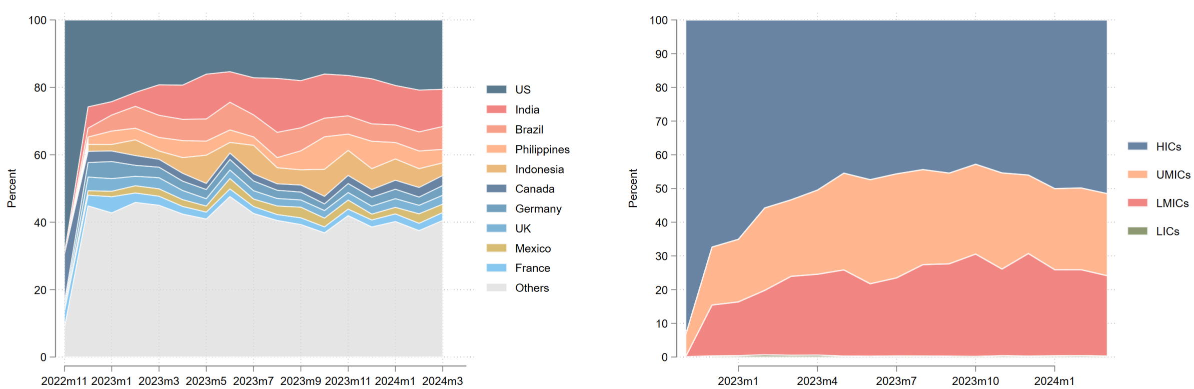
Figure 10: Geographic distribution of ChatGPT monthly traffic, March 2024

Table 1: Ranking of ChatGPT traffic, March 2024

No.	Economy	Monthly traffic, million visits	Share in global traffic, %	No.	Economy	Monthly traffic per internet user	No.	Economy	Monthly traffic per person aged 15-64
1	United States	482.9	20.6	**1**	Singapore	2.67	**1**	Brunei Darussalam	3.82
2	India	260.0	11.1	**2**	Brunei Darussalam	2.67	**2**	Singapore	3.51
3	Brazil	159.3	6.80	**3**	Estonia	2.12	**3**	British Virgin Islands	3.28
4	Philippines	94.38	4.03	**4**	Canada	1.92	**4**	Estonia	3.07
5	Indonesia	88.37	3.77	**5**	Moldova	1.88	**5**	Guam	2.90
6	Canada	70.04	2.99	**6**	Suriname	1.71	**6**	Canada	2.71
7	Germany	67.99	2.90	**7**	Iceland	1.69	**7**	Iceland	2.52
8	United Kingdom	62.16	2.65	**8**	Australia	1.61	**8**	Australia	2.32
9	Mexico	58.53	2.50	**9**	United States	1.54	**9**	United States	2.23
10	France	54.95	2.35	**10**	Malta	1.50	**10**	Netherlands	2.18
11	Viet Nam	54.66	2.33	**11**	Netherlands	1.50	**11**	Malta	2.16
12	Colombia	44.84	1.91	**12**	Norway	1.33	**12**	Norway	2.03
13	Japan	44.78	1.91	**13**	Switzerland	1.32	**13**	Tuvalu	2.02
14	Spain	44.78	1.91	**14**	Liechtenstein	1.22	**14**	Switzerland	1.99
15	Australia	39.71	1.70	**15**	Bulgaria	1.22	**15**	French Polynesia	1.96
16	Taiwan, China	30.76	1.31	**16**	Luxembourg	1.21	**16**	Suriname	1.95
17	Italy	29.69	1.27	**17**	Panama	1.20	**17**	Cayman Islands	1.88
18	Malaysia	28.18	1.20	**18**	Philippines	1.18	**18**	Moldova	1.84
19	Poland	28.01	1.20	**19**	Colombia	1.18	**19**	Liechtenstein	1.82
20	Pakistan	27.55	1.18	**20**	New Zealand	1.09	**20**	New Zealand	1.74
21	Türkiye	26.55	1.13	**21**	St. Kitts and Nevis	1.09	**21**	Luxembourg	1.72
22	Netherlands	24.94	1.07	**22**	Sweden	1.08	**22**	Sweden	1.65
23	Argentina	22.99	0.98	**23**	Finland	1.05	**23**	Gibraltar	1.61
24	Ukraine	20.81	0.89	**24**	United Arab Emirates	1.03	**24**	Bulgaria	1.61
25	Peru	20.81	0.89	**25**	Dominica	1.03	**25**	Finland	1.59
26	Russian Federation	19.80	0.85	**26**	Belgium	1.02	**26**	Belgium	1.54
27	Korea, Rep.	19.57	0.84	**27**	Czechia	1.02	**27**	Denmark	1.49
28	Chile	15.06	0.64	**28**	Latvia	1.01	**28**	Ireland	1.48
29	Singapore	14.86	0.63	**29**	Denmark	0.98	**29**	Latvia	1.48
30	Morocco	14.25	0.61	**30**	Portugal	0.98	**30**	United Kingdom	1.47

Generative AI tools have achieved remarkably rapid global diffusion. Figure 11 shows ChatGPT's traffic distribution since the release of GPT-3.5. Initially, upon its November 30, 2022 launch, over 70% of traffic originated from the US, where the model and website was developed. However, ChatGPT quickly spread globally, with the US traffic share plummeting to 25% within one month and subsequently stabilizing around 20% (Figure 11a). Notably, 40% of traffic now originates from countries outside the top 10, indicating a widely dispersed user base. The distribution of monthly unique users, as presented in Appendix Figure A5, mirrored these trends. This extraordinary scale and speed of diffusion, both in terms of traffic and users, demonstrates a global interest in and adoption of generative AI that extends far beyond traditional centers of technological innovation.

Middle-income countries have emerged as crucial players in this landscape, collectively accounting for half of ChatGPT traffic (Figure 11b) and surpassing high-income countries within six months following the release of GPT-3.5. India, Brazil, the Philippines, and Indonesia are particularly prominent, comprising four of the top five countries in terms of ChatGPT traffic by the end of March 2024. Furthermore, about half of the top 30 countries by total traffic are middle-income economies.



(a) By leading economies

(b) By income level

Figure 11: Distribution of ChatGPT monthly traffic

Note: Data are based on Semrush's estimates. In panel (b), HIC, UMIC, LMIC, and LIC stand for high-income countries, upper-middle-income countries, lower-middle-income countries, and low-income-countries, respectively.

Middle-income economies exhibit disproportionately high adoption of generative AI compared to other economic indicators. Figure 12 illustrates this trend by comparing generative AI traffic, search engine traffic, electricity consumption, and GDP for the top 10 economies in terms of generative AI usage, using the United States as a benchmark (set to 100). Notably, the five middle-income countries on the list—India, Brazil, Indonesia, the Philippines, and Mexico—show generative AI traffic levels significantly higher relative to the US than their other metrics would suggest. For instance, India accounts for only 14% of US GDP, 35% of US electricity consumption, and 30% of US search engine traffic, yet generates more than 50% of US generative AI traffic. This is even more pronounced for the Philippines, which represents a mere 1.4% of US GDP but generates nearly 20% of US generative AI traffic. Such patterns contrast sharply with those observed in advanced economies, where search engine and generative AI traffic tend to align more closely with overall economic scale.

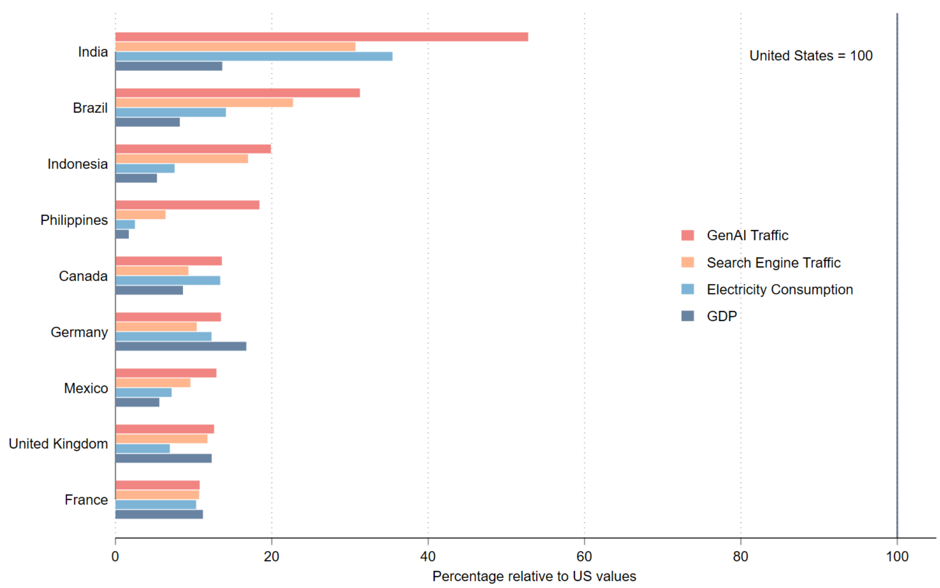


Figure 12: GenAI traffic, search engine traffic, electricity consumption, and GDP of leading countries relative to the US

Note: GenAI traffic represents the total number of visits to our selection of 40 generative AI tools in March 2024. Search engine traffic is the total monthly visits to Google, Bing, and Yahoo during the same period. Electricity consumption for 2022, measured in billion kWh, is from the US Energy Information Administration. GDP measured in 2023 current US dollars is from the IMF.

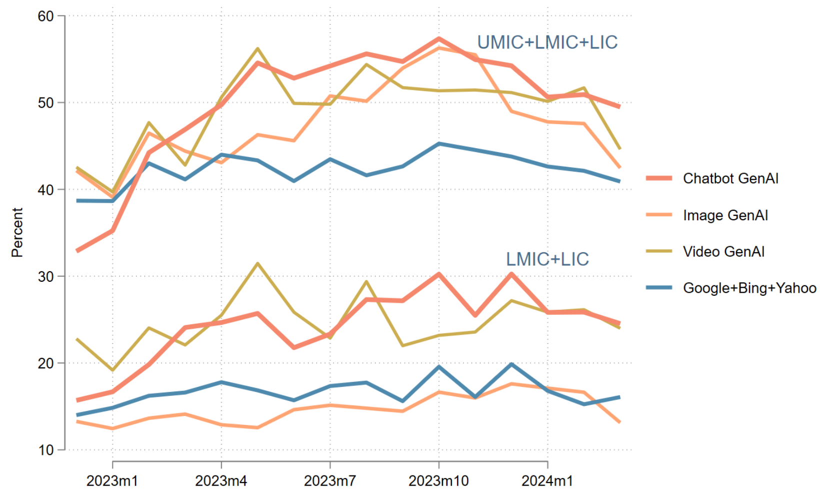


Figure 13: Website traffic distribution of GenAI and search engines by income level

Figure 13 compares the distribution of generative AI tool traffic by type and country income level with search engines as a benchmark. Globally, about 15% of search engine traffic comes from lower-middle-income and low-income economies, and slightly over 40% from non-high-income economies. However, generative AI tools show higher usage from middle-income and low-income economies since mid-2023, with about half of the traffic originating from these economies. Chatbots, in particular, have gained the most popularity among non-high-income economies compared to other types of generative AI tools. This trend highlights the strong adoption and integration of generative AI in economies with growing digital maturity. Low-income countries, however, lag far behind, accounting for less than 1% of generative AI traffic. Despite this low overall usage, their traffic share for chatbots is notably higher than Google's, with chatbots capturing nearly three times the traffic share (Appendix Figure A4). This broad adoption of generative AI tools in middle-income countries illustrates a promising trend towards narrowing the digital divide in terms of total traffic at the economy level.

However, when analyzing the intensity of usage per internet user, as shown in Figure 14, a distinct pattern emerges. The economies exhibiting the highest usage intensities are predominantly advanced ones, as detailed in the second part of Table 1. This pattern highlights a persistent digital divide, where economic development and societal factors serve as barriers to deeper technological integration, much like other technological disparities seen in low- and middle-income economies.

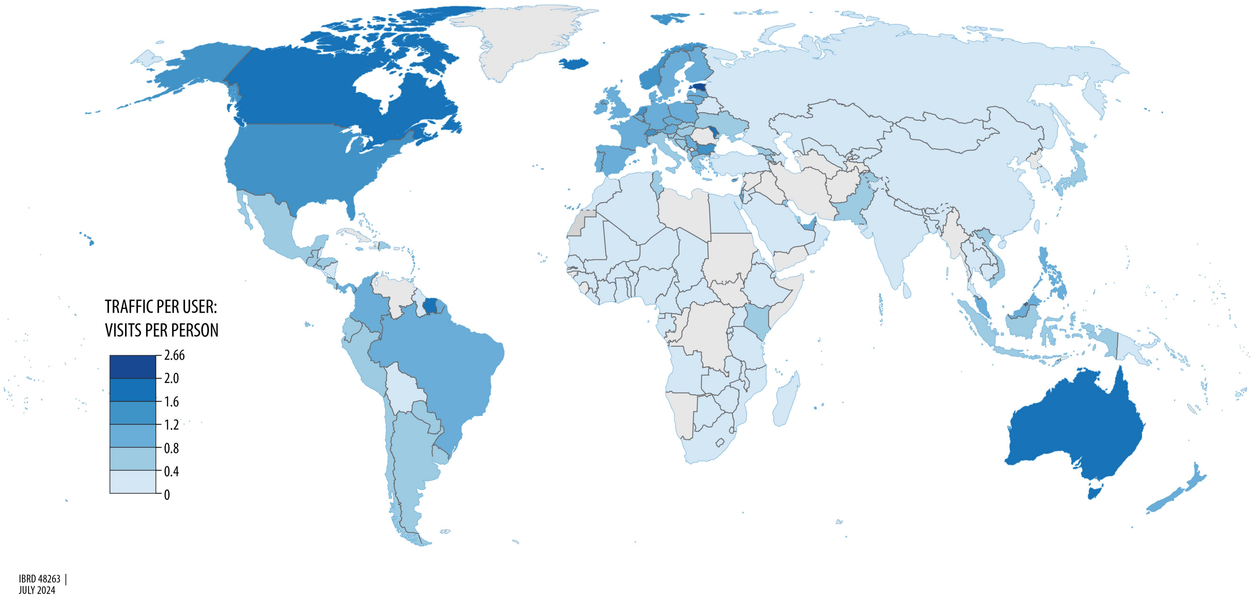


Figure 14: ChatGPT monthly traffic per internet user, March 2024

While generative AI has spread rapidly and widely, particularly in middle-income countries, the depth of integration and per-user intensity still favors high-income economies. This dichotomy presents both opportunities and challenges for addressing the global digital divide in the context of emerging AI technologies.

6 Exploring the Geographic Divide: Factors Affecting Generative AI Usage

This section examines country-level factors that explain differences in generative AI usage across countries. As discussed in the previous section, there is a considerable digital divide in generative AI usage per internet user across countries' income groups. The median monthly visits to ChatGPT per internet user in high-income economies is 0.91, which is 1.6 (5.3) times that in upper (lower) middle-income economies. As of March 2024, 28 economies have more than one visit per internet user, with 79% of these being high-income economies, 18 % upper middle-income economies, and only one lower middle-income economy. No low-income economies feature in this high-usage group. Figure 15 further illustrates this divide, showing an exponential increase in monthly visits per internet user as GDP per capita rises.[7]

However, substantial variations exist within income groups. The Philippines, a lower middle-income economy, outshines its peers with relatively high ChatGPT usage. This can be attributed to its strong Information and Communications Technology (ICT) and Business Process Outsourcing (BPO) industry. Similarly, Estonia stands out among high-income economies, likely due to its specialization in ICT-BPO, e-services and e-government solutions. These examples illuminate how an economies' industry composition and occupational structure affects the adoption rates of generative AI tools.

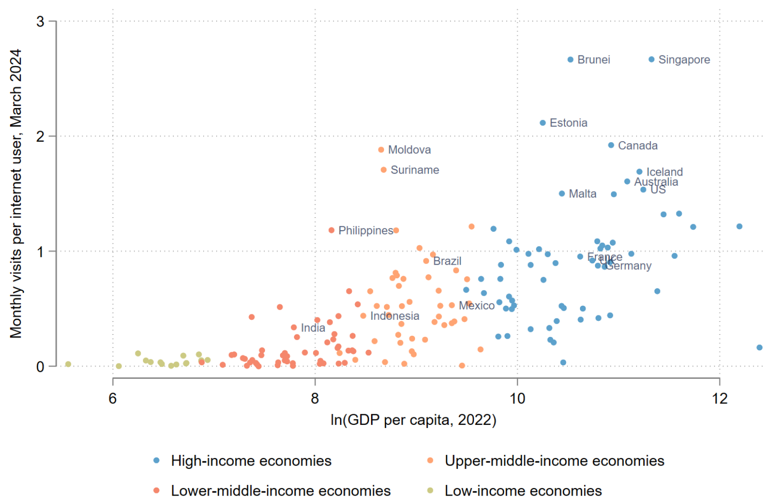


Figure 15: ChatGPT monthly visits per internet user against GDP per capita, March 2024

Note: Website traffic data are based on Semrush's estimates. Internet users by economy are from ITU.

Figure 16 further explores how various economic factors relates to ChatGPT usage. The first row assesses the role of digital infrastructure, using fixed broadband penetration rate and median fixed broadband download speed. The second row focuses on specialization in the digital sector, using an economy's digitally delivered services exports share and digital skills. All charts reveal a clear positive correlation with ChatGPT usage intensity, showing the importance of digital infrastructure, digital skills, and digital sector development in driving the adoption of generative AI tools.

[7]Similar patterns are shown in Figure A6 with monthly users per internet user as the y-axis.

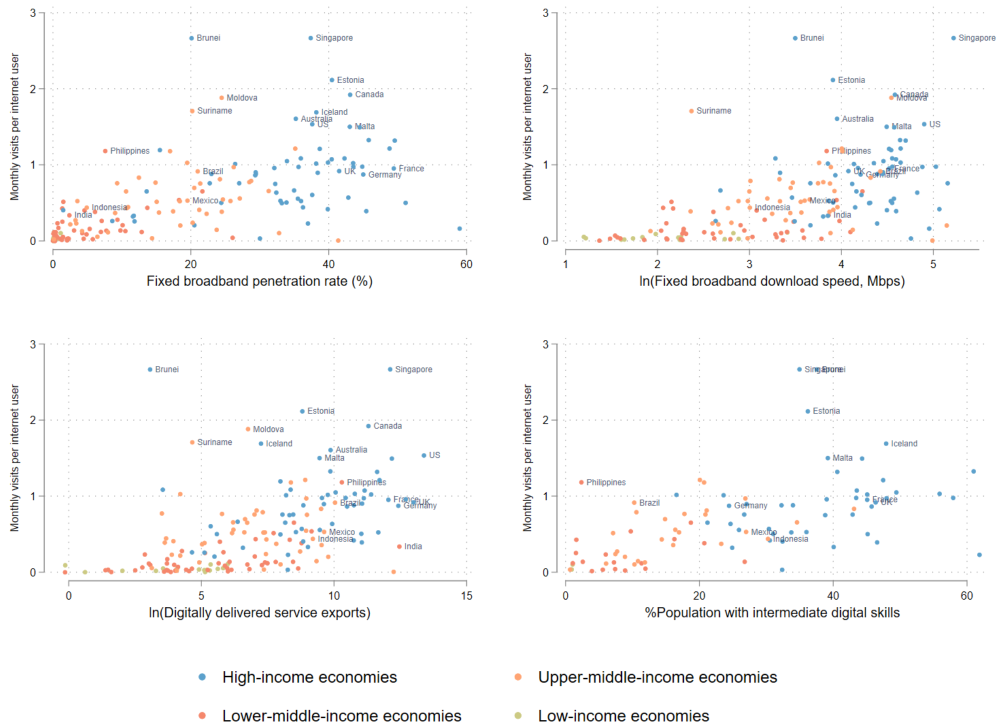


Figure 16: ChatGPT monthly visits per internet user against economic factors, March 2024

Note: Website traffic data are based on Semrush's estimates. Internet users by economy are from ITU.

The above bi-variable correlational analyses present limitations, particularly due to the intercorrelations among the variables and their collective links to GDP per capita, which may conceal the specific impacts of individual factors. To mitigate these issues and refine our understanding, we move to panel data regression analysis to pinpoint key factors that explain differences in generative AI adoption across countries and to compare their magnitudes.

Our analysis proceeds in three stages. First, to establish baseline correlations, we regress ChatGPT usage on each factor individually, controlling for GDP per capita and time fixed effects. Second, while a single regression including all independent variables might seem ideal, the large number of potential predictors and their inherent intercorrelations raise concerns about multicollinearity, which can hinder interpretability. To mitigate this, we employ a Lasso regression to select a subset of variables that maximize predictive power. Third, we then estimate a final regression including only these selected variables to examine their combined influence on ChatGPT traffic. It is important to emphasize that this analysis explores potential correlations between country-level factors and generative AI adoption; we do not claim causal relationships, nor do we attempt to exhaustively model all possible explanatory channels.

For the first step, the specification is as follows:

$$ln(\text{Traffic per internet user})_{it} = \alpha X_{it} + \beta \ln(\text{GDP per capita})_{it-1} + \delta_t + u_{it}. \quad (1)$$

Here, i represents an individual country, and t denotes the time period, measured in quarters. The key dependent variable is the log of quarterly ChatGPT traffic per internet user for country i in quarter t. We include only one independent variable at a time, denoted as X_{it}, while controlling for the log of quarterly GDP per capita with one-period lag and quarterly fixed effects, δ_t.

There are two points to address in the specification. First, the dependent variable is normalized by the number of internet users to account for scale effects. This measurement reflects the intensity of ChatGPT usage. To align with this dependent variable, we either transformed independent variables into intensity measures (standardized by total population, GDP, etc.) or into logarithm.

Second, while our website traffic data is monthly, many independent variables are available only annually. This difference in frequency is common in empirical work, reflecting the varying pace of change in different factors. For example, human capital and sectoral structures typically evolve gradually, while internet infrastructure can improve rapidly, leading to significant changes in internet speed and user numbers within a single year. To address this frequency mismatch and maintain consistency across variables, we constructed a country-quarter panel dataset. We used quarterly data where available, including GDP and internet speed.[8] For population and internet users, we interpolated annual figures to quarterly values.[9] For other independent variables with minimal within-year variation, we used the annual value for all quarters.[10]

[8] Quarterly GDP was calculated using quarterly growth rates from the OECD database. For countries with OECD quarterly data (including major developing economies like China, India, and Indonesia), we derived quarterly GDP directly. For other countries, we evenly distributed the annual growth rate across quarters. Country-level internet speed data is based on Ookla's Global Fixed and Mobile Network Performance Maps, also available quarterly.

[9] Annual growth rates were decomposed into evenly distributed quarterly rates for imputation.

[10] See Appendix Table A2 for summary statistics of the dependent variables, and Appendix Table A3 for sources and summary statistics of the independent variables.

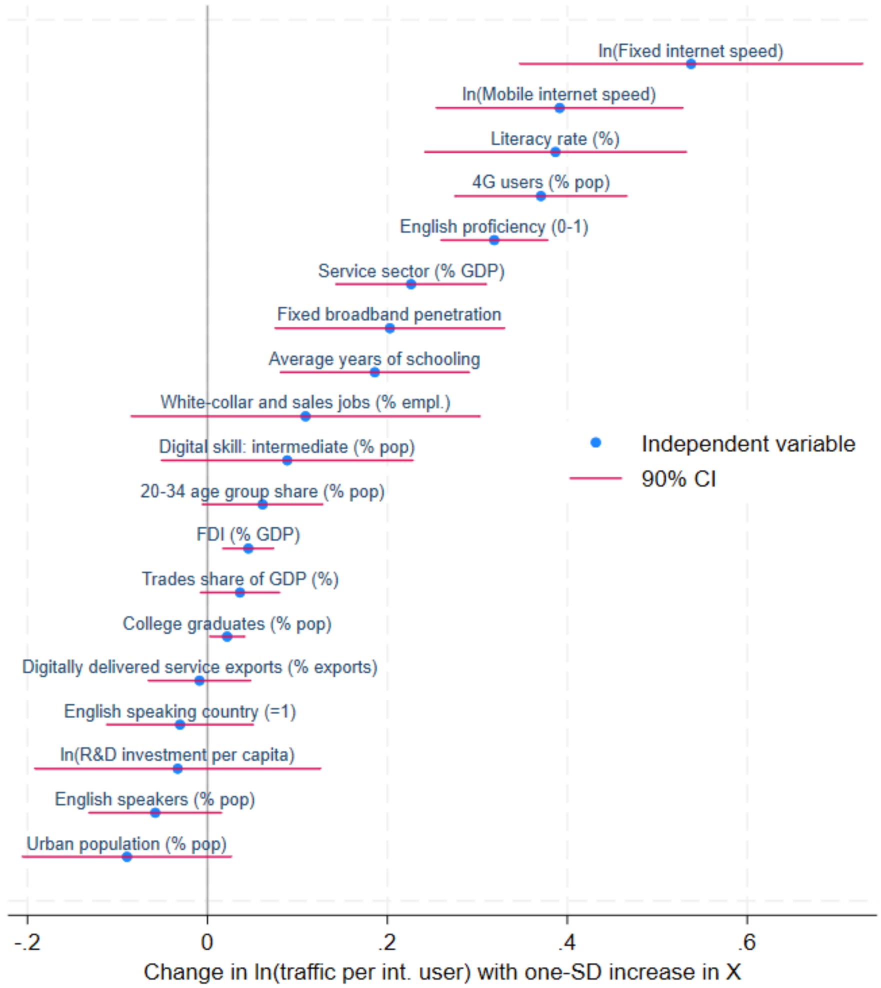


Figure 17: Regression estimates of the correlation between country-level factors and ChatGPT quarterly traffic per internet user

Note: The figure displays the coefficients for independent variables across different regressions based on Equation 1. To ensure comparability, we standardize the coefficients by multiplying them by the standard deviation of each independent variable. Standard errors are similarly adjusted to construct the confidence intervals. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China.

The results for individual regressions are presented in Figure 17. To ensure comparability, the coefficients are standardized by multiplying them by the standard deviation of each independent variable. This allows the values to be interpreted as the change in log traffic per internet user associated with a one-standard-deviation increase in the independent variable.

Better digital infrastructure coverage and quality, higher human capital, English proficiency, higher Foreign Direct Investment (FDI) inflows, a large services sector are significantly associated with higher generative AI traffic per internet user. Among these, fixed and mobile internet speed, literacy rate, 4G user penetration, and English proficiency are most strongly related to ChatGPT usage, suggesting that improvements in digital infrastructure, along with higher levels of human capital and English proficiency, are key drivers of generative AI adoption. In contrast, some variables, like urban population, exhibit a negative but statistically insignificant correlation with ChatGPT usage intensity.

Many of the independent variables presented in Figure 17 capture similar aspects of a country's development level, leading to intercorrelation among them. Before including all the variables in a single regression, we first conducted a Lasso regression to select the most informative combination of independent variables, improving predictive power while reducing model complexity, to mitigate the multicollinearity issue. The results are presented in Appendix Table A5. The 11 selected independent variables fall into three categories: 1) macroeconomic and demographic factors—urban population share, youth population share, service sector share, and FDI share of GDP; 2) digital infrastructure—fixed and mobile internet speed, and 4G user penetration; and 3) human capital—English proficiency, literacy rate, college graduates, and the share of white-collar jobs. In the Lasso regression, all these factors show a positive correlation with ChatGPT usage intensity, except for the urban population share.

With the selected independent variables a single regression, Table 2 juxtaposes factors related to the usage intensity of ChatGPT, applying the same regression specification as in Equation 1, where X_{it} is a vector including the selected regressors. Quarterly GDP per capita (log) is also included as an additional independent variable for reference, with Column (4) excluding it for comparison. Columns (1) to (3) present the regressions for each of the three categories, while Columns (4) and (5) present the regression with all independent variables included.

Table 2: Correlation between ChatGPT quarterly traffic per internet user with country-level factors

Dependent variable	ln(Quarterly ChatGPT traffic per internet user)						
	Total					Mobile	Desktop
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln(Quarterly GDP per capita)	0.74***	0.31***	0.35***		-0.04	-0.60***	0.06
	(0.06)	(0.06)	(0.10)		(0.10)	(0.21)	(0.10)
20-34 age group share (% pop)	2.41**			5.29***	5.28***	2.67	7.11***
	(1.10)			(0.95)	(0.95)	(2.96)	(1.00)
Urban population (% pop)	-0.41			-0.56	-0.53	2.27***	-1.34***
	(0.31)			(0.38)	(0.34)	(0.76)	(0.37)
Service sector (% GDP)	1.94***			1.14**	1.14**	-2.15**	2.56***
	(0.42)			(0.51)	(0.50)	(1.01)	(0.54)
FDI (% GDP)	0.08			0.40**	0.40**	0.08	0.77***
	(0.17)			(0.17)	(0.17)	(0.44)	(0.19)
ln(Fixed internet speed)		0.46***		0.46***	0.47***	1.17***	0.37**
		(0.13)		(0.12)	(0.13)	(0.20)	(0.15)
ln(Mobile internet speed)		0.31***		0.29***	0.30***	0.71***	0.46***
		(0.10)		(0.09)	(0.10)	(0.21)	(0.13)
4G users (% pop)		0.55***		0.65***	0.66***	1.74***	0.54**
		(0.16)		(0.17)	(0.17)	(0.36)	(0.22)
English proficiency (0-1)			1.24***	1.14***	1.18***	1.59***	1.25***
			(0.17)	(0.17)	(0.18)	(0.40)	(0.19)
Literacy rate (%)			2.03***	1.46***	1.53***	0.65	1.78***
			(0.49)	(0.41)	(0.48)	(0.76)	(0.63)
College graduates (% pop)			0.03*	0.05***	0.05***	0.18***	0.05**
			(0.02)	(0.02)	(0.02)	(0.06)	(0.02)
White-collar and sales jobs (% empl.)			0.88	1.23*	1.37	-1.03	1.18
			(0.92)	(0.72)	(0.99)	(1.56)	(0.93)
Quarterly FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	670	670	670	670	670	670	670
Adjusted R-squared	0.456	0.500	0.476	0.543	0.542	0.347	0.530

Note: Robust standard errors are in parentheses. To make the coefficients more interpretable, all independent variables measured in percentage points are divided by 100, scaling them to a range between 0 and 1. Missing values in independent variables are imputed with predictions from the corresponding auxiliary cross-country regression on ln(GDP per capita), ln(Population) and regional dummies. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The pattern of these selected independent variables in Table 2 is similar to the findings in Figure 17, with some variations across individual variables. First, all variables, except for urban population share, are positively correlated with ChatGPT usage intensity, and most are significant. Second, the correlation with the percentage of the population aged 20-35 becomes significant. In Column (5), where all variables are included, a one percentage point increase in the youth population is associated with a 5.3% increase in ChatGPT usage intensity. This positive coefficient aligns with the previous descriptive evidence that youth dominate ChatGPT usage. Third, the share of white-collar and sales jobs in employment shows a significant correlation in Column (4), where GDP per capita is not controlled, suggesting that ChatGPT usage is more prevalent among high-skill professional jobs. An additional finding is that after including the 11 selected independent variables, GDP per capita is no longer significant. This regression analysis extends and further justifies the robustness of the findings in Figure 17.

The strong correlation between country-level English proficiency and ChatGPT usage can be attributed to several interconnected factors. ChatGPT's training on predominantly English-language data results in better performance and user experience in English. This is compounded by the internet's English-centric content and the tech industry's use of English as a lingua franca. Countries with higher English proficiency often have education systems emphasizing technology and digital literacy, fostering a more tech-savvy population primed for AI adoption. Early adoption patterns, initially driven by English-language marketing and outsourcing demand emanating from advanced English-speaking countries, may have set a precedent for ongoing usage trends. Additionally, many professional fields that benefit from ChatGPT, such as programming and research, predominantly operate in English, further skewing usage towards English-proficient populations.

In Table 2, we further extend the analysis with distinguishing website traffic by desktop PC visits or mobile device visits. Comparing Columns (6) and (7) reveals differences in the usage patterns of ChatGPT across devices. Desktop traffic is significantly associated with FDI and the size of the service sector relative to GDP, suggesting a strong link to productivity-related activities. Additionally, desktop traffic correlates more closely with youth population share and higher literacy rates. In contrast, mobile traffic is positively associated with urban population density and demonstrates stronger correlations with internet infrastructure, particularly mobile internet speed and 4G coverage. Furthermore, mobile traffic is negatively correlated with GDP per capita, suggesting that developing countries are more likely to adopt Generative AI through mobile devices, which offer more equitable access. These findings underscore the importance of tailoring policies to bridge digital divides. Investments in improving mobile internet infrastructure can expand access to GenAI tools for broader populations via mobile devices. At the same time, enhancing equitable access to desktop-based tools can maximize their potential for productivity and economic development.

In Appendix Table A6, we use a similar framework to analyze Google traffic intensity as a reference for comparison with ChatGPT usage. As an online platform, ChatGPT is expected to follow a similar trajectory to Google, the most visited website in many countries. However, differences arise in how strongly and significantly each independent variable correlates with website traffic. To examine these differences, we pooled the ChatGPT and Google traffic data and introduced interaction terms between the independent variables and a ChatGPT dummy, as shown in Column (5). While the general patterns remain similar, two key distinctions emerge. First, Google traffic per internet user is significantly associated with GDP per capita, whereas ChatGPT traffic is not, reinforcing our earlier finding that middle-income countries exhibit disproportionately high adoption of Generative AI tools relative to their GDP levels. Second, ChatGPT traffic is significantly correlated with youth population share, unlike Google traffic, further confirming that Generative AI users skew younger.

We then study how these country-level factors correlate to usage intensity of different types of generative AI tools and search engines,[11] and present regression results in Table 3. Results in Columns (1) and (4) are close to the corresponding columns in Tables 2 and A6 , as ChatGPT dominates traffic to all chatbots and Google for search engines. The results reveal distinct patterns between Generative AI tools and search engines. All three types of Generative AI usage intensity shows no significant correlation with GDP per capita after including other independent variables, unlike search engines, which are strongly associated with higher income levels. This reflects the disproportionate adoption of Generative AI tools in developing countries, consistent with our descriptive observations. Generative AI usage intensity is more closely tied to younger populations, compared to search engine usage. It is also strongly correlated with mobile internet speed and 4G coverage, suggesting the potential for Generative AI tools to spread more rapidly and equitably in developing countries through mobile internet infrastructure. Additionally, the magnitude of mobile internet speed increases progressively from chatbot tools to image and video generation tools, reflecting their varying dependency on high-quality internet connections. Unlike chatbots, video and

[11] This category contains three globally used search engines, Google, Bing, and Yahoo.

image generation tools show no significant correlation with college graduate share, consistent with their popularity in recreational contexts rather than professional applications.

In Appendix Table A7, we examine additional ChatGPT adoption outcomes, specifically users per internet user and time spent per visit. The correlations between ChatGPT users per internet user and other country-level factors are very similar to those in Table 2. However, on the intensive margin—average time spent on ChatGPT per visit is significantly correlated only with the share of young population, mobile internet speed, 4G coverage, English proficiency, and literacy rate. Additionaly, the average duration per visit negatively correlates to GDP per capita in Column (8). The overall explaining power of all variables together is lower, indicated by the lower adjusted R squared. This is partly because of less variation in the intensive margin across economies. Table A2 shows that the standard deviation of time per visit is about half of the mean, while the standard deviation of visits or users per internet user about equals the means. This indicates that the digital divide in Generative AI is primarily at the extensive margin–how many people are accessing ChatGPT. Once people have used ChatGPT, the intensive margin–time spent on the tool per visit–have lower variations.

Table 3: Correlation between GenAI and search engine quarterly traffic per internet user with country-level factors

Dependent variable	ln(Quarterly traffic per internet user)			
	Chatbot	Image	Video	Search engine
	(1)	(2)	(3)	(4)
ln(Quarterly GDP per capita)	-0.04	0.01	-0.12	0.22***
	(0.10)	(0.14)	(0.16)	(0.06)
20-34 age group share (% pop)	5.28***	5.30***	3.54*	0.42
	(0.93)	(1.68)	(2.11)	(0.89)
Urban population (% pop)	-0.54	0.09	0.33	-0.11
	(0.34)	(0.47)	(0.56)	(0.19)
ln(Fixed internet speed)	0.46***	0.67***	0.68***	0.35***
	(0.13)	(0.16)	(0.16)	(0.06)
ln(Mobile internet speed)	0.29***	0.35**	0.51***	0.08
	(0.09)	(0.17)	(0.16)	(0.06)
4G users (% pop)	0.65***	1.20***	1.84***	0.90***
	(0.16)	(0.24)	(0.29)	(0.13)
Service sector (% GDP)	0.96*	0.63	0.95	1.30***
	(0.50)	(0.65)	(0.90)	(0.34)
FDI (% GDP)	0.45***	0.78***	0.67*	0.49***
	(0.17)	(0.28)	(0.35)	(0.17)
English proficiency (0-1)	1.15***	0.76***	1.10***	0.93***
	(0.17)	(0.25)	(0.33)	(0.16)
Literacy rate (%)	1.69***	3.72***	2.27***	2.16***
	(0.47)	(0.82)	(0.88)	(0.30)
College graduates (% pop)	0.05***	0.06	0.10	0.06*
	(0.02)	(0.07)	(0.09)	(0.04)
White-collar and sales jobs (% empl.)	1.42	-0.47	-0.66	0.19
	(0.99)	(1.02)	(1.12)	(0.44)
Quarterly FE	Yes	Yes	Yes	Yes
Observations	670	670	670	670
Adjusted R-squared	0.545	0.554	0.490	0.811

Note: Robust standard errors are in parentheses. The dependent variable in each column corresponds to the aggregated quarterly visits of chatbots, image GenAI, video GenAI, and search engines (Google, Bing, and Yahoo). To make the coefficients more interpretable, all independent variables measured in percentage points are divided by 100, scaling them to a range between 0 and 1. Missing values in independent variables are imputed with predictions from the corresponding auxiliary cross-country regression on ln(GDP per capita), ln(Population) and regional dummies. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

7 Early Impacts of Generative AI on Website Traffic

In this section, we explore the early impacts of generative AI on individuals' online activities and the implications on the digital ecosystem. Generative AI tools can disrupt the current traffic patterns and advertising-based business models through multiple channels: First, chatbots can provide direct answers, potentially reducing the need for users to click through to multiple websites and aggregate information by themselves. This may divert traffic from traditional search engines and information websites. Second, AI-generated content may compete with human content creators, reducing traffic to blogs, news sites, and other content platforms. However, high-quality, curated content will become more valuable, benefiting some content creators that offer authoritative, novel, and unique content. Third, AI assistants could act as intermediaries, potentially reducing direct traffic to e-commerce websites. If traffic is diverted, it could significantly affect the current attention-advertising based business model. Fewer page views and clicks could shrink ad revenue for many websites. However, traditional websites and platforms will integrate generative AI features to remain competitive. New monetization models will also emerge to leverage AI capabilities. Eventually, a new balance will be struck between AI-mediated and direct web interactions.

Analysis of monthly traffic patterns across various websites reveals distinct impacts potentially correlated with the emergence and updates of ChatGPT. Figure18 compares the normalized traffic trends of three popular information-acquiring websites: Google, Wikipedia, and Quora. Despite ongoing speculation about whether Bing or ChatGPT could supplant Google as the go-to portal for internet users seeking information, we observe no clear trend in Google's traffic before and after the launch of GPT 4. As of March 2024, Google's traffic remains 80 times higher than ChatGPT's (Figure 3). This substantial gap suggests that the fluctuations in Google's traffic are more likely attributable to seasonality rather than ChatGPT's influence. Similarly, Quora's traffic exhibits high volatility without clear correlations to ChatGPT's trajectory. Wikipedia's traffic, however, was quite stable before the launch of GPT 4, but displays a downward trend since the launch of GPT 4. This shift in Wikipedia's traffic suggests a potential migration of users towards ChatGPT for information inquiries and learning purposes.

These observations indicate that while generative AI tools like ChatGPT are making inroads in the information-seeking landscape, their impact on established platforms varies. Google's resilience suggests that traditional search engines still hold significant value for users, while Wikipedia's decline hints at areas where AI might be more readily displacing existing information sources. The diverse responses across these platforms underscore the complex and evolving nature of user behavior in the face of advancing AI technologies.

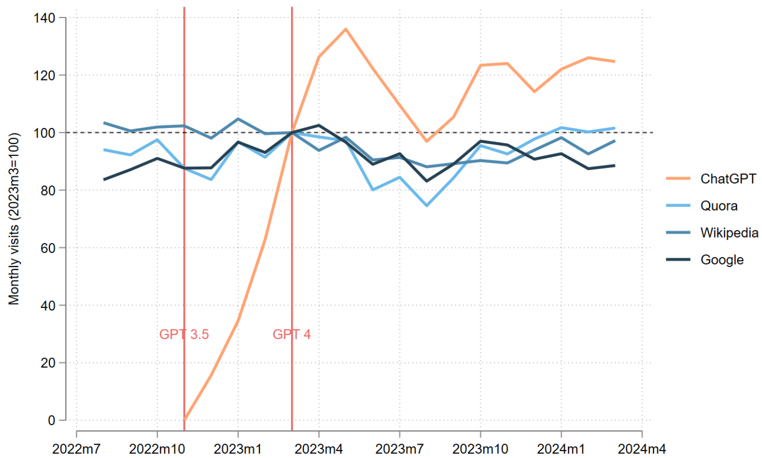


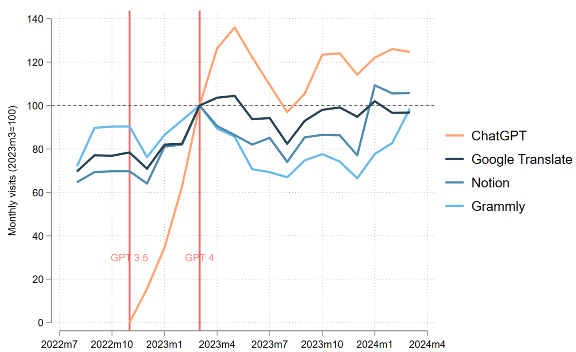
Figure 18: Google, Wikipedia and Quora Monthly visits relative to 2023m3

The impact of GPT-4's launch is more pronounced on platforms like Google Translate and Grammarly, as illustrated in Figure 19a. Grammarly experienced a significant 40% drop in traffic immediately following GPT-4's introduction, while Google Translate saw a 20% decline. However, both platforms later recovered as they upgraded their AI capabilities. Conversely, Notion, a productivity and note-taking application released since 2016, shows more stable traffic and appears less negatively affected by ChatGPT. This varied response underscores the dynamic nature of the tech landscape, where adaptability and continuous innovation are crucial for sustaining relevance and user engagement.

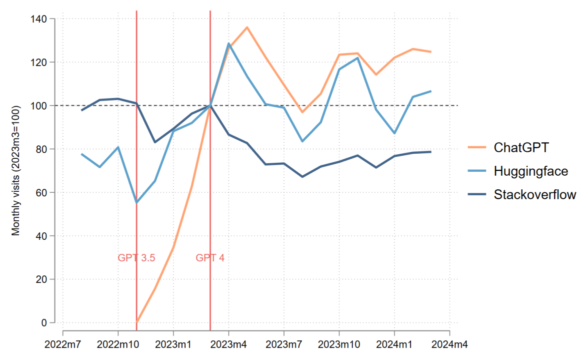
ChatGPT's influence is particularly evident among IT professionals. Figure 19b compares monthly traffic trends of two prominent IT professional communities: Stack Overflow and Hugging Face. As of March 2024, Stack Overflow's traffic is approximately 14% of ChatGPT's, while Hugging Face's is just over 1%. Stack Overflow experienced a notable decline in traffic following GPT-4's release, with traffic dropping about 15% in the first month and hitting the bottom at 30% after six months.[12] The decline reflects changing user behavior, particularly in how IT professionals

[12] The decline of traffic is also confirmed by an official Stack Overflow blog post, linking this decline to the release of GPT-4 (https://stackoverflow.blog/2023/08/08/insights-into-stack-overflows-traffic/).

seek solutions and interact with Q&A platforms in the era of generative AI. Subsequently, Stack Overflow announced a layoff of 28% of its workforce in October 2023, further highlighting the broader implications of these shifting dynamics. In contrast, Hugging Face, known for its AI model development tools, saw a dramatic increase in visits, nearly doubling from November 2022 to May 2023. This surge demonstrates the complementary role of generative AI like ChatGPT in fostering new demands within the IT industry and labor market. This transformation not only affects user behavior but also has major implications for the workforce and skill requirements in the tech industry.



(a) Text-related websites



(b) IT professional websites

Figure 19: ChatGPT and other websites Monthly traffic, relative to 2023m3

Note: Data are based on Semrush's estimates.

In addition to website traffic analysis, monitoring Google Trends for specific keywords offers valuable insights into the popularity and demand of internet activities. Google Trends measures the relative frequency of specific search queries over designated periods and geographic locations, providing an index that reflects public interest in various topics. This data is valuable as it offers nearly real-time insights into public preferences and behaviors, thereby complementing the website traffic data analyzed earlier. Numerous studies have utilized Google Trends data across different economic contexts, such as predicting GDP trajectories (Choi and Varian 2012) and evaluating the impact of COVID-19 on population well-being (Brodeur, Clark, Fleche, and Powdthavee 2021).

Table 4: ChatGPT's selection of 30 verbs impacted by generative AI usage

Analyze	Assist	Automate	Build	Chat	Code
Compose	Control	Cook	Design	Detect	Diagnose
Drive	Edit	Guide	Invest	Learn	Navigate
Optimize	Plan	Play	Predict	Read	Recognize
Secure	Shop	Stream	Teach	Translate	Write

In this study, we employ the Google Trend index to gauge the effect of generative AI tools on internet activities. We first ask ChatGPT to identify 30 verbs most likely impacted by the use of generative AI tools (shown in Table 4). We then tracked the weekly Google Trends index for these keywords across economies from January 2022 to March 2024. The Google Trend index is normalized by the peak search volume observed in each economy during the period, yielding values between 0 and 100. Figure 20 presents the trends for the keywords "Translate" and "Write". The popularity of "Translate" has remained relatively stable but has experienced a clear decline since 2024, mirroring the trend seen in Google Translate website traffic. On the other hand, the keyword "Write" has shown more volatility, likely influenced by academic cycles and holiday seasons, and there has been a general downward trend following the widespread adoption of ChatGPT.

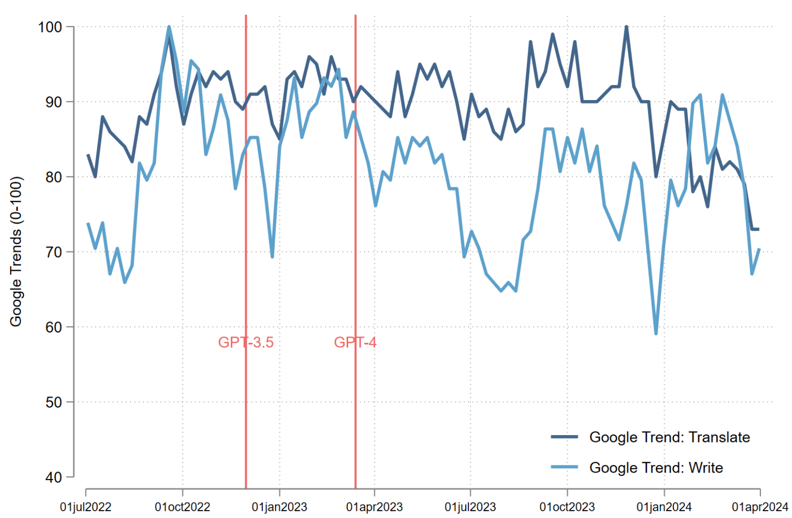


Figure 20: Google Trend of keywords "Translate" and "Write"

Note: Data are from Google Trends.

Simply presenting the time trend provides some hints on ChatGPT's effect. However, the trend is not very clear just from observation on the figures, and there are many reasons other than the release of ChatGPT that affect the popularity of the keywords on Google. To investigate the correlation of ChatGPT usage and the Google Trend of each keyword more rigorously, we collect the Google Trends of each keyword searched in each economy and run panel data regression. We first take the monthly average of the Google Trend index to match Semrush monthly traffic of ChatGPT. For each keyword, we run the following regression:

$$\text{GoogleTrend}_{it}^{(\text{keyword}_k)} = \alpha \ln(\text{ChatGPT}_{it-1}) + \beta X_{it} + \delta_t + \theta_i + u_{it}. \tag{2}$$

In the equation, the dependent variable $\text{GoogleTrend}_{it}^{(\text{keyword}_k)}$ is the Google Trend index of keyword k of economy i in month t. The independent variable of interest is the intensity of ChatGPT usage. Specifically, $\ln(\text{ChatGPT}_{it-1})$ stands for the log of ChatGPT's monthly visits per internet user, of economy i in the previous month $t-1$. We use the one-month lag of ChatGPT usage to avoid the simultaneity problem due to the reverse impacts from Google Trend to ChatGPT. Control variables X_{it} include monthly traffic of Google of economy i in month t, as well as an economy-specific trend. Google traffic controls for the overall Google search activity, and the economy-specific trend controls for the underlying trend of a certain keyword happening in the country, which may not be impacted by the usage of ChatGPT. We also control for month fixed effects δ_t and economy fixed effects θ_i. It is worth noting that as the dependent variable is normalized within an economy and country fixed effects are added in the regressions, the coefficient of interest, α, can be interpreted as the within-economy change of popularity of a keyword searched on Google.

Figure 21 presents the regression results, showing point estimates of the effect of ChatGPT usage intensity on Google Trends for various keyword. For most keywords, the correlations are insignificant, which is expected given the early stage of generative AI adoption. However, three keywords stand out with significant correlations: "Chat" and "AI" are positively correlated with ChatGPT usage intensity. Unsurprisingly, as they directly relate to ChatGPT and generative AI, Google searches for these terms increase as ChatGPT usage intensifies.

Notably, the keyword "Learn" shows a strong negative and significant correlation with ChatGPT usage intensity. The point estimate of -2.4 indicates that a one percent increase in ChatGPT's monthly visits per internet user in the previous month is associated with a 0.024 percentage point

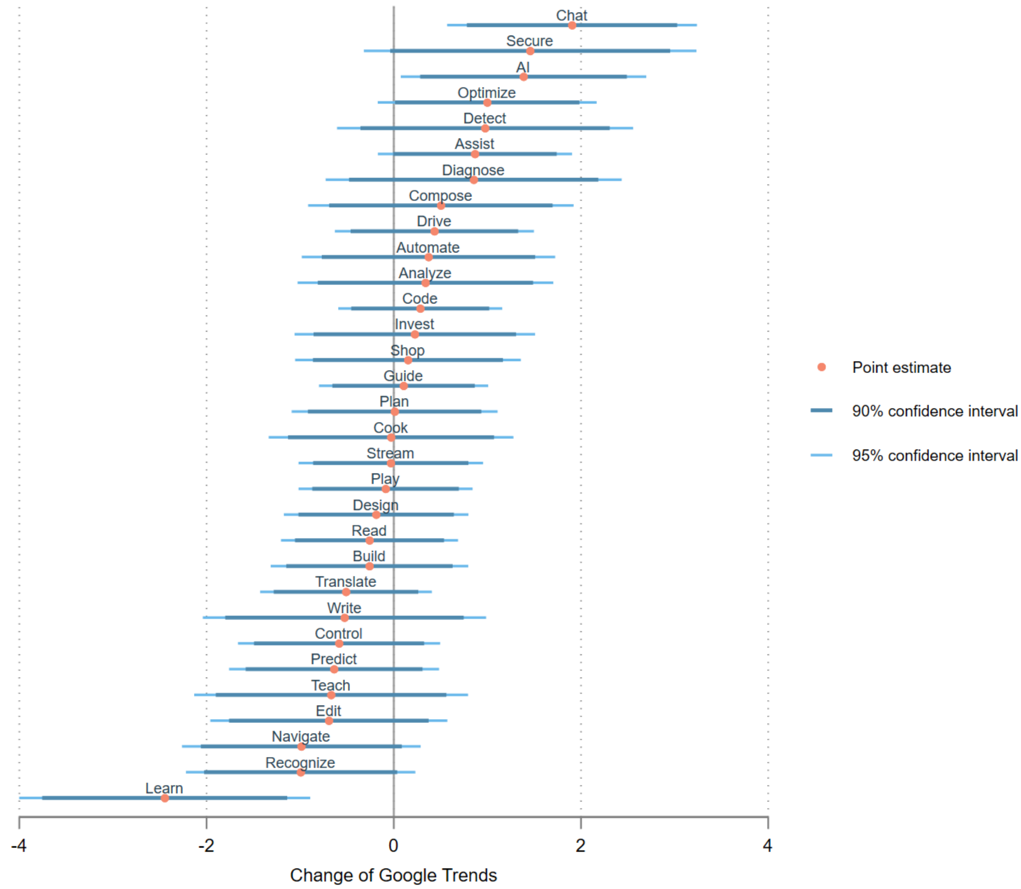


Figure 21: Correlation between ChatGPT usage and keywords in Google Trend

Note: The point estimates are coefficients of ln(ChatGPT monthly visits) in regressions with the Google trend index of the keyword as the dependent variable. The economies are restricted to those with monthly ChatGPT visits per internet user greater than 0.1 in March 2024.

reduction in Google Trend for “Learn”. This implies a substitution effect, with ChatGPT potentially replacing some learning function traditionally performed through Google searches. This finding provides compelling evidence that ChatGPT is influencing how people learn on the internet.

Although correlations for other functions are statistically insignificant, comparing them yields valuable insights. The keyword “Secure” has the second highest magnitude of point estimate, with a significance level close to 0.1, reflecting the widespread concerns that Generative AI development may jeopardize societies. Keywords with positive correlations to ChatGPT usage intensity tend to be associated with tasks that require domain knowledge, logical reasoning, and problem solving, such as “Optimize”, “Diagnose”, “Analyze”, and “Code”. These complementary effects may indicate ChatGPT’s current limitations in these areas, prompting users to verify information on Google. On the contrary, words related to language processing and simpler tasks like “Translate”, “Write”, and “Edit” show negative correlations, highlighting ChatGPT’s strengths in these areas.

While acknowledging the imperfections in our measures and results, these trends provide valuable direction for further exploration as more comprehensive data becomes available. Moreover, this analysis reinforces our confidence in the website traffic data and the insights derived from our previous sections. The observed patterns suggest a nuanced impact of ChatGPT on information-seeking behaviors, with varying effects across different types of tasks and knowledge domains.

8 Conclusion

This paper leverages unconventional data, including website traffic data and Google Trends, to shed light on generative AI adoption patterns by individuals across countries. Our analysis yielded several key findings:

First, we documented a proliferation of generative AI tools and their rapid adoption, noting the dominance of chatbots in the generative AI landscape, signs of market saturation and intensifying competition. As of March 2024, There are at least hundreds of generative AI tools around the world. The top 40 most visited new generative AI tools collectively have nearly 3 billion visits per month and hundreds of millions of unique users. Among the top 40 tools, chatbots occupy the top seven positions and account for a staggering 95% of the traffic, with ChatGPT alone commanding 82.5% of total traffic. Nonetheless, traffic to some generative AI tools has plateaued since mid-2023, hinting at market saturation, intensifying competition, and potential challenges for future growth.

Second, users of generative AI tools heavily skew toward young, highly educated males compared to general internet and Google users. The youth and male bias is particularly pronounced for video generation tools. While users of image and video generation tools have similar education backgrounds as Google users, chatbot users are more highly educated, likely due to frequent usage by college-educated white-collar workers for professional purposes. In contrast, usage of image and video generation tools tend to be more experimental and recreational. Generative AI tools are also primarily accessed via desktop computers and used during weekdays, indicating that they are predominantly used for productivity purposes and tasks related to work and education.

Third, generative AI tools have achieved unprecedented global diffusion both in terms of scale and speed, though low-income countries are falling further behind middle-income countries. ChatGPT is used in 209 of 218 economies worldwide. The United States accounted for over 70% of total traffic for ChatGPT upon its launch, but that share dropped to 25% within one month. Traffic originating from middle-income economies surpassed that of high-income economies within six months, and middle-income economies now contribute more than half of the traffic. In addition to the US, India, Brazil, the Philippines, and Indonesia round out the top five economies in terms of ChatGPT traffic. The over-representation of middle-income economies is remarkable when put into perspective: for example, India only accounts for 14% of US GDP, 35% of US electricity consumption, but over 50% of US ChatGPT traffic. Similar patterns are observed across many other countries, attesting to the widespread interest and uptake of generative AI. Still, low-income economies only represent less than 1% of ChatGPT traffic.

Forth, panel data regressions reveal that countries' income level, share of youth population, the availability and quality of digital infrastructure, English proficiency, and human capital are strongly correlated with higher uptake of generative AI. The size of the service sector predict higher chatbot usage but not other types of generative AI usage. Higher internet speed is more important for image and video generation tools than chatbots. Youth population, better digital infrastructure, higher literacy rate and English fluency also predict more intensive usage of ChatGPT, measured with average duration per session.

Finally, we found indicative evidence that generative AI tools are disrupting the current traffic patterns for certain websites and altering individuals' online activities. Information websites like Wikipedia, translation and writing tools like Grammarly and Google Translate, IT professionals' community Stack Overflow have experienced substantial drops in traffic immediately after the launch of GPT-4. Traffic to some of these sites have recovered as they integrated generative AI capabilities, underscoring the dynamic nature of the tech landscape and the importance of adaptability and continuous innovation for sustaining relevance. Cross country panel data regressions also suggest that ChatGPT is changing how people acquire information, learn new skills, and conduct language-processing tasks. Such tasks are increasingly conducted with the help of ChatGPT, while more complex cognitive and analytical tasks seem to have been augmented by ChatGPT.

These findings have significant implications for policymakers, businesses, and researchers. The impact of generative AI on economic development and societal structures presents both opportunities and challenges. For developing regions, targeted investments in digital infrastructure, digital skills, English language proficiency, and the development of domestic white-collar service industry are imperative to leverage the full potential of AI technologies. Even though ChatGPT and many other generative AI tools support hundreds of languages, English fluency is a highly significant predictor of generative AI uptake. Governments and organizations need to prioritize multilingual AI development, investing in datasets and research for diverse languages. Digital literacy programs combining English skills with AI literacy could help bridge the gap for non-English speakers. Localization efforts, cultural adaptation of AI tools, and equitable access initiatives are crucial to prevent language barriers from exacerbating existing digital divides.

As the generative AI landscape continues to evolve rapidly, ongoing research is crucial to monitor adoption trends and their societal impacts. However, as generative AI becomes integrated into existing applications and new devices, monitoring its usage will be more challenging. Researchers need to develop innovative methods to effectively track generative AI usage in the new era. Future studies could also focus on the long-term impacts of AI on labor markets, education systems, and economic structures across different regions. Additionally, investigating the ethical implications and potential biases in AI adoption patterns will be essential for ensuring that these technologies contribute to inclusive and sustainable growth.

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Appendix: Additional Figures and Tables

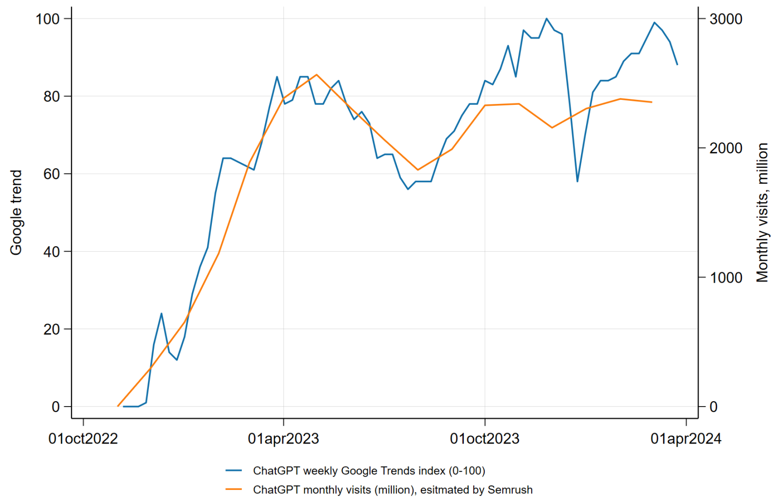


Figure A1: ChatGPT Monthly visits and Google Trend index

Note: Website traffic data are based on Semrush's estimates. Google Trend index reflects the keyword "ChatGPT" searched worldwide in each week between November 2022 and March 2024, which is normalized by the peak during the period, yielding values between 0 and 100.

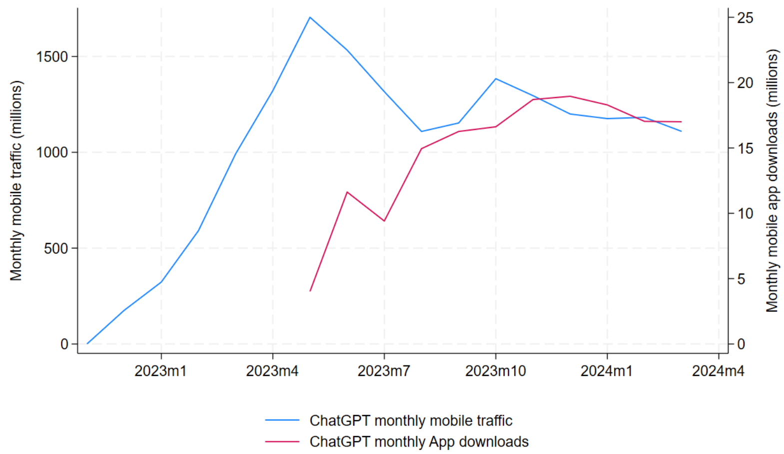


Figure A2: ChatGPT mobile traffic and ChatGPT mobile app downloads

Note: ChatGPT monthly mobile traffic is from Semrush, including both visits through browsers on mobile devices and visits via mobile apps. ChatGPT mobile app downloads data is from Statista, https://www.statista.com/statistics/1497377/global-chatgpt-vs-gemini-app-downloads/.

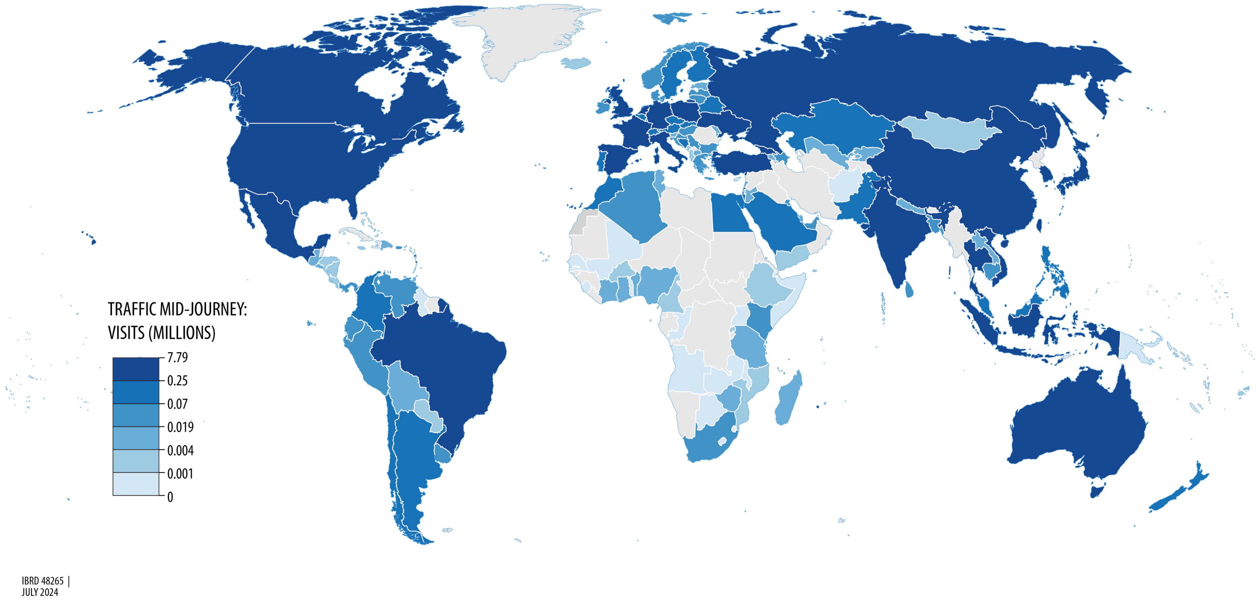


Figure A3: Midjourney monthly traffic, March 2024

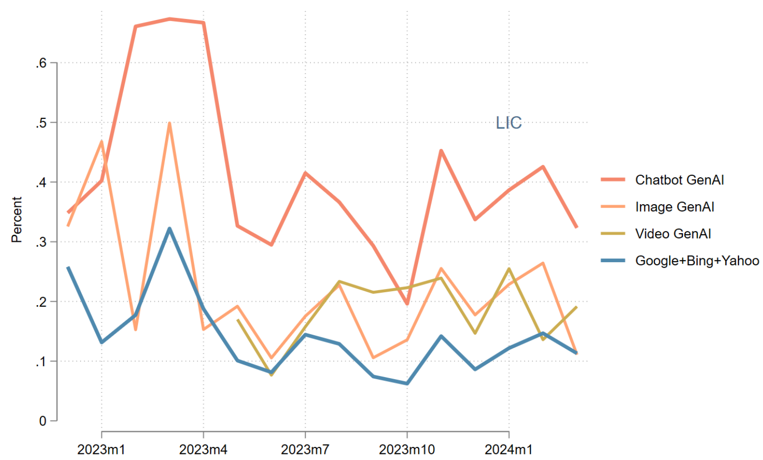
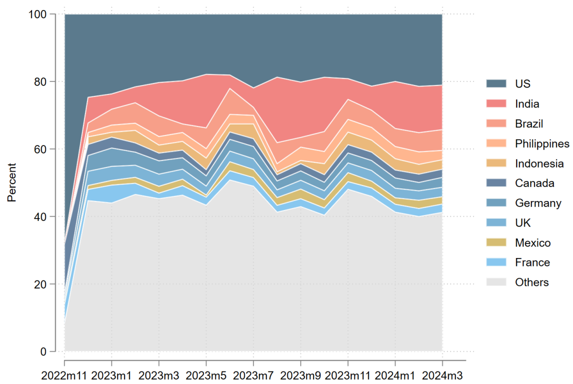
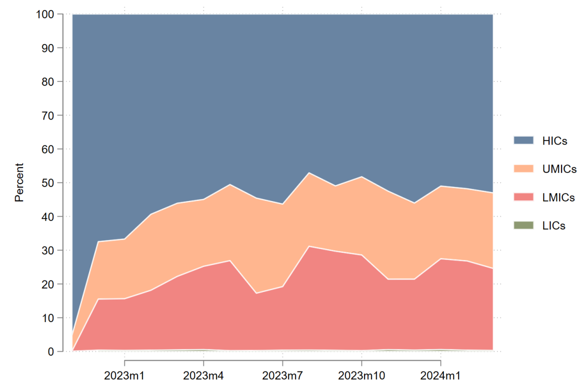


Figure A4: LIC's share of GenAI and search engines website traffic



(a) By leading economies



(b) By income level

Figure A5: Distribution of ChatGPT monthly unique users

Note: Data are based on Semrush's estimates. In panel (b), HIC, UMIC, LMIC, and LIC stand for high-income countries, upper-middle-income countries, lower-middle-income countries, and low-income-countries, respectively.

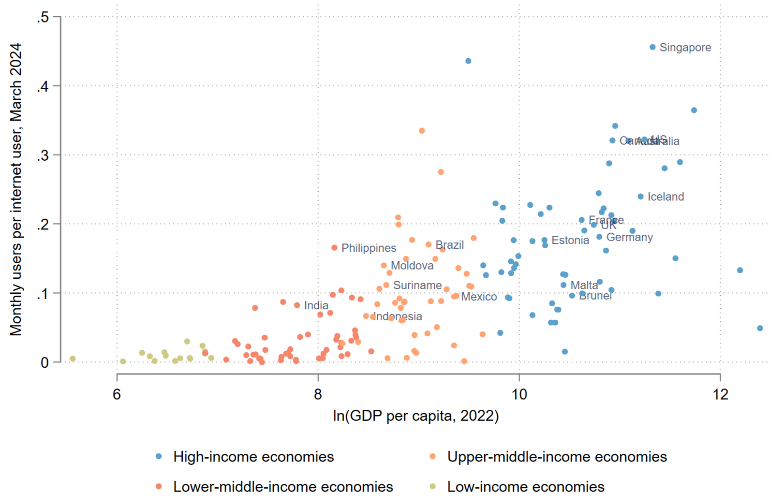


Figure A6: ChatGPT monthly users per internet user against GDP per capita, March 2024

Note: Website traffic data are based on Semrush's estimates. Internet users by economy are from ITU.

Table A1: List of selected Generative AI tools

	GenAI tool	Target website domain	Type	Traffic in March 2024 (million visits)
1	ChatGPT	chat.openai.com	Chatbot	2,343.2
2	Gemini	gemini.google.com	Chatbot	132.9
3	Poe	poe.com	Chatbot	43.4
4	Perplexity	perplexity.ai	Chatbot	40.2
5	Claude	claude.ai	Chatbot	32.3
6	DeepAI	deepai.org	Chatbot	31.1
7	Copilot	copilot.microsoft.com	Chatbot	26.2
8	Midjourney	midjourney.com	Image	24.7
9	Prezi	prezi.com	Image	18.0
10	Nightcafe	creator.nightcafe.studio	Image	13.9
11	Leonardo	app.leonardo.ai	Image	13.6
12	Gamma	gamma.app	Image	11.6
13	Pixai	pixai.art	Image	9.6
14	Runway	runwayml.com	Video	9.0
15	Ideogram	ideogram.ai	Image	8.9
16	Playground	playground.com	Image	8.8
17	Youchat	you.com	Chatbot	8.7
18	Blackbox AI	blackbox.ai	Chatbot	8.7
19	ChatPDF	chatpdf.com	Chatbot	6.8
20	MaxAI	maxai.me	Chatbot	6.1
21	Craiyon	craiyon.com	Image	5.8
22	OpusClip	opus.pro	Video	4.7
23	Synthesia	synthesia.io	Video	4.1
24	Phind	phind.com	Chatbot	3.9
25	Writesonic	writesonic.com	Chatbot	3.8
26	Stability AI	stability.ai	Video	3.2
27	Le chat	chat.mistral.ai/chat/	Chatbot	3.0
28	Designs.AI	designs.ai	Image	1.9
29	Ernie Bot	yiyan.baidu.com	Chatbot	1.5
30	Liner	getliner.com	Chatbot	1.5
31	Artbreeder	artbreeder.com	Image	1.4
32	Kimi chatbot	kimi.moonshot.cn	Chatbot	1.3
33	Fliki	app.fliki.ai	Video	1.2
34	Easy-peasy	easy-peasy.ai	Chatbot	1.2
35	Genmo AI	genmo.ai	Video	1.0
36	Tongyi Qianwen	tongyi.aliyun.com/qianwen/	Chatbot	0.9
37	Meta image	imagine.meta.com	Image	0.4
38	Iflytek spark	xinghuo.xfyun.cn	Chatbot	0.4
39	InVideo	invideo.io/ai/	Video	0.3
40	Doubao	doubao.com	Chatbot	0.3

Table A2: Summary statistics for monthly website usage across economies

		ChatGPT		Google		Chatbot		Image		Video		Search Engine	
	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Monthly, 2024 March													
Visits, million	178	12.9	44.6	900	3,183	14.8	50.7	0.65	2.57	0.13	0.54	940	3,444
Visits per internet user	178	0.52	0.52	34.9	42.7	0.57	0.58	0.028	0.054	0.004	0.006	34.9	43.3
ln(Visits)	178	13.8	3.0	17.8	2.9	13.9	3.0	10.1	3.9	8.2	4.1	17.8	2.9
Users, million	178	2.6	9.5	45.7	159.0								
Users per internet user	178	0.10	0.09	1.5	1.7								
ln(Users)	178	12.2	2.9	14.8	2.8								
Time per visit, second	178	770	362	1,171	278								
ln(Time per visit)	178	6.5	0.8	7.0	0.2								
Monthly, 2023 April-2024 March													
Visits, million	2136	11.8	39.6	938	3,246	12.8	42.9	0.63	2.20	0.14	0.54	978	3,495
Visits per internet user	2136	0.49	0.53	34.2	36.5	0.52	0.56	0.032	0.157	0.006	0.024	34.4	37.4
ln(Visits)	2136	13.7	3.1	17.8	2.9	13.8	3.0	10.1	4.0	8.2	4.2	17.9	2.9
Users, million	2136	2.7	9.3	49.7	171.0								
Users per internet user	2136	0.11	0.11	1.9	1.9								
ln(Users)	2136	12.3	2.9	15.1	2.7								
Time per visit, second	2136	673	333	1,183	221								
ln(Time per visit)	2136	6.4	0.7	7.1	0.2								

Note: Website traffic data are based on Semrush's estimates. Due to the limited usage of some GenAI tools and search engines in mainland China, we have excluded traffic from this region from our regression analysis sample.

Table A3: Summary statistics of country-level independent variables for regression analysis

Variables	Source	N	Mean	SD	Max	Min
ln(Quarterly GDP per capita)	IMF, OECD	670	7.60	1.42	10.41	4.29
ln(Population)	WDI	179	15.6	2.2	21.1	9.3
20-34 age group share (% pop)	WDI	179	22.5	3.5	32.0	13.1
Urban population (% pop)	WDI	166	61.4	22.7	100	13.7
Internet user share (% pop)	ITU	179	70.2	25.0	100	5.8
Fixed broadband penetration (%)	WDI	178	17.7	15.9	59.0	0
Fixed internet speed (mbps) , quarterly	Ookla	670	89.7	68.5	3.7	314.6
Mobile internet speed (mbps), quarterly	Ookla	670	70.0	55.3	3.0	384.6
4G coverage (% pop)	GSMA, WDI	165	56.2	37.1	140	1.4
Trade share of GDP (%)	WTO, WDI	173	75.8	48.4	355	17.9
Service sector share of GDP (%)	WDI	176	55.4	13.2	94.2	19.3
Digitally delivered service exports (% exports)	WTO	168	34.5	88.5	703	0.1
Foreign direct investment inflows (% GDP)	WDI	159	2.45	11.22	112.6	-34.01
R&D investment per capita	WDI	128	0.89	1.07	5.56	0.01
Share of white-collar + sales jobs (%)	ILO	125	37.7	13.0	70.3	7.2
English proficiency (0-1)	EFI	102	0.48	0.26	1	0
English speaker (% pop)	Wikipedia	166	39.4	30.5	100	0.07
English speaking country (=1)	Wikipedia	179	0.34	0.48	1	0
Literacy rate (%)	WDI	144	85.6	17.5	100	27.3
College graduates (% pop)	WDI	154	21.8	56.4	63.0	1.1
Average years of schooling	WDI	137	9.24	3.29	14.1	1.37
Digital skill: intermediate (% pop)	ITU	91	25.4	16.2	61.8	0.7

Note: This table presents summary statistics of the independent variables used in the regression analysis in Section 6. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China.

Table A4: Correlation between ChatGPT monthly traffic and Google Trends of key words "ChatGPT" and "AI"

	ln(ChatGPT traffic)		ln(ChatGPT users)	
	(1)	(2)	(3)	(4)
ln(Google trends: ChatGPT)	0.64***		0.44***	
	(0.04)		(0.03)	
ln(Google trends: AI)		0.20***		-0.01
		(0.06)		(0.05)
Country FE	Yes	Yes	Yes	Yes
Observations	2189	1951	2189	1951

Note: Robust standard errors are in parentheses. Monthly data from January 2023 to March 2024 is used for the regression. Google Trends provides within-country comparable data scaled from 0 to 100, so we control for country fixed effects to ensure comparability across countries in the regressions. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Lasso regression results for independent variable selection

Variable	Coefficient
ln(Fixed internet speed)	0.362
Literacy rate (%)	0.265
English proficiency (0-1)	0.267
4G users (% pop)	0.255
ln(Mobile internet speed)	0.219
Share of white collar + sales jobs	0.166
20-34 age group share (% pop)	0.179
Service sector share of GDP (%)	0.138
FDI share of GDP (%)	0.041
College graduates (% pop)	0.019
Urban population (% pop)	-0.119
lambda	0.002
Out-of-sample R-squared	0.530
CV mean prediction error	1.246

Note: The dependent variable is log of quarterly ChatGPT traffic per internet user. The input of independent variables are the 19 variables in Figure 17 plus ln(GDP per capita). Missing values in independent variables are imputed with predictions from the corresponding auxiliary cross-country regression on ln(GDP per capita), ln(Population) and regional dummies. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China.

Table A6: Correlation between monthly traffic of Google with other factors

Dependent variable	ln(Quarterly traffic per internet user)				
	Google				Google or ChatGPT (This column shows interaction terms with the ChatGPT dummy)
	(1)	(2)	(3)	(4)	(5)
ln(Quarterly GDP per capita)	0.87***	0.58***	0.59***	0.21***	-0.25**
	(0.04)	(0.04)	(0.06)	(0.06)	(0.12)
20-34 age group share (% pop)	-2.00**			0.51	4.78***
	(1.00)			(0.90)	(1.31)
Urban population (% pop)	-0.02			-0.10	-0.43
	(0.21)			(0.19)	(0.39)
Service sector (% GDP)	2.06***			1.29***	-0.15
	(0.32)			(0.35)	(0.61)
FDI (% GDP)	0.05			0.48***	-0.08
	(0.23)			(0.18)	(0.25)
ln(Fixed internet speed)		0.40***		0.36***	0.11
		(0.07)		(0.07)	(0.15)
ln(Mobile internet speed)		0.07		0.09	0.21*
		(0.07)		(0.06)	(0.11)
4G users (% pop)		1.00***		0.93***	-0.27
		(0.13)		(0.13)	(0.21)
English proficiency (0-1)			1.09***	0.92***	0.25
			(0.16)	(0.16)	(0.24)
Literacy rate (%)			2.76***	2.25***	-0.72
			(0.32)	(0.30)	(0.56)
College graduates (% pop)			0.04	0.06*	-0.01
			(0.03)	(0.04)	(0.04)
White-collar and sales jobs (% empl.)			0.05	0.20	1.18
			(0.51)	(0.45)	(1.08)
Quarterly FE	Yes	Yes	Yes	Yes	Yes
Main term					Yes
Observations	670	670	670	670	1340
Adjusted R-squared	0.726	0.764	0.756	0.807	0.872

Note: Robust standard errors are in parentheses. In Column 5, the regression sample includes both Google and ChatGPT traffic. Each row presents the interaction terms between each independent variable and the ChatGPT dummy, with the coefficients representing the difference between Google and ChatGPT. The main terms for all independent variables are also controlled, and the coefficients are identical to those in column 4. To make the coefficients more interpretable, all independent variables measured in percentage points are divided by 100, scaling them to a range between 0 and 1. Missing values in independent variables are imputed with predictions from the corresponding auxiliary cross-country regression on ln(GDP per capita), ln(Population) and regional dummies. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: Correlation between ChatGPT monthly users per internet user and time per visit with country-level factors

Dependent variable	ln(Monthly ChatGPT users per internet user)				ln(Time spent per ChatGPT visit)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Quarterly GDP per capita)	0.71***	0.33***	0.39***	0.05	0.05*	-0.10***	-0.05	-0.20***
	(0.06)	(0.06)	(0.09)	(0.09)	(0.03)	(0.03)	(0.04)	(0.05)
20-34 age group share (% pop)	1.80*			4.50***	1.24*			1.68***
	(0.93)			(0.82)	(0.67)			(0.62)
Urban population (% pop)	-0.54**			-0.69**	0.01			-0.03
	(0.27)			(0.30)	(0.13)			(0.14)
Service sector (% GDP)	2.20***			1.61***	0.38*			0.11
	(0.38)			(0.44)	(0.21)			(0.20)
FDI (% GDP)	-0.06			0.21	-0.13			-0.03
	(0.17)			(0.16)	(0.09)			(0.09)
ln(Fixed internet speed)		0.36***		0.37***		0.08		0.06
		(0.12)		(0.12)		(0.05)		(0.05)
ln(Mobile internet speed)		0.32***		0.31***		0.21***		0.23***
		(0.08)		(0.08)		(0.07)		(0.07)
4G users (% pop)		0.56***		0.68***		0.18**		0.18**
		(0.14)		(0.15)		(0.07)		(0.07)
English proficiency (0-1)			1.21***	0.99***			0.25***	0.21**
			(0.15)	(0.15)			(0.07)	(0.09)
Literacy rate (%)			1.51***	1.00**			1.04***	1.04***
			(0.44)	(0.42)			(0.34)	(0.35)
College graduates (% pop)			0.06**	0.07***			-0.02	-0.01
			(0.02)	(0.02)			(0.01)	(0.01)
White-collar and sales jobs (% empl.)			0.76	1.17			-0.22	-0.04
			(0.79)	(0.83)			(0.34)	(0.31)
Quarterly FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	670	670	670	670	664	664	664	664
Adjusted R-squared	0.506	0.538	0.514	0.583	0.068	0.131	0.112	0.179

Note: Robust standard errors are in parentheses. For Columns (1)–(4), the dependent variable is the log of the quarterly average of monthly ChatGPT users as a proportion of internet users in the country. To make the coefficients more interpretable, all independent variables measured in percentage points are divided by 100, scaling them to a range between 0 and 1. Missing values in independent variables are imputed with predictions from the corresponding auxiliary cross-country regression on ln(GDP per capita), ln(Population) and regional dummies. The data used for the regressions covers the period from 2023Q2 to 2024Q1. Countries with limited access to ChatGPT are excluded, including China. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.