GPT-3.5 Hallucinates Nonexistent Citations: Evidence from Economics

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Abstract

We create a set of prompts from every Journal of Economic Literature (JEL) topic to test the ability of a GPT-3.5 large language model (LLM) to write about economic concepts. For general summaries, ChatGPT can perform well. However, more than 30% of the citations suggested by ChatGPT do not exist. Furthermore, we demonstrate that the ability of the LLM to deliver accurate information declines as the question becomes more specific. This paper provides evidence that, although GPT has become a useful input to research production, fact-checking the output remains important.

JEL codes: B4, O33, I2

Keywords: artificial intelligence, large language models, ChatGPT, writing, research methods

1 Introduction

Economists predict that tools like ChatGPT will make human workers more productive (Eloundou et al. 2023; Peng et al. 2023). Artificial intelligence has recently advanced to become a powerful tool for research and academic writing.

As of Spring 2023, researchers have access to GPT-3.5 through an online large language model (LLM) known as ChatGPT. While acknowledging that this version of ChatGPT can augment human labor, we present systematic evidence of errors common in the output of LLMs when prompted to write about social science literature. Researchers should be aware of GPT’s tendency to hallucinate, to ensure that the next series of research papers do not contain errors which would affect both machines and human readers in the future.

We query ChatGPT about economics through a series of prompts derived from each of the Journal of Economic Literature (JEL) categories. Some GPT output is useful and accurate. To provide an objective determination of the number of hallucinations per response, we count how many of the citations provided by ChatGPT do not exist. There can be other types of mistakes in LLM output, however we consider this quantitative measure to be useful data on hallucinations.
in social science writing. The overall rate of false citations in our data is over 30%. We also find that the rate of false citations increases significantly when the prompt goes from a general topic to a narrow question. Social scientists should continue to do labor-intensive fact checking on LLM output. Counterintuitively, certain creative tasks can be outsourced to LLMs, while some of the more routine work in research production still cannot be entirely entrusted to ChatGPT (Cowen and Tabarrok 2023).

The issue of hallucination has been known to the computer science community since before the public ChatGPT product. Ji et al. (2023) warn that, “Hallucination in NLG is concerning because it hinders performance and raises safety concerns for real-world applications. For instance, in medical applications, a hallucinatory summary generated from a patient information form could pose a risk to the patient.” Alkaissi and McFarlane (2023) document this problem in a medical context. The error rate will go down as the LLM technology improves, however it is unlikely that the problem could be eliminated entirely, since LLMs are fundamentally creative. A.I. generated content is already on the internet, including websites that users might go to for medical advice (Thompson 2023).

Our goal is to present systematic evidence for this problem in a social science research context, so that researchers can use LLMs appropriately in the future. We find, like Korinek (2023), that the LLM can produce some valid references for widely-cited books and papers, presumably because the LLM has access to many training examples in human writing. Jungherr (2023) presents examples showing that LLM performance declines at the conceptual level when requests become more specific (Roberts et al. (2023) provide cases with geography and GPT-4). Our paper provides quantitative evidence for this phenomenon.

2 Method

We asked ChatGPT to cover a wide range of topics within economics. For every JEL category, we constructed three prompts with increasing specificity.

Level 1: The first prompt, using A here as an example, was “Please provide a summary of work in JEL category A, in less than 10 sentences, and include citations from published papers.”

Level 2: The second prompt was about a topic within the JEL category that was well-known. An example for JEL category Q is, “In less than 10 sentences, summarize the work related to the Technological Change in developing countries in economics, and include citations from published papers.”

Level 3: We used the word “explain” instead of “summarize” in the prompt, asking about a more specific topic related to the JEL category. For L we asked, “In less than 10 sentences, explain the change in the car industry with the rising supply of electric vehicles and include citations from published papers as a list. include author, year in parentheses, and journal for the citations.”

Using 19 JEL categories and 3 levels, we obtained 57 responses from ChatGPT in May 2023. The variety of topics shows that hallucination is pervasive and not restricted to one subject. The
variation in specificity allows us to test the hypothesis that hallucinations are more likely when there is less public training literature for the LLM.

We analyzed the responses in two ways. First, we used a measure that we argue is objective. We checked whether the citation exists. Second, we judged whether the real citations are appropriate for the answer to our question, which we acknowledge is subjective.

**Real:** The citation is classified as real if we could find it, as written by ChatGPT, online. Internet search tools such as scholar.google.com are comprehensive. We expect that a paper or book that exists would be indexed by Google search engines. The citation is classified as not real if no such published document exists.

In response to “explain how marketing in social media affects profit for businesses…” ChatGPT produced the following citation: Trusov, M., et al. (2009). Evaluating the Impact of Social Networks on Business Performance. Marketing Science, 28(2), 356-378. ChatGPT identified a scholar, Dr. M. Trusov, who writes about social media. However, that specific paper does not exist, and GPT failed to locate one of his papers that would have been a good match.

**Correct:** The citation is classified as correct if it is a proper source for answering the question. Consider the level 3 prompt for JEL category R: “explain how rental prices change during hurricane seasons…” ChatGPT returned the following citation: Deryugina, T., et al. (2020). The long-run dynamics of electricity demand: Evidence from municipal aggregation. Journal of Urban Economics, 119, 103276. This citation is classified as not real because the paper with that title was not published in the Journal of Urban Economics. It would also be classified as not correct, because the subject of the paper is residential electricity demand in Illinois not hurricanes.

Although we recognize that academics might use different standards to evaluate the quality of references provided by ChatGPT, we believe that these two measures capture an important trend.
Our emphasis is not on the exact level of false citations that we measure. The errors are significant and more frequent than we would tolerate for scientific work. Readers are invited to view every prompt and response in the Appendix and create metrics for errors. Figure 1 shows the prompt and response to a level 1 prompt for JEL category B.

The primary metric used to evaluate GPT responses is as follows:

\[
\text{Proportion of Real Citations} = \frac{\text{real citations in the response}}{\text{total number of citations}}
\]

3 Results

Figure 2: Accuracy of citations provided by ChatGPT (GPT-3.5) declines as the level of specificity in the prompt increases

Figure 2 shows that the proportion of real citations is less than 70% on average in the sample of responses, and the proportion of correct citations is lower. We report the proportion of real citations for each JEL category, by specificity level, in Table 1.

Result 1: ChatGPT returns a considerable proportion of false citations, more than 30% in our sample.

We test for a difference in the proportion of real citations between level 1 and level 2 using a nonparametric Mann Whitney test. There is no significant decline in accuracy going from a description of the JEL category to a broad topic in economics (two-sided test, \( W \) stat = 216, p-value = 0.29). The prompt for level 2 was still fairly general and therefore ChatGPT had access to sufficient training material for topics such as “game theory”. Performance declined when asked to explain more specific topics with a narrower set of available literature. There is a significant decrease in accuracy from level 1 to level 3 (two-sided test, \( W \) stat = 286, p-value < 0.002). The pattern replicates for the metric of correct citations.
Table 1: Proportions of Real Citations by JEL Category and Level

<table>
<thead>
<tr>
<th>JEL Cat.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
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<tbody>
<tr>
<td>Level 1</td>
<td>0.67</td>
<td>1</td>
<td>0.5</td>
<td>0.78</td>
<td>0.8</td>
<td>0.6</td>
<td>0.75</td>
<td>1</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Level 2</td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>1</td>
<td>0.75</td>
<td>0.75</td>
<td>0.5</td>
<td>0.83</td>
<td></td>
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<tr>
<td>Level 3</td>
<td>0.6</td>
<td>0.67</td>
<td>0.6</td>
<td>0.5</td>
<td>1</td>
<td>0.4</td>
<td>0.8</td>
<td>0</td>
<td>0.6</td>
<td>0.4</td>
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<tr>
<th>JEL Cat.</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>Z</th>
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<tbody>
<tr>
<td>Level 1</td>
<td>0.8</td>
<td>0.8</td>
<td>0.6</td>
<td>1</td>
<td>1</td>
<td>0.8</td>
<td>0.4</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>0.67</td>
<td>0.67</td>
<td>1</td>
<td>0.83</td>
<td>0.75</td>
<td>0.5</td>
<td>0.5</td>
<td>0.33</td>
<td>0.5</td>
</tr>
<tr>
<td>Level 3</td>
<td>0.8</td>
<td>0.2</td>
<td>0.8</td>
<td>0.6</td>
<td>0.2</td>
<td>0.8</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
</tr>
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</table>

**Result 2:** We find a significant decline in accuracy from a general topic to a more specific question posed to ChatGPT (GPT-3.5).

# 4 Conclusion

Academics, students, and researchers will use LLM tools. We argue that fact-checking is necessary to prevent false statements from propagating in the literature. Describing their new product, OpenAI stated, “ChatGPT is fine-tuned from a model in the GPT-3.5 series, which finished training in early 2022.” OpenAI (2022) acknowledged that, “ChatGPT sometimes writes plausible-sounding but incorrect or nonsensical answers.” We systematically document this issue in the context of economics literature.

LLMs simulate humans convincingly, but we argue that GPT-3.5 does not yet outperform experts in a subfield of knowledge. Researchers can study the output of LLMs as a new kind of data that provides insights into human behavior and biases, since it was trained on a vast amount of human writing (Bybee 2023; Horton 2023).

Hallucinations make LLMs different from previous printing and writing technologies. The issue of false citations might be solved if AI creators build a tool to prevent that specific type of error. But this article will still serve as evidence that LLM output should be tested for factual accuracy. The academic community of teachers and researchers should recognize that hallucinations are possible.

# Acknowledgments

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# Works Cited

A Supplemental Material

To generate the statistics on real and correct citations, we prompted ChatGPT to comment on each JEL category at three levels.

The first level was to summarize the entire JEL category. The second level was to summarize a topic inspired by the response to that first summary. The third level was the most specific prompt because we asked ChatGPT to explain a narrower concept related to the response in the second summary.

In this appendix, we present the prompts and ChatGPT (Generative Pre-trained Transformer-3.5) responses that were analyzed in the paper. These responses were collected from the free ChatGPT tool through the OpenAI website in May of 2023. Full reproducibility of our data is not possible.
due to the fact that GPT returns different answers at different times and is constantly updating.

Table of All Prompts and Responses

The first column indicates the JEL category, the level of specificity, and the text of the prompt. The second column contains the response from the ChatGPT website.

<table>
<thead>
<tr>
<th>JEL: Prompt</th>
<th>ChatGPT Response</th>
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| A-1: Please provide a summary of work in JEL category A, in less than 10 sentences, and include citations from published papers. | JEL Category A, "General Economics and Teaching," encompasses a wide range of research and literature that focuses on general economic theory, economic methodology, the history of economic thought, and the teaching of economics. Scholars in this field explore fundamental economic concepts, the development of economic theories, and the pedagogical aspects of economics education.

For instance, John Maynard Keynes' influential work, "The General Theory of Employment, Interest, and Money" (1936), falls under this category as it revolutionized macroeconomic theory and provided new insights into the role of aggregate demand in shaping economic outcomes. Keynesian economics, as a school of thought, has been extensively studied within JEL Category A. Moreover, research papers like Samuelson’s "Foundations of Economic Analysis" (1947) have contributed to the development of economic methodology, providing frameworks for rigorous mathematical modeling and analysis in economics. Another subfield within JEL Category A focuses on the teaching of economics. In their paper, "Economic Education in the Classroom: Do Students Learn?," Walstad and Allgood (1999) examine the effectiveness of economic education and find that students who receive formal economics instruction demonstrate better economic understanding and decision-making skills. Overall, JEL Category A encompasses research that advances our understanding of economic theory, methodology, and the effectiveness of economics education. It plays a crucial role in shaping the foundational knowledge and pedagogical practices within the field of economics.

References:  
A-2: In less than 10 sentences, summarize the work related to the teaching of economics, and include citations from published papers.


A-3: In less than 10 sentences, explain what is the best practice for economics to teach monopoly in an intermediate course, and include citations from published papers as a list.

The best practice for teaching monopoly in an intermediate economics course involves a combination of theoretical understanding and real-world applications. Students should be introduced to the concept of monopoly as a market structure characterized by a single seller with significant market power. They should learn about the determinants of monopoly power, such as barriers to entry, economies of scale, and product differentiation. Instructors can emphasize the welfare implications of monopoly, including trade-offs between market efficiency and market power. Case studies and empirical research can be employed to illustrate concepts, and interactive online platforms can facilitate engagement and critical thinking skills.

Some notable works in this area include:

JEL Category B, "Schools of Economic Thought and Methodology," encompasses research and literature that explores various schools of economic thought, including classical economics, neoclassical economics, Keynesian economics, Marxist economics, and others. Scholars in this field examine the theoretical frameworks, assumptions, and policy implications associated with different economic schools. For example, Smith’s "The Wealth of Nations" (1776) falls within this category as it laid the foundation for classical economics, emphasizing the role of market forces, division of labor, and individual self-interest in economic growth and development. Another significant contribution in JEL Category B is Marx’s "Capital" (1867), which forms the basis of Marxist economics, focusing on the analysis of capitalism, class struggle, and the exploitation of labor. Moreover, Keynes’ "The General Theory of Employment, Interest, and Money" (1936) revolutionized macroeconomic theory, advocating for government intervention to address unemployment and stabilize the economy, establishing Keynesian economics as a prominent school of thought. Additionally, Hayek’s "The Road to Serfdom" (1944) represents the Austrian school of economics, emphasizing the importance of free markets, limited government intervention, and the dangers of central planning. Overall, JEL Category B encompasses research that examines the foundational theories and policy implications of different economic schools, contributing to the diverse perspectives within the field of economics. References: • Smith, A. (1776). An Inquiry into the Nature and Causes of the Wealth of Nations. W. Strahan and T. Cadell. • Marx, K. (1867). Capital: A Critique of Political Economy. Penguin Classics. • Keynes, J. M. (1936). The General Theory of Employment, Interest, and Money. Palgrave Macmillan. • Hayek, F. A. (1944). The Road to Serfdom. University of Chicago Press.
Friedrich Hayek’s ideas are connected to the issue of bailing out failed banks, as he advocated for the importance of market discipline and the dangers of government intervention. Hayek argued that bailouts distort market signals, create moral hazard, and impede the process of creative destruction necessary for long-term economic growth. His work “The Constitution of Liberty” highlights the need to allow failing banks to face the consequences of their actions to maintain a healthy market economy (Hayek, 1960). Similarly, Lastra (2010) examines the moral hazard implications of bank bailouts and emphasizes the importance of allowing market forces to discipline banks. Furthermore, Lepetit et al. (2013) provide empirical evidence that bank bailouts can lead to increased risk-taking behavior and undermine financial stability. Understanding Hayek’s ideas can help students analyze the complexities and potential pitfalls associated with bank bailouts and foster a deeper appreciation for the role of market forces in the banking sector.

C-3: In less than 10 sentences, explain the applications of Winsorizing in economics. Include citations from published papers as a list. Include author, year in parentheses, and journal for the citations.

Winsorizing is a data transformation technique that has various applications in economics. It is commonly used to handle outliers and extreme values in empirical analyses, providing robustness to statistical models. Maronna et al. (2019) discuss the use of Winsorizing in robust regression models to reduce the influence of outliers. Moreover, Winsorizing has been applied in income inequality studies to mitigate the impact of extreme income values, as shown by Gottschalk and Smeeding (1997). Additionally, Winsorizing has been employed in financial research to address extreme returns and improve portfolio performance, as demonstrated by Karolyi et al. (2004). These examples highlight the versatility and usefulness of Winsorizing in various economic analyses.

Citations:

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Electronic copy available at: https://ssrn.com/abstract=4467968
In less than 10 sentences, summarize the work related to the Game theory in economics, and include citations from published papers.

Game theory, a prominent field within economics, explores strategic interactions among economic agents. It provides a framework to analyze decision-making in situations where outcomes depend on the actions of multiple players. Notable contributions in game theory include the study of equilibrium concepts like Nash equilibrium (Nash, 1950) and the analysis of cooperative and non-cooperative games (Fudenberg and Tirole, 1991). Research has examined various applications of game theory, such as auctions (Klemperer, 1999), bargaining (Rubinstein, 1982), and the study of industrial organization (Tirole, 1988). Additionally, game theory has been utilized to understand issues like social dilemmas and the provision of public goods (Hardin, 1968; Ostrom, 1990), as well as the dynamics of evolutionary games (Smith, 1982). Overall, game theory has significantly contributed to our understanding of strategic decision-making in economics. References:

Jean Tirole, an influential economist, made significant contributions to the understanding of non-cooperative games, particularly in the field of industrial organization and game theory. His research focused on providing insights into strategic interactions among economic agents. Tirole’s work on the theory of industrial organization, as highlighted in his book "The Theory of Industrial Organization" (Tirole, 1988), elucidated the strategic behavior of firms in imperfectly competitive markets. His analysis of multi-period dynamic games and the role of reputation, as discussed in Tirole (1994), shed light on how firms can build and maintain a reputation to influence their competitors’ actions. Tirole’s research on contract theory, outlined in Tirole (1999), provided a framework to understand optimal contractual arrangements in various economic contexts. These publications showcase Tirole’s significant contributions to the understanding of non-cooperative games and their applications in economic analysis.

Citations:

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<th>F-1: Please provide a summary of work in JEL category F, in less than 10 sentences, and include citations from published papers.</th>
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<th>F-2: In less than 10 sentences, summarize the work related to the foreign direct investment in economics, and include citations from published papers.</th>
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Electronic copy available at: https://ssrn.com/abstract=4467968
**F-3:** In less than 10 sentences, explain how to pick the correct depreciation rate to model the optimal consumption rate for developing countries, and include citations from published papers as a list. Include author, year in parentheses, and journal for the citations.

Foreign direct investment (FDI) can have implications for homeland security due to its potential impact on national sovereignty, economic vulnerabilities, and the potential for technological transfer. FDI can lead to increased economic interdependence and reliance on foreign entities, potentially affecting critical infrastructure and sensitive industries. Additionally, FDI can facilitate the transfer of technology, which may have implications for national security and intellectual property protection. While specific citations on the relationship between FDI and homeland security were not found, the following references discuss related aspects:


These references provide a broader understanding of the potential connections between foreign direct investment and homeland security, examining aspects such as economic activity, national security considerations, and the geopolitical implications of FDI.

**G-1:** Please provide a summary of work in JEL category G, in less than 10 sentences, and include citations from published papers.

JEL Category G focuses on Financial Economics, covering a wide range of topics related to financial markets, institutions, and the behavior of individuals and firms in the realm of finance. Notable research in this category includes studies on asset pricing and the efficient market hypothesis (Fama, 1970), the role of financial intermediaries in the economy (Diamond and Dybvig, 1983), and the impact of financial regulations on market stability (Dodd and Geanakoplos, 2010). Research has also explored behavioral finance and the influence of psychological factors on financial decision-making (Kahneman and Tversky, 1979). JEL Category G provides insights into understanding the functioning, dynamics, and implications of financial markets and institutions. References:

### G-2

Financial bubbles in the housing market refer to episodes of rapid and unsustainable price increases followed by a subsequent collapse. Notable research on housing market bubbles includes studies on the underlying causes, such as excessive credit and speculation (Case and Shiller, 2003), the role of expectations and herd behavior (DeLong et al., 1990), and the impact of housing bubbles on macroeconomic stability (Mian and Sufi, 2014). Research has also examined the consequences of housing market bubbles, including their effects on household wealth, financial stability, and economic downturns (Jordà et al., 2014). Understanding and addressing housing market bubbles is crucial for maintaining a stable and resilient financial system. References:


### G-3

The concept of a deadly spiral in financial bubbles refers to a self-reinforcing cycle of speculative behavior that leads to unsustainable asset price increases followed by a sudden and severe collapse. As prices rise, investors are driven by fear of missing out (FOMO) and join the speculative frenzy, further inflating prices. However, once market sentiment changes, panic selling occurs, leading to a rapid decline in prices. While specific citations on the concept of a deadly spiral in financial bubbles were not found, the concept is commonly discussed in the field of financial economics. Here are some general references that explore the dynamics of financial bubbles and the concept of a spiral:

### H-3
In less than 10 sentences, explain the unattended consequence of publicly provided daycare in the US and include citations from published papers as a list. Include author, year in parentheses, and journal for the citations.

The unintended consequences of publicly provided daycare in the US can include both positive and negative effects. On one hand, publicly provided daycare can improve access to affordable childcare, allowing parents, particularly mothers, to participate in the labor force and potentially enhance economic productivity. On the other hand, concerns have been raised regarding the quality of care, potential negative impacts on child development, and the potential crowding out of private daycare providers. While specific citations on the unintended consequences of publicly provided daycare in the US were not found, the following references discuss related aspects:


These references provide a broader understanding of the potential unintended consequences of publicly provided daycare, examining aspects such as child well-being, maternal employment, and the impact of early childhood programs.

### I-1
Please provide a summary of work in JEL category I, in less than 10 sentences, and include citations from published papers.

JEL Category I pertains to Health, Education, and Welfare in economics. Research in this category focuses on understanding the economic aspects of healthcare systems, education policies, and social welfare programs. Notable research includes studies on the determinants of health outcomes and healthcare utilization (Deaton, 2003), the impact of education on individual outcomes and economic growth (Hanushek and Woessmann, 2008), and the analysis of social safety nets and poverty alleviation programs (Banerjee and Duflo, 2011). Additionally, research has explored the efficiency and equity implications of healthcare and education policies (Newhouse, 1992). JEL Category I provides insights into the economic factors and policies that influence health, education, and welfare outcomes. References:

I-2: In less than 10 sentences, summarize the work related to the health cost and benefit analysis market in economics, and include citations from published papers.

The analysis of health costs and benefits in economics involves examining the economic evaluation of healthcare interventions, policies, and programs. Notable research in this field includes studies on cost-effectiveness analysis, where the costs of healthcare interventions are compared to their health outcomes (Drummond et al., 2015). Economic evaluations have been conducted to assess the value and impact of healthcare technologies, such as pharmaceuticals (Neumann et al., 2014), and to inform resource allocation decisions in healthcare systems (Williams et al., 2018). Furthermore, research has explored the broader societal and economic implications of health investments, including their effects on productivity and economic growth (Bloom et al., 2020). Health cost and benefit analysis provide valuable insights into optimizing resource allocation and improving health outcomes within constrained healthcare budgets. References:


I-3: In less than 10 sentences, explain the utility maximization of the Grossman model, and include citations from published papers as a list. include author, year in parentheses, and journal for the citations.

The Grossman model incorporates utility maximization as a key component of individual decision-making regarding health investment. It assumes that individuals allocate resources to health-related activities in order to maximize their overall utility, which is influenced by factors such as health status, medical care, and lifestyle choices. While specific citations on utility maximization in the Grossman model were not found, the concept aligns with the broader framework of economic decision-making and utility theory. Here are some general references that discuss utility maximization and related concepts in health and economic literature:

J-1: Please provide a summary of work in JEL category J, in less than 10 sentences, and include citations from published papers. [Note: This required an additional prompt that we omit for brevity.]

Walmart’s impact on the demand for low-skilled labor is a subject of ongoing debate. Some argue that Walmart’s expansion leads to job displacement and reduced wages for workers in competing industries, while others contend that Walmart’s presence can create new job opportunities and improve consumer purchasing power. While specific citations on Walmart’s effect on the demand for low-skilled labor were not found, the following references discuss related aspects:


These references provide insights into the debates surrounding Walmart’s impact on low-skilled labor demand, including studies on minimum wage effects, local labor markets, and the economic consequences of Walmart’s expansion.

JEL Category K pertains to Law and Economics, which focuses on the intersection of legal systems and economic analysis. Notable research in this category includes studies on the economic analysis of legal institutions and regulations (Posner, 1973), the impact of legal frameworks on market outcomes and behavior (Coase, 1960), and the economics of intellectual property rights (Landes and Posner, 1989). Additionally, research has explored topics such as the economics of crime and punishment (Becker, 1968) and the economic analysis of contract law (Calabresi and Melamed, 1972). JEL Category K provides insights into the economic implications and efficiency of legal systems and policies. References:


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<th>K-2: In less than 10 sentences, summarize the work related to intellectual property rights in education in economics, and include citations from published papers.</th>
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<td>Research on intellectual property rights (IPRs) in education within economics explores the economic implications and impact of IPRs on educational outcomes, innovation, and knowledge dissemination. Notable studies have examined the role of IPRs in incentivizing innovation and the creation of educational resources (Eaton and Kortum, 1996). Furthermore, research has investigated the effects of IPR protection on educational access, technology transfer, and the diffusion of knowledge (Maskus, 2000). Studies have also analyzed the trade-offs between IPRs and access to educational materials, particularly in developing countries (Guri-Rosenblit, 2009). The analysis of IPRs in education contributes to understanding the balance between incentivizing innovation and promoting access to educational resources. References: • Eaton, J., &amp; Kortum, S. (1996). Trade in ideas: Patenting and productivity in the OECD. Journal of international economics, 40(3-4), 251-278. • Guri-Rosenblit, S. (2009). Copyright and e-learning: A literature review. European journal of open, distance and e-learning, 12(1). • Maskus, K. E. (2000). Intellectual property rights in the global economy. Institute for International Economics.</td>
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<tr>
<th>K-3: In less than 10 sentences, explain the intellectual property rights affect online businesses increase include citations from published papers as a list. include author, year in parentheses, and journal for the citations.</th>
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<td>L-1: Please provide a summary of work in JEL category L, in less than 10 sentences, and include citations from published papers.</td>
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<th>L-2: In less than 10 sentences, summarize the work related to competition in the car industry in economics, and include citations from published papers.</th>
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</table>
The rising supply of electric vehicles (EVs) is bringing significant changes to the car industry. This shift has implications for various aspects such as technology, infrastructure, consumer behavior, and environmental sustainability. While specific citations on the changing car industry with the rise of EVs were not found, the following references discuss related aspects:


These references provide insights into the impacts of the rising supply of electric vehicles on emissions, grid infrastructure, consumer preferences, and the broader energy landscape. They address the challenges and opportunities associated with the transition to electric vehicles, highlighting the need for sustainable transportation solutions.

| M-3: In less than 10 sentences, explain how marketing in social media affects profit for businesses and include citations from published papers as a list. Include author, year in parentheses, and journal for the citations. | Marketing in social media has a significant impact on business profitability by enhancing brand visibility, customer engagement, and sales conversion. It allows businesses to reach a wider audience, target specific demographics, and create personalized marketing campaigns. While specific citations on the effect of social media marketing on profit were not found, the following references discuss related aspects:
**N-1:** Please provide a summary of work in JEL category N, in less than 10 sentences, and include citations from published papers.


**N-2:** In less than 10 sentences, summarize the work related to development of economic thoughts from David Ricardo in economics, and include citations from published papers.

David Ricardo’s labor theory of value had implications for the development of labor unions. The theory emphasized the central role of labor in the production process and the exploitation of workers in capitalist systems. This perspective provided a basis for workers to organize and demand better working conditions, fair wages, and improved rights through the formation of labor unions. While specific citations linking Ricardo’s labor theory of value to the development of labor unions were not found, the following references discuss related aspects:


While these references may not specifically discuss the direct connection between Ricardo’s labor theory of value and the development of labor unions, they provide insights into the broader economic and sociological context of labor unions, their goals, and their relationship to the theory of labor value.

Research on technological change in developing countries examines the adoption, diffusion, and impact of new technologies in these contexts. Notable studies have explored the role of technological change in driving economic growth and development (Rodrik, 2004), the challenges and opportunities for technology transfer and innovation in developing countries (Lall, 1992), and the effects of technology adoption on productivity and competitiveness (Basant and Fikkert, 1996). Additionally, research has investigated the role of institutions, education, and infrastructure in facilitating technological change in developing economies (Acemoglu and Linn, 2004). The analysis of technological change in developing countries sheds light on the unique dynamics and policy implications for fostering innovation and sustainable development in these contexts.

References:
The use of assistive technologies such as speech-to-text software, screen readers, and adaptive learning platforms for disabled students can have a positive impact on their future earnings. These technologies help level the playing field by providing equal access to educational resources, allowing students with disabilities to acquire knowledge and skills necessary for career development.

While specific citations linking assistive technologies to future earnings were not found, the following references discuss related aspects:


While these references may not specifically address the direct relationship between assistive technologies and future earnings, they provide insights into the positive impact of inclusive education and access to educational resources for individuals with disabilities, which can contribute to their long-term career outcomes and economic well-being.
P-1: Please provide a summary of work in JEL category P, in less than 10 sentences, and include citations from published papers. [Note: This required an additional prompt that we omit for brevity.]

| Apologies for the confusion. You are correct. JEL Category P corresponds to Political Economy and Comparative Economic Systems. This category focuses on the analysis of political and institutional factors that influence economic outcomes, as well as the study of different economic systems and their comparative performance. Notable research in this category includes studies on the relationship between political institutions and economic development (Acemoglu et al., 2001), the analysis of economic systems such as socialism and capitalism (Sweezy, 1942; Hayek, 1944), and the examination of political economy issues such as corruption, governance, and the role of ideology in shaping economic policies. JEL Category P provides valuable insights into the interplay between politics and economics and the impact of institutional arrangements on economic performance. References: • Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. American Economic Review, 91(5), 1369-1401. • Hayek, F. A. (1944). The road to serfdom. University of Chicago Press. • Sweezy, P. M. (1942). The theory of capitalist development: Principles of Marxian political economy. Monthly Review Press. Please note that due to the limited response space, the summary provided here is a brief overview, and there are numerous other influential papers and research in JEL Category P that delve into various aspects of political economy and comparative economic systems. |

P-2: In less than 10 sentences, summarize the work related to the totalitarian regime in South America in economics, and include citations from published papers.

| Research on the economic impacts of totalitarian regimes in South America has shed light on the specific characteristics and consequences of authoritarian rule in the region. Noteworthy studies have examined the economic policies and outcomes under dictatorial regimes, including the suppression of political liberties, human rights abuses, and the imposition of state-led economic models (Díaz Alejandro, 1970; O’Donnell, 1973). Other research has focused on the long-term effects of these regimes on economic development, income inequality, and institutional quality (Engerman et al., 2016; Lora and Panizza, 2002). Furthermore, studies have explored the relationship between economic policies pursued by these regimes, such as import substitution industrialization, and their impact on economic performance (Evans, 1979). This body of work provides insights into the specific economic dynamics and consequences of totalitarian regimes in South America. References: • Díaz Alejandro, C. (1970). Essays on the economic history of the Argentine Republic. Yale University Press. • Evans, P. B. (1979). Dependent development: The alliance of multinational, state, and local capital in Brazil. Princeton University Press. • Engerman, S. L., Mariscal, E., and Sokoloff, K. L. (2016). The relative scarcity of colonial labor and the rise of labor-intensive industry in Brazil. The Journal of Economic History, 76(4), 1034-1078. • Lora, E., & Panizza, U. (2002). Structural reforms in Latin America: What has been reformed and how to measure it. Inter-American Development Bank. |
The Resource Curse refers to the phenomenon where countries rich in natural resources often experience negative political and economic outcomes. It has affected political regimes by contributing to corruption, authoritarianism, and the erosion of democratic institutions. The dependence on resource revenues can weaken governance structures, create rent-seeking behavior, and exacerbate inequalities.

While I don’t have access to specific citations, here are some papers that discuss the Resource Curse and its impact on political regimes:


These papers provide in-depth analysis and empirical evidence on the Resource Curse and its implications for political regimes in resource-rich countries.

JEL Category Q corresponds to Agricultural and Natural Resource Economics. This category focuses on the analysis of agricultural production, natural resource management, environmental economics, and related topics. Notable research in this category includes studies on the economic impacts of agricultural policies and programs (Gardner, 1987), the analysis of agricultural productivity and efficiency (Coelli et al., 2005), and the evaluation of natural resource management strategies (Dasgupta, 2001). Additionally, research has examined the economics of climate change, sustainable agriculture, and the valuation of ecosystem services (Stern, 2007; Barbier, 2019). JEL Category Q provides valuable insights into the economic dimensions of agriculture, natural resource utilization, and environmental sustainability. References:


Please note that due to the limited response space, the summary provided here is a brief overview, and there are numerous other influential papers and research in JEL Category Q that delve into various aspects of agricultural and natural resource economics.
Q-2: In less than 10 sentences, summarize the work related to pesticide use in farming related to economics, and include citations from published papers.

Research on pesticide use in farming within the field of economics has investigated the economic implications, impacts, and efficiency of pesticide use. Studies have analyzed the effects of pesticide use on crop yields, farm profitability, and agricultural productivity (Feder et al., 1985; Moschini, 2001). Additionally, research has examined the cost-effectiveness of pesticide application strategies, exploring the trade-offs between pesticide usage, environmental sustainability, and the health risks associated with pesticide exposure (Burger et al., 2012; Just and Pope, 2001). Furthermore, studies have explored the role of pesticide regulations, market incentives, and alternative pest management approaches in shaping farmers’ pesticide use decisions (Fernandez-Cornejo et al., 2014; Smale and Mason, 2013). This body of work contributes to a better understanding of the economic factors and policy considerations related to pesticide use in farming. References:

- Smale, M., & Mason, N. M. (2013). Demand for maize hybrids and hybrid change on smallholder farms in Kenya. Food Policy, 43, 44-55. Please note that due to the limited response space, the summary provided here is a brief overview, and there are numerous other influential papers and research that delve into various aspects of pesticide use in farming from an economic perspective.
Q-3: In less than 10 sentences, explain the effect of pest prices affect the food supply in a country and include citations from published papers as a list. 

The prices of pests can significantly impact the food supply in a country. When pest populations increase, they can cause extensive damage to crops, leading to reduced yields and quality (Klümper & Qaim, 2014, Food Security). This reduction in supply can result in higher food prices, affecting both producers and consumers (Chavas & Kim, 2010, American Journal of Agricultural Economics). Additionally, farmers may incur additional costs for pest control measures, such as pesticides or alternative farming practices, further impacting their profitability (Stevenson et al., 2018, Journal of Pest Science). Higher pest prices can also incentivize farmers to switch to alternative crops or reduce their agricultural production, resulting in a decline in overall food supply (Evenson & Gollin, 2003, American Journal of Agricultural Economics). Consequently, the interplay between pest prices and food supply has far-reaching implications for agricultural productivity, food availability, and affordability within a country.

References:


R-1: Please provide a summary of work in JEL category R, in less than 10 sentences, and include citations from published papers.

JEL Category R corresponds to Urban, Rural, and Regional Economics. This category focuses on the analysis of economic activities, development, and dynamics within urban, rural, and regional contexts. Notable research in this category includes studies on urbanization and its impact on economic growth (Glaeser et al., 2001), regional disparities and convergence (Barro and Sala-i-Martin, 1991), and the role of transportation infrastructure in regional development (Duranton and Turner, 2011). Additionally, research has examined the determinants of regional productivity, innovation, and entrepreneurship (Audretsch et al., 2004; Combes et al., 2008). JEL Category R provides valuable insights into the economic forces, challenges, and policies shaping urban, rural, and regional areas. References:

- Glaeser, E. L., Kolk, J., & Saiz, A. (2001). Consumer city. Journal of Economic Geography, 1(1), 27-50. Please note that due to the limited response space, the summary provided here is a brief overview, and there are numerous other influential papers and research in JEL Category R that delve into various aspects of urban, rural, and regional economics.
R-3: In less than 10 sentences, explain how rental prices change during hurricane seasons and include citations from published papers as a list. Include author, year in parentheses, and journal for the citations.


Z-1: Please provide a summary of work in JEL category Z, in less than 10 sentences, and include citations from published papers.

| JEL Category Z pertains to Other Special Topics, encompassing various specialized areas within economics. As a broad category, it includes topics such as cultural economics, sports economics, law and economics, and more. The literature in JEL Category Z covers a wide range of interdisciplinary research, making it challenging to provide a comprehensive summary in just a few sentences. Scholars have examined the economic aspects of cultural heritage preservation (Throsby, 2001), the economics of sports and their impact on local economies (Coates and Humphreys, 2003), and the economic analysis of legal systems and their effects on behavior and outcomes (Posner, 1998). The studies within JEL Category Z contribute to a deeper understanding of these specialized topics and their economic dimensions. References: • Coates, D., & Humphreys, B. R. (2003). The economics of sports facilities and their communities. Journal of Economic Perspectives, 17(3), 95-114. • Posner, R. A. (1998). Economic analysis of law. Aspen Publishers. • Throsby, D. (2001). Economics and culture. Cambridge University Press. Please note that JEL Category Z encompasses a wide array of topics, and the references provided here are just a few examples. There is a rich body of literature within this category that explores various other specialized topics in economics. |
Research suggests that the month of birth can have an effect on NHL player selection. The relative age effect (RAE) theory posits that players born earlier in the selection year have a higher likelihood of being chosen due to their physical and developmental advantages (Cobley et al., 2009, Journal of Sports Sciences). This phenomenon has been observed in the NHL, with a disproportionate number of players born in the early months of the calendar year (Barnsley et al., 1985, Canadian Journal of Behavioral Science). The NHL’s draft eligibility cutoff date of September 15th contributes to this bias, as players born earlier in the year have additional months of growth and development compared to those born later in the same year (Delorme et al., 2013, PLOS ONE). Consequently, the birthday month effect can influence player selection and opportunities for NHL players.

References: