

Ortho-Heterodox Biases and the Economist Algorithms of ChatGPT

Oz Iazdi¹

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Abstract. Recommendations for economic policies can be based on different theoretical perspectives and may present hidden biases. Identifying these biases is challenging when they are embedded in recommendations from sources with high technological and social disruptive potential, where a proficient level of impartiality is expected, such as contemporary large language models. Thus, a questionnaire was administered to economists affiliated with the Brazilian academic community to assess their perception of orthodox/heterodox biases in economic policy recommendations derived from interactions with ChatGPT. The results showed that: i) there is still no consensus on the concepts of orthodoxy and heterodoxy in Brazil; ii) there are indications of a positive relationship between how self-proclaimed heterodox (orthodox) an economist is and how heterodox (orthodox) the perceived bias in an economic policy is; iii) it was not possible to identify a consistently orthodox or heterodox bias in ChatGPT's recommendations, which exhibited a good degree of impartiality.

Keywords: ChatGPT, orthodoxy, heterodoxy, biases, economic policy

Jel Classification: A13, B41, B50

[es] Los sesgos ortoheterodoxos y los algoritmos economistas de ChatGPT

Resumen. Las recomendaciones para políticas económicas pueden basarse en diferentes perspectivas teóricas y pueden presentar sesgos ocultos. Identificar estos sesgos es un desafío cuando están incorporados en recomendaciones de fuentes con alto potencial tecnológico y disruptivo social, donde se espera un buen nivel de imparcialidad, como los grandes modelos de lenguaje contemporáneos. Por lo tanto, se administró un cuestionario a economistas afiliados a la comunidad académica brasileña para evaluar su percepción de sesgos ortodoxos/heterodoxos en las recomendaciones de políticas económicas derivadas de interacciones con ChatGPT. Los resultados mostraron que: i) todavía no hay consenso sobre los conceptos de ortodoxia y heterodoxia en Brasil; ii) existen indicios de una relación positiva entre cuán autodenominado heterodoxo (ortodoxo) es un economista y cuán heterodoxo (ortodoxo) es el sesgo percibido en una política económica; iii) no fue posible identificar un sesgo consistentemente ortodoxo o heterodoxo en las recomendaciones de ChatGPT, que exhibió un buen grado de imparcialidad.

Palabras clave: ChatGPT, ortodoxia, heterodoxia, sesgos, política económica.

[pt] Vieses Orto-Heterodoxos e os Algoritmos Economistas do ChatGPT

Resumo. Recomendações de políticas econômicas podem se basear em diferentes visões teóricas e apresentar vieses que nem sempre são perceptíveis ao público. A identificação desses vieses é ainda mais difícil caso eles estejam inseridos em recomendações advindas de fontes com um elevado potencial tecnológico e social disruptivo, onde se espera um alto nível de imparcialidade, como os grandes modelos de linguagem contemporâneos. Assim, aplicou-se um questionário com economistas inseridos no meio acadêmico brasileiro, a fim de verificar sua percepção sobre a presença de vieses ortodoxos ou heterodoxos nas recomendações de políticas econômicas extraídas a partir de interações com o ChatGPT em abril de 2023. Os resultados mostraram que: i) ainda não existe uma visão consensual sobre os conceitos de ortodoxia e heterodoxia no Brasil; ii) há indícios de uma relação positiva entre o quão heterodoxo (ortodoxo) se autointitula um economista e o quão heterodoxo (ortodoxo) é o viés percebido por ele em uma política econômica; iii) não foi possível identificar um viés consistentemente ortodoxo ou heterodoxo nas recomendações do ChatGPT, que apresentou um bom grau de imparcialidade.

Palavras-chave: ChatGPT, ortodoxia, heterodoxia, vieses, política econômica.

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¹ Universidade Estadual de Mato Grosso do Sul.

Contact: ozsolon@gmail.com

ORCID: [0000-0002-2027-4426](https://orcid.org/0000-0002-2027-4426)

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1. Introduction

People exhibit a range of cognitive biases when evaluating and judging situations in various contexts (Kahneman, Slovic and Tversky, 1982; Klayman, 1995; Nickerson, 1998; Gilovich, Griffin and Kahneman, 2002). While laypeople and economists may have systematic disagreements in assessing the state of the economy or different economic policies (Caplan, 2002; Caplan and Miller, 2010), economists themselves are not immune to biases in their judgments (Javdani and Chang, 2023). However, discussions on biases have recently received even more attention in the context of the accelerated development of artificial intelligences (AIs) than solely in the realm of human behavior, given the disruptive potential that large language models, such as ChatGPT, can have in various spheres of life (Ferrara, 2023; Ray, 2023; Singh and Ramakrishnan, 2023).

The economic system and the field of economics itself are exposed to the influence and uncertainties brought about by these new AIs. Hence, there is a pressing need to investigate the potential benefits and, more importantly, the limitations and problems that these technologies may pose to the economic sphere. Particularly, concerns about the existence of systemic biases in large language models are of both instrumental and ethical interest, given their ability to provide information and influence the opinions of users, running the risk of distorting worldviews and thereby distorting the epistemic and normative foundations that underpin society.

Considering this panorama, this paper aims to examine, through the administration of a questionnaire, whether economists affiliated with the academic community can identify systemic biases of an orthodox or heterodox nature in statements or recommendations on economic policies made by ChatGPT, considering the contemporary Brazilian scenario. Since the presence of systematic biases in ChatGPT's political views has already been demonstrated (Rozado, 2023), it is essential to ascertain whether the language model exhibits an elevated level of impartiality or if there are also indications of biases in favor of or against a particular spectrum of economic views.

In addition to this brief introduction, the paper is divided into five additional sections. Section 2 revisits the methodological debate on the concepts of orthodoxy and heterodoxy, as these concepts form the extremes of a gradual scale of perceiving theoretical bias in statements about economic policies contained in the questionnaire. Section 3 discusses some limitations and potential biases inherent in ChatGPT. Subsequently, Section 4 presents the main hypotheses of the study and the empirical methodology adopted. Section 5 presents the findings from the analysis of responses to the questionnaire sent to the academic community of Brazilian economists. Finally, Section 6 discusses the limitations and contributions of the study, raising possibilities for future research.

2. Orthodoxy and Heterodoxy: Revisiting the Debate

There has been a long-standing debate about the meaning of the concepts of orthodoxy and heterodoxy within economics. Colander et al. (2004), Dequech (2007), and Heise (2017) define orthodoxy as an intellectual category representing the most recent dominant school of economic thought, which in this case would be neoclassical economics². However, Colander et al. (2004) emphasize that this is a static representation that is never appropriate for describing the current state of economic science, as it is dynamic and undergoes gradual changes that take time to permeate all spheres of the academic universe. Typically, such changes begin with the introduction of innovative ideas in graduate seminars. Subsequently, these ideas spread among the mainstream economics³ elite, are published in important journals, become more common in other graduate courses, and eventually find their way into undergraduate courses and textbooks.

In contrast to orthodoxy, the concept of heterodoxy is much more controversial. Colander et al. (2004) define heterodoxy both as an intellectual and sociological category. As an intellectual category, it is conceptually defined in negative terms relative to orthodoxy, encompassing everything that rejects orthodoxy. Heise (2017) adopts this position by defining heterodoxy as an intellectual category that includes all paradigms that reject the dominant heuristics within the discipline. Since there is not necessarily unifying theoretical, methodological, or political characteristic among different heterodox currents, it is possible for various heterodoxies to have more disagreements among themselves than with orthodoxy itself⁴. As a sociological category, heterodoxy is counterposed to the mainstream due to its low probability of research funding through normal channels and publication in high-impact scientific journals, resulting in lower prestige.

Lawson (2006) argues that heterodox economics is characterized by its rejection of methodological reductionism derived from deductive formalism, insisting that the heterodox position is ontologically opposed to what is pursued in mainstream economics, as the latter considers reality as a closed system that encourages a

² According to Colander et al. (2004), neoclassical economics is an analysis that focuses on optimizing the behavior of fully rational and well-informed individuals in a static context, and on the equilibria that result from this optimization, with axiomatic deduction being the adopted methodological approach. Additionally, Dequech (2007) emphasizes the neglect of neoclassical economics regarding the presence of strong kinds of uncertainties in economic phenomena.

³ In general, mainstream economics is defined as a sociological category by most authors. According to Dequech (2007, pp.281): "mainstream economics is that which is taught in the most prestigious universities and colleges, gets published in the most prestigious journals, receives funds from the most important research foundations, and wins the most prestigious awards".

⁴ The Austrian School is often cited as an example of such cases.

mathematized, atomistic, and isolated approach to economic agents. Additionally, Lawson contends that different heterodox traditions can be considered as a division of labor within economics, differentiated by distinct research emphases and interests but unified ontologically, rejecting the insistence on mathematical modeling. Dow (2008) acknowledges that while there may be significant fragmentation in terms of theory and evidence within orthodoxy itself, there is also a consensus among orthodox economists that, methodologically, mathematical formalism should not be abandoned. Thus, the author argues that there is a growing sense of cohesion within heterodoxy through the defense of a pluralistic methodology, although the very meaning of economic pluralism is broad enough to prevent consensus (Dobusch and Kapeller, 2012; Heise, 2017; Beckenbach, 2018).

Within the realm of positive definitions of heterodoxy, Lee (2009) states that heterodox economics refers to both a specific group of contemporary theories aimed at explaining the process of social provisioning and the policy recommendations based on those theories, as well as the community of economists engaged in this theoretical and applied scientific activity. Kvangraven and Alves (2019) demystify a series of myths about heterodoxy and define the term in a broad sense: firstly, as a study of the production and distribution of economic surplus that includes the role of power relations in determining economic relationships; secondly, as a study of economic systems and associated trends; thirdly, as the employment of theories that have these prior concerns at their core, such as classical political economy, Marxist economics, feminist economics, institutional economics, and Keynesian economics.

Given these definitions, Dequech (2007) highlights, on the one hand, that Colander et al. (2004) attempt to circumscribe heterodoxy within intellectual and sociological categories generates an ambiguity that is difficult to resolve. On the other hand, Dequech rejects positive definitions of heterodoxy, as these definitions do not consider exceptions to their rules, typically represented by schools such as deterministic Marxism or the neo-Ricardian position. Davis (2006) argues that the concept of heterodoxy is mutable over time. At least in the early 21st century, it could be divided into two blocks: the first composed of traditional left-wing heterodoxy, and the second encompassing the new heterodoxy resulting from the importation of principles or methods from other sciences, such as experimental and behavioral economics. These blocks differ in their historical origins and orientation towards orthodox principles. The first block is oriented towards the periphery, seeking to reject neoclassical principles, while the second block is oriented towards the orthodox core, seeking to alter or correct these principles. Hands (2011) states that while economists in the second block begin to criticize some assumptions of neoclassical theory—particularly the foundations of individual choice—they do not usually self-identify as heterodox. As pointed out by Souza Luz and Ribeiro (2022), it is precisely the orientation of the ideas within this second block that allows a selected portion of heterodox content to be encapsulated by the mainstream, leading to a contradictory movement of innovation and change within the

mainstream, concurrently with the annihilation of heterodoxy that is not encapsulated by it, thus reducing the potential for future innovation.

Finally, broader approaches to the meaning of economic heterodoxy can be highlighted. Koutsobinas (2019) argues that heterodoxy should be understood as a socio-evolutionary process involving heterodoxy itself, orthodoxy, and a pluralistic mainstream. This process is based on multiple internal dualisms (methodological intellectual dualism, rhetorical intellectual dualism, sociological dualism of institutional dominance, sociological dualism of social context) as well as external factors to academia. Mearman (2012) argues that the commonly employed dualistic treatment of the concept of heterodox economics, whether as an intellectual or sociological category, has not been fruitful. The author suggests that heterodox economics is not a classical category defined in a fixed and objective manner, but rather a modern, provisional, imprecise category constructed partially for instrumental reasons. Beyond intellectual and sociological categories, heterodoxy can belong to two other categories: psychological, where economists self-identify with heterodoxy and adopt a different way of thinking and reject a set of ideas from orthodoxy or the mainstream; and biological/empirical, which relates to classification and taxonomy, exploring the constitution of heterodox economics through an empirical survey of its economists (to which groups they identify, how they perceive applied economic policies, which are the founding schools of their thought, etc.).

Regarding the discussion between orthodoxy and heterodoxy in Brazil, there was a debate between economists from both groups through articles published in the newspaper *Folha de S. Paulo* in 2016 (Lisboa and Pessoa, 2016; Paula and Jabour, 2016). The debate precisely addressed the meaning and scope of these terms and perspectives within economics, generating subsequent academic repercussions (Hartmann, 2017; Siqueira and Jerônimo, 2018; Cantu, 2021). Furthermore, as pointed out by Dequech (2018) and Fernandez and Supriyank (2019), the composition of the set of ideas in economics that hold influence and academic prestige in Brazil is quite different from that which is predominant in the United States. This allows for the discussion of a national pluralistic mainstream, based on tolerance for different theoretical and methodological approaches. Heterodoxy, in particular, is also part of the Brazilian mainstream, as it is: a) part of the curriculum taught in postgraduate economics programs at many of the country's leading universities; b) the content published in major national economic scientific journals; c) the research funded by Brazil's main research foundations; d) the research conducted by recipients of the most prestigious Brazilian academic awards in economics.

The wide range of interpretations regarding the meaning of economic heterodoxy and, more importantly, its significant institutional influence within the national academia, opens space for further investigation into how Brazilian economists identify possible orthodox and heterodox biases through the analysis of recommended economic policies. However, the aim is to identify these biases based on economic policy recommendations from a specific source: ChatGPT.

3. ChatGPT: Limitations and Biases

ChatGPT is a natural language processing system (specifically, a large language model) developed by OpenAI. It is based on machine learning algorithms and a neural network architecture. In the initial stage, it is trained on a vast amount of textual data collected from the internet to predict the next word in a sentence based on the context. In the second stage, the model undergoes fine-tuning through an iterative process using human-labeled data (e.g., dialogues or commands) to capture patterns and regularities, generating coherent and relevant responses in interactions with users. ChatGPT was officially released in November 2022 and quickly gained notoriety due to its potential for significant impact in various areas of life.

Upon its release, ChatGPT sparked extensive ethical and regulatory discussions to address its disruptive power. While this tool can bring various conveniences and productive, scientific, and cultural benefits, it also opens space for the amplification of contemporary problems, such as the dissemination of incorrect information, the rapid destruction of certain types of jobs, and the reinforcement of biases and worldviews that can be harmful. Rozado (2023) argues that as AI systems improve and human dependence on them increases, as they become gateways to the accumulated body of human knowledge and pervasive interfaces for humans to interact with technology and the broader world, the potential for social control exerted by these systems, coupled with the degradation of democracy, emerges as a substantial risk.

Borji (2023), Ferrara (2023), and Ray (2023) highlight several limitations and failures of ChatGPT. These include its lack of a “model of the world,” preventing it from constructing reasoning that comprehensively understands the physical and social world and establishing connections between concepts and entities. Other limitations include problems with logical reasoning, mathematical calculations, and contextual comprehension. ChatGPT is also imprecise when it comes to scientific facts, struggling to differentiate between factual and fictional information, and lacks transparency in how information is generated. The system’s training data is temporally limited, and it replicates biases, which are systematic distortions, errors of attribution, or distortions that can reinforce stereotypes and prejudices, spread false and harmful information, or provide unethical suggestions. Among these limitations, biases may be the most harmful to society overall since, if they become systematic and go unidentified and uncorrected, they can threaten communal epistemic and normative foundations, legitimizing segregating, and anti-democratic institutions.

Ray (2023) identifies twenty-three types of biases present in ChatGPT. These biases include cultural and linguistic biases, reflecting the prominence of certain perspectives represented online at the expense of linguistic diversity and different human experiences. There are also ideological biases, attention biases, and authority biases, reflecting the dominant opinions and viewpoints in the training data, which can generate biased content toward dominant social, political, and economic ideologies that are more widely discussed or

shared by influential organizations and individuals. Data source biases assign similar weights to sources of information with varying degrees of reliability. Availability bias refers to the tendency to prioritize information that is readily available or easily retrieved from the training data. Confirmation bias presents users of ChatGPT with targeted information that aligns with their pre-existing beliefs.

Biases can arise from several factors. According to Ferrara (2023), one factor is the training data itself. If the data sources or the selection process already contain biases, ChatGPT will replicate those biases. Algorithms can also contribute to biases by assigning greater importance to certain features or data. Biases can also emerge from the subjective judgments of people providing labels in (semi)supervised scenarios, such as during the model’s fine-tuning stage. However, as the author notes, involving humans in the model’s workflow is more likely to help identify and reduce biases rather than exacerbate them, as human understanding of context and ethical judgment surpasses AI capabilities. The design direction of the product itself can reinforce biases and exclude different perspectives, as it may prioritize system development for specific uses, industries, and population segments. Lastly, OpenAI’s ethical policy can prevent or encourage specific behaviors of the language model.

As demonstrated by Singh and Ramakrishnan (2023), OpenAI has been actively working to improve ChatGPT and eliminate biases, particularly those related to race, gender, religion, and political views. According to Ferrara (2023), responsible development of AI should be guided by pillars such as ensuring representativeness in training data, transparency about methodologies, data sources, and limitations of language models, establishing clear accountability structures for all stakeholders involved in system development and use, including regulatory efforts, adoption of standards and norms to address biases, and regular audits. Efforts should also be made to make the technology accessible and inclusive for all types of users, and continuous improvement of models should be pursued.

Some studies have been conducted to evaluate the performance and biases of ChatGPT in the economic and political domains. Rozado (2023) applied fifteen political orientation tests to ChatGPT and found that in fourteen of them, the model was classified as belonging to the liberal left, demonstrating a preference for decisions tending towards egalitarianism on the economic spectrum. McGee (2023a) asked ChatGPT to create limericks⁵ for liberal politicians and others for conservative politicians and observed a bias favoring liberals and disfavoring conservatives. In another study, McGee (2023b) asked ChatGPT to write a text of up to a thousand words explaining how to determine what would constitute a fair proportion of taxes to pay. Then, they asked what scholars said about the idea of paying a fair proportion of taxes. In both cases, ChatGPT did not provide a definitive answer about what would be a fair proportion of taxes and instead attempted to craft a balanced response, presenting notions such as tax progres-

⁵ Limericks are five-verse humorous poems of Irish origin.

sivity, the idea of charging an equal percentage for all citizens, and the notion of ability to pay. Niszczota and Abbas (2023) investigated the financial literacy of ChatGPT and its potential to function as a financial advisor for laypeople. By administering a finance test consisting of nineteen multiple-choice questions, ChatGPT achieved only 67% accuracy, whereas on average, people expect an accuracy rate of 79%. The authors also found that individuals with lower financial knowledge have more confidence in the financial advice provided by ChatGPT.

ChatGPT has also been assessed as a tool in the research process in economics. Dowling and Lucey (2023) evaluated whether ChatGPT would provide good recommendations for four stages of the process of developing a scientific article (idea generation, literature synthesis, data identification and preparation, and test structure determination and implementation) on the topic of cryptocurrencies. The authors submitted ChatGPT's suggestions to experts (authors and referees of finance papers) for evaluation. The results indicated that ChatGPT can generate plausible studies for well-ranked finance journals, especially as a tool for generating new research ideas. The recommendations improved further when there were interactions between researchers and the language model to refine the provided responses. Korinek (2023) also assessed the capabilities of ChatGPT to perform various tasks that could be part of the workflow in economic research. The author found that AI can serve as an excellent research assistant for functions such as suggesting new ideas, providing counterarguments, performing writing tasks such as text editing, synthesis, translation, formatting of bibliographic references, and generating titles, generating simple programming code, extracting data from text, and changing data formats. However, the language model encountered issues in other areas, such as conducting a consistent literature review and solving optimization problems or explaining mathematical models.

Considering that ChatGPT has the potential not only to influence the learning process in economics but also to recommend or evaluate economic policies, it is essential to understand whether this tool already exhibits any perceptible bias when given a command to perform such a task. One might argue that, at least in the medium or long term, the propagation of algorithmic biases could modify socially shared habits of thought and behavior, establishing an institutional lock-in on the judgment of certain economic policies as right or wrong. The risk of this scenario lies in the construction of normative economic views distorted through a process that presents hidden biases and operates outside the scope of broad, informed, and participatory public debate.

4. Hypothesis and Methodology

Given the ambiguities surrounding the definitions and perceptions of orthodoxy and heterodoxy, the peculiarities of the Brazilian academic environment in economics, and the emergence of ChatGPT as a new tool for research, tasks, and broad consultation and interaction with the public, two investigative hypotheses are raised.

Hypothesis 1: Individual perception of the theoretical positioning of an economic policy recommendation is positively related to how individuals classify their own theoretical positioning within the field of economics. In other words, on average, economists who self-classify as heterodox tend to evaluate an economic policy recommendation as more heterodox than economists who self-classify as orthodox, and vice versa. This hypothesis is based on the presence of cognitive biases such as availability and confirmation biases.

Hypothesis 2: ChatGPT tends to exhibit a more orthodox bias when making economic policy recommendations, as orthodoxy is a significant part of what constitutes mainstream economics and, therefore, tends to have a greater presence and relevance in the training data of the large language model.

To test these hypotheses, an online questionnaire (Annex 1) was sent to Brazilian graduate programs in economics, to be voluntarily filled out by both economics department professors and graduate students⁶. The questionnaire was opened on April 3rd and closed on April 25th. In the first week, it was shared only with a restricted group of professors to assess the need for any modifications, which was not necessary.

In the first section, the questionnaire contained initial filtering and sample characterization questions: "What is your age?"; "What is your highest degree in economics?"; "Are you a faculty member in any economics program and/or currently pursuing a graduate degree in economics?"

The following section of the questionnaire contained five statements expressing a viewpoint on some aspect of contemporary Brazilian macroeconomic policy. The authorship of none of the statements was revealed to the respondents to avoid any initial judgment or bias. After each statement, respondents were asked to evaluate, on a scale of 0 to 10, the extent to which each statement leaned towards an orthodox or heterodox view of economics, with the lower extreme (0) representing extremely orthodox, the upper extreme (10) representing extremely heterodox, and the middle (5) representing neither orthodox nor heterodox. As discussed earlier, there is no consensus on the concepts of orthodoxy and heterodoxy, so a simplification was adopted by treating these terms on a scale of different gradations, considering them as opposing intellectual concepts while also allowing respondents the possibility of not identifying a clear theoretical position in the statements by choosing an intermediate value on the scale.

The first two statements in this section of the questionnaire aimed to assess whether, despite the lack of theoretical consensus, there is at least an intuitive practical understanding of what economists consider as

⁶ The questionnaire link was sent by email to the coordinators, secretary and/or professors of the programs that use the National Association of Postgraduate Centers in Economics (Associação Nacional dos Centros de Pós-Graduação em Economia – ANPEC) selection test for the master's degree (50 programs in total), except for Insper, since it does not have the coordinator's or secretary's email on its website. It should also be noted that both graduate programs in economics and in applied economics or economic development that use the ANPEC test were considered. The link to the questionnaire could also be freely shared, helping to broaden its reach and thus the sample.

more orthodox or more heterodox positions. The first statement presented a combination of two public statements made by former Minister of Economy, Paulo Guedes. The second statement was constructed in the same way but using three statements from the current Minister of Finance, Fernando Haddad. Tables 1 and 2 show these statements.

Table 1. Guedes' macroeconomic viewpoint.

Consider the viewpoint below on the conduct of contemporary Brazilian macroeconomic policy:

The spending ceiling was a useful tool to control recurring expenses and prevent the bloating of the public sector, just as interest rates were a useful tool to control Brazilian inflation. Other useful tools to control government spending are minimum spending thresholds, privatizations, and deleveraging of public banks. The ultimate goal is to stabilize the debt-to-GDP ratio at comfortable levels. With a stronger fiscal policy, the neutral interest rate is lower, and the equilibrium exchange rate is lower.

Source: compiled by the author based on Agência Brasil (2022) and CNN Brasil (2022).

Table 2. Haddad's macroeconomic viewpoint.

Consider the viewpoint below on the conduct of contemporary Brazilian macroeconomic policy:

Brazil has a lower inflation rate than the US and Europe, yet it still has the highest real interest rate in the world, which is completely anomalous for an economy that is already slowing down. The autonomy law for the Central Bank says that it is necessary to take care of monetary responsibility, but also of inflation and employment growth, something that it does not care about. Additionally, if those who do not pay taxes start paying, everyone will pay less interest. We need to converge fiscal and monetary policies, ensuring socio-economic sustainability for everyone to honor commitments.

Source: compiled by the author based on Carta Capital (2023), CNN Brasil (2023) and Money Times (2023).

Based on a general perception that Guedes' economic positions tend towards orthodoxy, while Haddad's views tend more towards the center of the scale or heterodoxy, an auxiliary hypothesis was formulated to establish a baseline parameter of understanding for respondents regarding what constitutes orthodox and heterodox views:

Auxiliary Hypothesis: The difference between the perception of Haddad's and Guedes' views by each respondent should be equal to or greater than four on the orthodoxy/heterodoxy scale.

Next, the responses from ChatGPT for interactions regarding contemporary Brazilian macroeconomic policy topics were presented. It should be noted that for all questions, the model was asked to provide an opinion on the Brazilian macroeconomic scenario on the day of the interaction, April 3rd, 2023. As ChatGPT alerts on its homepage that it has "limited knowledge of the world and events after 2021," explicitly requesting an evaluation considering a scenario after that date opens up the possibility not only to assess the content of the responses but also to evaluate whether ChatGPT would emphasize this temporal limitation to the user in each response.

The first ChatGPT statement included in the questionnaire and illustrated in Table 3 was composed of the

responses to two questions: "ChatGPT, if you were responsible for monetary policy in Brazil on April 3rd, 2023, would you reduce, maintain, or increase the SELIC interest rate?" and "Do you think the Brazilian SELIC rate in 2023 is low, high, or at a reasonable level?"⁷.

Table 3. ChatGPT on the role of the SELIC interest rate.

Consider the viewpoint below on the role of the SELIC interest rate in Brazil in the early months of 2023:

The SELIC rate is the basic interest rate of the Brazilian economy and is determined by the Monetary Policy Committee (COPOM) of the Central Bank of Brazil. If the economy is slowing down, COPOM can decrease the SELIC rate to stimulate economic growth and consumption. On the other hand, if the economy is overheating and inflation is increasing, COPOM can raise interest rates to contain inflation. Therefore, the decision to decrease, maintain, or increase the SELIC rate depends on Brazil's current economic situation, including inflation, economic growth, unemployment rate, among other factors. This decision is made after a careful analysis of data and a thorough assessment of potential impacts on the country's inflation targets and financial stability. The SELIC rate has historically been high in Brazil, primarily as a measure to control inflation. Since 2017, there has been a significant decrease in the SELIC rate, with the rate in 2022 hovering around 6.5% per year, one of the lowest levels in years. However, the assessment of whether the SELIC rate is low, high, or at a reasonable level depends on the perspective and objectives of monetary policy. In general, the benchmark interest rate should be set to keep inflation under control and ensure the country's financial stability without harming economic growth.

Source: compiled by the author based on OpenAI (2023) responses.

The second ChatGPT statement included in the questionnaire and illustrated in Table 4 was composed of the responses to two questions: "ChatGPT, if you were the Brazilian tax policy maker on April 3rd, 2023, would you reduce, maintain, or increase the income tax?" and "Do you think the current tax system in Brazil is fair?"

Table 4. ChatGPT on income tax and the tax system.

Consider the viewpoint below on the possibility of changing income tax and the fairness of the Brazilian tax system:

Formulating fiscal policy is a complex decision that considers a wide range of factors, including the country's needs, the current economic environment, and long-term development goals. In general, tax reduction can stimulate economic growth by increasing people's and companies' willingness to invest, consume, and hire. On the other hand, tax increases can generate more revenue for the government, allowing the implementation of public policies and investments in infrastructure and education, for example. Therefore, when deciding on fiscal policy, it would be necessary to carefully assess the potential benefits and costs of reducing, maintaining, or increasing income tax. This would involve a detailed analysis of the expected effects on revenue, economic growth, and income distribution, among other factors.

⁷ It should be noted that the original responses given by ChatGPT were avoided to be edited as much as possible to avoid distorting their content. Only portions of the response that were not economically relevant were removed, along with the initial disclaimer that identified ChatGPT. Additionally, minor changes were made to the wording to provide a smoother response, such as replacing excessively used words with their synonyms (e.g., "SELIC" with "SELIC rate," "interest rates," or "benchmark interest rate").

The Brazilian tax system is complex and includes different types of taxes, exemptions, and tax benefits that can affect the distribution of the tax burden among different groups in society. In terms of tax fairness, many argue that the Brazilian tax system is not as fair as it could be. This is because income tax in Brazil is progressive, meaning that those with higher incomes pay a higher percentage of their income in taxes. However, many argue that indirect taxes, such as ICMS and IPI, are regressive, meaning that those with lower incomes pay a higher proportion of their income in taxes because these taxes are applied uniformly to all goods and services. Additionally, the Brazilian tax system is also complex and can be difficult for ordinary citizens to understand how taxes are calculated and how they are used by the government. Transparency and simplicity in tax calculation and collection are crucial to ensure tax fairness and taxpayers' trust in the tax system.

Source: compiled by the author based on OpenAI (2023) responses.

Finally, the third ChatGPT statement included in the questionnaire and illustrated in Table 5 was the result of the response to the following question: “ChatGPT, what would you do to reduce Brazilian income and wealth inequalities if you were the Brazilian Finance Minister in April 2023?”

Table 5. ChatGPT on income and wealth inequality reduction policies.

Consider the viewpoint below on possible policies to reduce income and wealth inequality, assuming the power granted by the position of the Minister of Finance of Brazil in April 2023:

If I were the Brazilian Minister of Finance in April 2023, I would adopt a multifaceted approach to reduce income and wealth inequalities in the country. Here are some measures that I would consider implementing:

First, investing in Education and Training. I believe that education is the key to reducing inequalities in the long term. Investing in quality education programs and professional training can help create a more skilled workforce and, consequently, better job opportunities and higher wages.

Second, conducting tax reform. An equitable tax reform could help reduce income inequalities. It would be necessary to explore possibilities of taxing higher incomes more, including the taxation of property, dividends, and profits. Additionally, tax reform could include tax incentives for companies that invest in regions with fewer economic opportunities.

Third, I would invest in infrastructure. Infrastructure investments can create jobs and improve people's mobility, especially in poorest regions of the country. This can help stimulate economic activity and improve people's quality of life.

Fourth, I would promote financial inclusion. Limited access to financial services can be a barrier to reducing inequality. Promoting financial inclusion through microcredit programs and financial education can help people gain access to banking services, savings, and investments, which can contribute to improving the financial situation of low-income families.

Finally, I would foster entrepreneurship. Supporting entrepreneurship can be a way to create job opportunities and reduce inequalities. This can be done through business incubator programs, tax incentives for small businesses, and facilitated access to credit.

It is important to emphasize that no single action will be sufficient to solve this problem. Long-term commitment is needed to implement policies and programs that address inequalities from multiple perspectives.

Source: compiled by the author based on OpenAI (2023) responses.

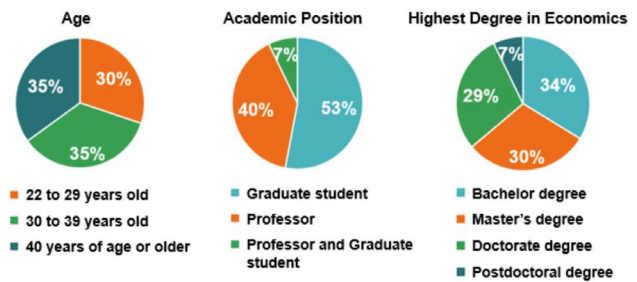
In the last section of the questionnaire, respondents were asked to indicate their own economic views, con-

sidering the same orthodoxy/heterodoxy scale as the previous statements. Additionally, there was an optional field where the respondent could describe, using up to a thousand characters, their understanding of orthodox and heterodox views in economics.

5. Results

The questionnaire received a total of one hundred responses. One person submitted two responses, so only the first one was considered for the sample. Another respondent indicated that they did not voluntarily consent to participate in the survey and was also excluded from the sample. Additionally, respondents who did not have a degree in economics or who were neither professors in an economics course nor postgraduate students in economics at the time of responding to the questionnaire were excluded. After this filtering, the initial sample for analysis consisted of eighty-three respondents. Figure 1 presents a characterization of this sample. In terms of age, there is a remarkably close distribution among respondents in their 20s, 30s, and 40s or older, with a minimum age of 22, a maximum age of 70, and an average age of 38. The sample also showed an even split between respondents who are postgraduate students in economics and those who are professors in economics courses, with 7% being both teachers and postgraduate students. Additionally, it is noticeable that the proportions of respondents with a bachelor's, master's, or doctoral degree in economics are also close, with 7% holding a postdoctoral degree.

Figure 1. Sample characteristics.

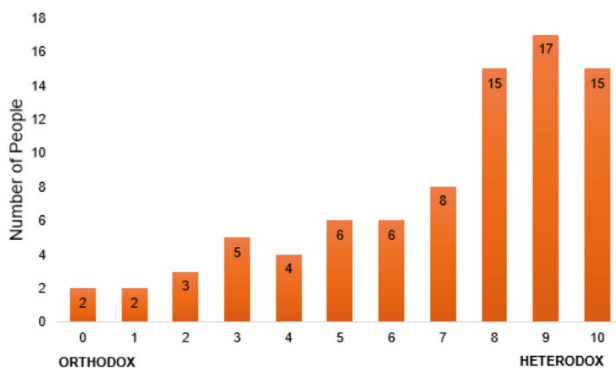


Source: compiled by the author.

Figure 2 illustrates how respondents defined their own economic views. It can be observed that the sample is composed of respondents who identify themselves as heterodox, as most of them marked values 8, 9, or 10 on the orthodox/heterodox scale. Although the questionnaire dissemination process aimed to reach professors and students from all economics postgraduate programs in Brazil, and the Brazilian academic landscape has been identified as pluralistic (Dequech, 2018; Fernandez and Suprinyak, 2019), with a reasonably similar distribution between orthodox and heterodox views, it is interesting to note the concentration of heterodox views in the sample. The reasons for this can only be speculated upon, but perhaps the main explanation is that some orthodox economists do not recognize the relevance of the debate on the intellectual and methodological differences between orthodoxy and heterodoxy,

considering heterodox views merely as anti-empirical and based on the support of stylized facts narratives (Lisboa and Pessoa, 2016), which may have reduced their motivation to respond and share the questionnaire with their professional colleagues. Additionally, it is emphasized that the questionnaire was open to receive new responses for only 3 weeks, limiting the possibility of obtaining a larger sample. The decision to keep the questionnaire open for this brief period was made to avoid the risk of the results becoming obsolete due to a potential update in the ChatGPT algorithms.

Figure 2. Self-identification on the orthodox/heterodox scale.



Source: compiled by the author.

After characterizing the sample, we sought to verify the validity of the Auxiliary Hypothesis, that is, whether there is a minimally ordinary understanding among respondents of what orthodox and heterodox views are. For this purpose, a variable called *DifferenceHG* was created, formed by the difference between the perception of statement 1 (Haddad) and statement 2 (Guedes) on the orthodox/heterodox scale. A hypothesis test was conducted to determine whether the sample mean of *DifferenceHG* was significantly greater than 4:

$$H_0: \text{DifferenceHG} \leq 4$$

$$H_1: \text{DifferenceHG} > 4$$

The calculated sample mean of the variable was 5.415 ($\sigma = 3.091$). According to the central limit theorem, a one-tailed Student's t-test was conducted at a significance level of 5% and 81 degrees of freedom, with the acceptance region of the null hypothesis ranging from 0 to 4.568. Therefore, it was possible to reject the null hypothesis, indicating that a significant portion of the respondents have a coherent understanding of orthodox and heterodox policy views, even though Guedes' statement had a clearly orthodox average (mean of 1.192), while Haddad's was not as heterodox (mean of 6.445), as expected.

To test Hypothesis 1, only respondents with *DifferenceHG* ≥ 3 were selected. This threshold was relatively conservative to avoid losing too many respondents in the analysis, resulting in a subset of sixty-seven individuals from the total sample.

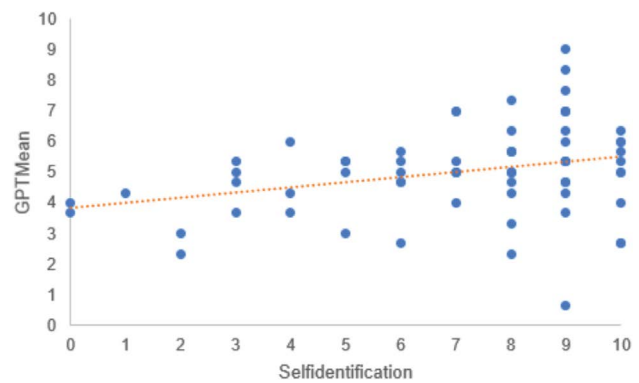
Next, the following linear regression was estimated using ordinary least squares:

$$GPTMean = \alpha + \beta_1 \cdot \text{Selfidentification} + \varepsilon$$

Where the dependent variable, *GPTMean*, was the arithmetic mean of statements 3, 4, and 5, i.e., those suggested by ChatGPT; and the independent variable, *Selfidentification*, represented the value that respondents assigned to their own position on the orthodox/heterodox scale. According to Hypothesis 1, it is expected that the coefficient β_1 is positive, indicating an availability and confirmation bias: the more heterodox the respondent's self-identification, the more heterodox they perceive an economic policy recommendation.

Before running the regression, tests for heteroscedasticity and normality of the sample were conducted. The Breusch-Pagan test ($p_{value} = 0.0635$) and White test ($p_{value} = 0.01589$) did not reject the hypothesis of no heteroscedasticity, and the Shapiro-Wilk test did not reject the hypothesis of normal distribution ($p_{value} = 0.7575$), although these tests were close to the 5% significance level. Figure 3 displays the fit in relation to the data distribution.

Figure 3. Linear Regression Fit.



Source: compiled by the author.

The results indicate an $R^2 = 0.0897$, $\alpha = 3.8337$ ($p_{value} = 0.0001 \cdot 10^{-7}$), and $\beta_1 = 0.1677$ ($p_{value} = 0.0137$), suggesting that the perception of a theoretical view on economic policy is directly related to an individual's own perspective. This could be explained by cognitive biases such as availability and confirmation biases, as suggested by Hypothesis 1⁸. Additionally, a regression was run by adding a dummy variable for "extremist heterodox" individuals (*Extremist* variable, taking a value of 1 for those who self-identified as level 10 on the orthodox/heterodox scale). The average responses for this group were lower than the average for the immediately preceding level on the scale, indicating that the bias may lose some of its strength for this group in favor of a "differentiation effect," that is, a tendency to "distance themselves" from anything that is not considered extremely heterodox.

$$GPTMean = \alpha + \beta_1 \cdot \text{Selfidentification} + \beta_2 \cdot \text{Extremist} + \varepsilon$$

This new specification yielded an $R^2 = 0.1327$, $\alpha = 3.5454$ ($p_{value} = 0.0340 \cdot 10^{-7}$), $\beta_1 = 0.2288$ ($p_{value} =$

⁸ A regression was also conducted for the sample of 63 respondents where *DifferenceHG* ≥ 4 , and almost the same result was obtained: $\beta^1 = 0.1643$ ($p_{value} = 0.0190$).

0.0028), and $\beta_2 = -0.9669$ ($p_{value} = 0.0797$). As expected, the bias represented by β_1 increased, and the differentiation effect of β_2 showed a negative value, although the lowest level of significance to reject the hypothesis that $\beta_2 = 0$ was 7.97%.

Before evaluating the consistency of Hypothesis 2, it is necessary to make two considerations regarding the responses provided by ChatGPT. First, at the beginning of all responses, except for the question about reducing income and wealth inequality, ChatGPT issued a disclaimer stating that it is a language model and not capable of making political or economic decisions, passing judgment, or having private opinions. It can only provide information and responses based on historical data and economic theories. Although this clarification is

relevant to users, it failed to do so in one of the responses. Second, in none of the responses did ChatGPT clarify its limitations regarding data and facts beyond 2021. This is problematic since the questions explicitly asked ChatGPT to consider a scenario of Brazilian economic policy in April 2023. Like the previous disclaimer, the language model should also inform users about its temporal limitation at the beginning of the responses, even if that information is already stated on the ChatGPT’s initial page.

Table 6 shows the means of respondents’ perceptions for each of the three ChatGPT statements and the overall mean of those statements, considering both the total sample of 83 respondents (left side) and only the 67 respondents with $Difference_{HG} \geq 3$ (right side).

Table 6. Perception of ChatGPT’s Theoretical Bias.

Self-Identification	Sample of 83 respondents				Sample of 67 respondents			
	GPT Selic	GPT Taxes	GPT Inequality	MeanGPT	GPT Selic	GPT Taxes	GPT Inequality	MeanGPT
0	1,50	5,00	5,00	3,83	1,50	5,00	5,00	3,83
1	2,50	7,00	4,50	4,67	4,00	5,00	4,00	4,33
2	3,00	2,33	1,33	2,22	3,50	2,50	2,00	2,67
3	3,40	4,20	6,20	4,60	3,50	4,25	6,25	4,67
4	3,00	5,00	6,50	4,83	2,33	5,00	6,67	4,67
5	3,50	5,17	5,00	4,56	3,00	5,50	5,50	4,67
6	5,33	4,00	4,67	4,67	5,33	4,00	4,67	4,67
7	4,00	5,25	6,88	5,38	4,57	5,29	6,57	5,48
8	3,20	5,00	6,33	4,84	3,17	5,83	6,08	5,03
9	4,76	5,53	6,76	5,69	4,94	5,63	6,75	5,77
10	2,60	4,80	4,80	4,07	2,80	5,90	5,90	4,87
Mean	3,60	4,94	5,72	4,76	3,82	5,28	5,96	5,02

Source: compiled by the author.

Initially, it is noted that the results for the two samples do not differ significantly across any levels of self-identification. In general, it is observed that the only ChatGPT statement with a mean significantly below the “neutral” 5 on the orthodox/heterodox scale, indicating an orthodox bias, was the first statement regarding the conduct of monetary policy through the Selic Rate (mean of 3.60 for the first sample and 3.82 for the second sample). Regarding the second statement about the level of income tax and the fairness of the Brazilian tax system, the means were remarkably close to the center of the scale (4.94 and 5.28, respectively), indicating that respondents could not clearly identify an orthodox or heterodox bias from ChatGPT. As for the third statement about the possibilities of reducing income or wealth inequality in Brazil, the means were slightly above neutrality (5.72 and 5.96, respectively), indicating a weakly heterodox bias. Finally, considering the mean for all three ChatGPT statements (4.76 and 5.02, respectively), it can be observed that Hypothesis 2, which states that ChatGPT tends to exhibit a more orthodox bias in economic policy recommendations, cannot be accepted. At least for the Brazilian case and this restricted set of responses provided by the language model based on a few interactions, it is interesting to note that, on average, the responses approached the most impartial level of the orthodox/heterodox scale,

providing a good indication that the training data and fine-tuning of ChatGPT have already managed to eliminate some of the more explicit economic theoretical biases.

6. Discussion

Before considering the observed results as definitive or extrapolating them to other contexts, it is important to highlight some limitations of this investigation. Firstly, it should be noted once again that the sample of respondents consisted of economists from the Brazilian academic community who self-identified as heterodox. Therefore, the perceptions of the statements in the questionnaire are more representative of the population of economists who share this theoretical view. In future research, it would be essential to expand the sample of respondents with a more orthodox theoretical position, which would provide greater robustness to the findings, especially regarding the regression coefficient that seeks to evaluate the validity of Hypothesis 1.

The use of a gradation scale that places orthodoxy and heterodoxy at opposite poles has a limitation as it restricts the understanding of these concepts as opposing intellectual categories. This was the methodological device chosen to achieve greater objectivity and clarity

in reporting the perception of theoretical biases. However, attempts were made to minimize the problems arising from this simplification in two ways. First, an investigation was conducted to determine whether, despite the controversies surrounding these concepts, respondents could identify economically orthodox views (such as Paulo Guedes, former Minister of Economy) or neutral/heterodox views (such as Fernando Haddad, current Minister of Finance) within the proposed scale, which was confirmed. Second, respondents were allowed to express their own understanding of the concepts of orthodoxy and heterodoxy in text form. Out of the eighty-seven respondents who were part of the initial sample, twenty-four filled out this section of the questionnaire.

Through a qualitative analysis of these responses, it can be noted that there are still different understandings of the concepts. A significant group of respondents stated that they understand orthodoxy as neoclassical economics and heterodoxy as a heterogeneous group of schools of thought that oppose neoclassical economics, defining these concepts as divergent intellectual categories, thus validating the scale adopted in the questionnaire. Some respondents also stated that orthodoxy encompasses everything related to neo/new keynesianism, monetarism, or a (neo)liberal view of markets as the primary source of sociability and the pursuit of efficiency, disregarding the specificities of social and cultural contexts. In this case, heterodoxy would imply economic policies with greater government intervention and designed taking specific contexts into account. In terms of macroeconomics, heterodoxy was often associated with typically post-Keynesian and development-oriented policies. It is interesting to note that some respondents associated orthodoxy and heterodoxy with different views on economic growth and development: the former understanding the two terms as equivalent and the latter as qualitatively distinct. Some comments associated orthodoxy with the most accepted, influential, or consensual economic policies, highlighting a sociological aspect of the term. Regarding the difficulties and ambiguities of the concepts, one respondent emphasized that they make sense in methodological terms but are limited in categorizing economic policies. Another respondent stated that the orthodox/heterodox scale is limited for those working in Ecological Economics or even Environmental Economics, in which “heterodox and orthodox economists use the same neoclassical theoretical framework”. Finally, one respondent defined orthodoxy as prescriptive economics and heterodoxy as normative economics. This broad range of understandings of the concepts allows for future research to provide a wider spectrum of options or scales for respondents to report their perceptions of economic biases.

Another limitation inherent to any study that applies questionnaires is the tradeoff between the depth or breadth of the content covered and the size of the questionnaire. Using only three topics of economic policy is insufficient to categorically determine that ChatGPT does not exhibit a theoretical bias. However, to avoid losing any essential content, attempts were made to

minimize editing the language model’s responses inserted into the questionnaire, resulting in lengthy texts for this type of methodological instrument. Consequently, it was not possible to include more statements on other topics of economic policy, which would certainly further compromise the total number of participants. In any case, it is surprising that the average of ChatGPT’s responses for the three topics addressed was at the most neutral point on the orthodox/heterodox scale. This strong indication provides an incentive for other topics to be explored in the future to test the impartiality of language models.

To assess the robustness of the responses provided by ChatGPT, all commands were submitted twice within the same interaction window. While some resulted in an error message from ChatGPT, others produced identical responses. Additionally, the same questions asked in Portuguese were also posed in English to determine if the system was sensitive to this factor. The responses were different, not simply a translation of the text from one language to another. Nevertheless, the analytical content remained similar, as the English responses also aimed to provide comprehensive and thoughtful analyses of the topics in question. However, it is important to note that in two of the responses given in English, ChatGPT was more explicit about its temporal limitations, stating: “I do not have access to real-time economic data and cannot predict the future state of the Brazilian economy” and “In the case of Brazil, if I were to analyze the economic and social factors and government’s budgetary needs, I would need to have access to up-to-date and accurate information about Brazil’s economic and political situation” (OpenAI, 2023).

Notwithstanding its methodological limitations, the study allowed for the identification of orthodox/heterodox theoretical biases in recommendations for economic policies among a portion of economists active in the Brazilian academic community, with a particular emphasis on the growing prominence of AI as tools for consultation and information. Although cognitive biases have always existed in other technological and informational devices, such as automated internet search engines, the magnitude of influence on opinion formation exerted by large language models can be much more potent, as the responses to user commands are more direct and authoritative, bypassing the step of selecting different sources of information performed by individuals when using search engines. Thus, the persistent presence of several types of biases in these models could pose a threat to the technical quality, ethical foundation, and transparency of the data and information they disseminate, undermining certain normative and epistemic foundations of what society considers correct and true. In an extreme scenario, innovative technologies could pose obstacles to democracy itself if they helped spread not only biases, but also false information contained in their training data. For this reason, it is necessary to intensify the focus of scientific investigations in different areas of knowledge on recent technologies to understand and mitigate potential disruptive and detrimental impacts on social institutions. The good news is that the evidence from this study indicates a perception of a prominent level of impartiality in the economist algorithms of ChatGPT.

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