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Brazilian Inequality and Trade Liberalization between Brazil and China and between Brazil and United States

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Abstract

This study evaluated the possible effects of a trade liberalization agreement between Brazil and the United States (US), and between Brazil and China on inequality in income, welfare, and consumption of Brazilian households. We used the General Equilibrium Analysis Project (PAEG) 2014, a model of the Brazilian economy that divides the country into five macro-regions and categorizes households into ten income groups by region. The findings suggest that eliminating trade tariffs between the US and Brazil tends to decrease income inequalities in underdeveloped regions while increasing them in developed regions. Similarly, eliminating trade tariffs between China and Brazil tends to amplify income inequalities in underdeveloped regions and alleviate them in developed regions. Moreover, Brazilian households experience greater gains in welfare and consumption due to the removal of trade tariffs between China

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and Brazil. This study contributes to the ongoing debate on the relationship between trade liberalization and inequality in Brazil.

Keywords: *trade liberalization; inequality; PAEG.*

Code JEL: F1, H2, H31, I3

Desigualdade Brasileira e Liberalização Comercial entre Brasil e China e entre Brasil e Estados Unidos

Resumo

Este estudo avaliou os possíveis efeitos de um acordo de liberalização comercial entre o Brasil e os Estados Unidos e entre o Brasil e a China sobre a desigualdade de renda, bem-estar e consumo das famílias brasileiras. Utilizamos o Projeto de Análise do Equilíbrio Geral (PAEG) 2014, modelo da economia brasileira que divide o país em cinco macrorregiões e categoriza os domicílios em dez grupos de renda por região. Os resultados sugerem que a eliminação das tarifas comerciais entre os EUA e o Brasil tende a diminuir as desigualdades de renda nas regiões subdesenvolvidas e aumentá-las nas regiões desenvolvidas. Da mesma forma, eliminar as tarifas comerciais entre a China e o Brasil tende a ampliar as desigualdades de renda nas regiões subdesenvolvidas e aliviá-las nas regiões desenvolvidas. Além disso, as famílias brasileiras experimentam maiores ganhos em bem-estar e consumo como resultado da remoção das tarifas comerciais entre a China e o Brasil. Este estudo contribui para o debate atual sobre a relação entre abertura comercial e desigualdade no Brasil.

Keywords*:* liberalização comercial; desigualdade; PAEG.

JEL Código: F1, H2, H31, I3

Introduction

The issue of international trade has been dominated in recent decades by supply-side theories that focus on differences in factor endowments or production technologies across countries. Using a variety of methodologies, many national and international researchers have shown that trade liberalization increases welfare, increases aggregate income, raises imports, and this enables depreciation of the exchange rate, which contributes to raising the competitiveness of exports from developing countries[5].

Academic and political debates about the advantages and disadvantages of liberalization have focused on the internal distributional consequences and on the question of how trade reforms affect labour markets. Experiences like the one observed in Mexico point to a chronological coincidence between trade liberalization reforms, increased salary premiums paid to skilled workers, and wage inequality.

[5] See for instance Frankel and Romer (1999) and Bueno and Feijó (2014).

These observations frustrate those who hoped that external openness might reduce inequality and poverty in developing countries (Attanasio; Goldberg; Pavcnik, 2004). That is, developing countries may experience a high degree of uncertainty due to trade liberalization, which makes the country more vulnerable to trade stocks, such as large price changes and changes in the exchange rate, which reduces the effectiveness of policies for poverty reduction and income redistribution (Winters, 2002).

Income inequality in Latin America is one of the largest in the world and may be linked to the unequal distribution of assets, mainly land and education (Goñi; López; Servén, 2011). According to Ferreira and Walton (2005), Brazil is one of the most unequal countries with a tendency to persist. Since 1960, the date of the first demographic census, income distribution has been uneven, and even after 30 years, inequality has been stable. One of the possible reasons for the stability of income inequality is the difference in income between qualified and unqualified workers. In 1920, the country went through a capital-intensive industrialization process (and not labour-intensive) through a rapid industrialization process, which contributed to the wage gap. Another relevant factor is the proportion of low added value in exports from Brazil, which reflects in low income from work (Skidmore, 2004).

Brazil had a stable inequality index until the mid-1990s, and from then on, it started to decrease. The stability of inflation, increase in real wages, and income transfer government programs helped to reduce inequality (Silveira Neto; Azzoni, 2011). Ferreira (2000) highlights that there is a tendency to reduce income inequality between states, but these values are close to their steady state. Therefore, a study about income inequality in Brazil is still relevant.

The Brazilian economy has undergone major transformations since the 1970s. One of the main ones was the increase in internationalization, which was associated with the growth of trade flows and capital flows (financial and FDI). Trade flow growth resulted from trade liberalization, which began in the early 1970s, but was strongly influenced by macroeconomic conditions in the period and strongly related to fluctuations in the international economy (the United States, the European Union, and China). The impact of trade liberalization on productivity established the well-known controversy of the 1970s, in which" some researchers, such as Fishlow (1972), and Taylor *et al.* (1980) claimed that the observed changes in productivity were of a cyclical nature, while Langoni (1974) and de ML Tolipan and Tinelli (1975) defended the thesis of structural changes[6].

The relationship between trade openness and inequalities in Brazil has still not been explored. Arbache (2001) and Menezes-Filho and Rodrigues Junior (2001), among others, observed that, in the 1990s, there was an increase in income inequalities in favour of skilled workers, contrary to that suggested by the Heckscher-Ohlin-Samuelson (HOS) model. They point out that one of the reasons was the growth in demand for skilled labor. However, the subject remains controversial, since Sacconato and Menezes Filho (2001) found evidence supporting HOS predictions.

Brazil's trade relationships with China and the US are crucial to its economic growth. China has been Brazil's main trading partner since 2009, and both countries have signed several agreements to promote bilateral trade cooperation. Despite the constraints of trade policies and trading conditions, bilateral trade between the two countries has increased tremendously over the past 20 years, amounting to

[6] It is a process of reallocation resources that countries go through over time.

approximately USD 170 billion in 2022. Brazil exports more to China than it imports from it, which is a rarity because China is usually a greater exporter. The pandemic has made Brazil more reliant on China, and the total trade transacted between Brazil and China in 2021 may be greater than that in 2020, which is approximately US$102.5 billion. However, trade liberalization with China can lead to increased income inequality (Zhao; Chang; Zhou, 2023). Similarly, Hammad (2023) explored the impact of China's productivity growth on the poor in Mexico and Brazil, revealing that the relative nominal wage and price index of the poor decreased. Despite these challenges, the study found that real wage inequality diminishes in both countries in the baseline case of trade liberalization.

On the other hand, the US is Brazil's second-largest trading partner after China. The two countries signed the Agreement on Trade and Economic Cooperation in 2011 to enhance cooperation in trade and investment between the two largest economies in the Western Hemisphere. The United States (US) goods and services trade with Brazil totaled an estimated $120.7 billion in 2022, with exports being $75.7 billion and imports being $45.0 billion. The U.S. goods and services trade surplus with Brazil was $30.7 billion in 2022. U.S. exports to Brazil were $53.8 billion in 2022, up 14.8% from 2021 and up 23% from 2012. U.S. goods imports from Brazil totaled $38.9 billion in 2022, up 24.6% from 2021, and up 21 percent from 2012. The United States had a service trade surplus of an estimated $15.7 billion with Brazil in 2022, up to 58.8% from 2021 (United States of America, 2023). The potential implications of trade liberalization on income inequality in Brazil and the United States are complex and depend on various factors. While trade liberalization can reduce interregional income inequality in Brazil, it may also increase poverty and inequality at the state level (Castilho; Menéndez; Sztulman, 2012; Horridge; Souza, 2009). Aboubacari *et al*. (2020) found that possible trade liberalization between Brazil, the US, the European Union, and China could have a significant impact on Brazil's economy. This has the potential to boost GDP growth and improve Brazilian households' well-being. Additionally, this could enhance Brazilian trade, including both imports and exports, leading to a more prosperous future for Brazil.

Brazil has been relatively close to external trade, which sets it apart from practically all other emerging economies including China and India. However, trade liberalization in Brazil only brings national benefits. Therefore, Brazil should consider implementing more trade liberalization policies to enhance its economic growth and trade relationships with other countries.

Thus, how would eliminating trade barriers between Brazil and the United States, and between Brazil and China affect inequality[7] in Brazil? The studying of the causes of Brazilian inequality is of paramount importance because the income inequality in Brazil is amongst the highest in the world and has been rising[8]. Therefore, when talking about income inequality, Brazil is a very interesting case. This article is of particular importance insofar as it will enable Brazilian authorities at different levels to

[7] Inequality refers to inequality in income, inequality in the welfare and consumption of families. We consider that income inequality is a major factor that causes both inequality in household welfare and inequality in household consumption. It is important to note that Brazil is part of a customs union, the Mercado Comum do Sul (Southern Common Market, MERCOSUL). Therefore, this study is purely speculative in nature.

[8] Brazil is one of the 10 most unequal countries in the world (Alvaredo *et al*., 2018).

have a clear understanding of the effects of the elimination of trade tariffs with the country's main partners on inequality, which will help guide future policy decisions.

This study sets out to thoroughly analyze the effects of the possible elimination of trade barriers between Brazil and the US and between Brazil and China on inequality in Brazil. Specifically, we study how changes in import tariffs affect income, welfare, and consumption inequality among Brazilian households. This analysis is based on a Computable General Equilibrium Model (CGEM) in which the household agent is highly disaggregated. To achieve this objective, the model, database, and software of the Project of Analysis of General Equilibrium of the Brazilian Economy (PAEG) are used.

The contribution of our study is twofold: On the one hand, it makes a direct connection between the effects of a trade liberalization agreement between a developing country and a developed country (US-Brazil) on income inequality, welfare inequality, and consumption inequality, and on the other, this same analysis has been made, considering two developing countries (Brazil-China). This type of linking enables precise capture of the effect of a reduction of trade barriers between a developing country (Brazil) and a developed country (US), on the one hand, and between two developing countries (Brazil and China) from another. This contribution to the existing literature is fundamental since the results found in the present paper will help the authorities of developing countries worldwide in the determination of efficient trade policies. Importantly, the choice of the US and China is because; these two countries are Brazil's largest trading partners. US and China have very different profiles and trade very different goods with Brazil.

To fulfill the proposed objectives, the article is structured in three sections, in addition to this introduction. Section 1 discusses the Literature review. Section 2 the empirical strategy. Section 3 shows and discuss the results, finally in section 4, we reiterate the main conclusions of this study.

Literature review

Studies on trade and income inequality have led to contradictory results. Frankel and Romer (1999) studied the impact of trade on income. They used data from 150 countries for the year 1985. To correct for the endogeneity of trade, they employed Instrumental Variable (IV) techniques and used the country's geographic characters such as countries' distance from their trading partners as instruments for trade. They showed that trade has a statistically significant impact on income across countries.

Rodriguez and Rodrik (2000) studied the impact of trade policies on economic growth and their finding questioned the validity of results obtained by Frankel and Romer (1999). They found little evidence supporting the claim that open trade policies are positively associated with economic growth and concluded that the existing correlation is not authenticated. They argued that the geography-based instruments used in the earlier studies might be correlated with other geographic variables that affect income through non-trade channels and the trade estimate is just capturing these non-trade effects. This is well supported by their empirical results that the trade openness coefficient was not statistically significant when geography indicators are introduced as controls in the income equation.

Hap (2013) computerized general equilibrium modeling demonstrates the relationship between trade liberalization and Cambodia's social welfare. The result of the simulation suggests that the welfare of the Cambodian economy and social welfare

increase when the government reduces the tariff. Using data from 140 countries in the period 1970-2014 and employing an IV approach, Autor, Dorn and Hanson (2019) re-examines the link between globalization and income inequality. The above authors emphasize that the link between globalization and income inequality differs between different groups of countries. They found a strong positive relationship between globalization and inequality in transition countries, including China and most Central and Eastern European countries. For the more advanced economies, however, the results do not suggest that globalization and income inequality are positively correlated.

Chakrabarti (2000) examines the effect of international trade on intra-national income distribution, considering a sample of 73 countries in 1985 and using an estimate of the instrumental regression variable across countries. Three results are emphasized in this paper. The first is that greater participation in trade significantly reduces income inequality. The second is that the strong negative association between trade and inequality does not arise because countries that have a more egalitarian distribution of income for reasons other than trade engage in more trade. Third, growth provides a channel through which trade lowers inequality by raising both initial income and subsequent growth.

Kahai and Simmons (2005) in one of the very few studies, used the Gini index as a measure of inequality to explore its link with globalization. Controlling for structural and social indicators, they find that for developing countries globalization is positively associated with an increase in inequality, while it is insignificant in the case of developed countries.

Daumal (2013) through a time, series model, sought to determine the impact of trade openness on regional inequality by considering the cases of India and Brazil. The author emphasizes that Brazil's trade liberalization contributes to the reduction of regional inequalities; the opposite result is found for India. According to the author, India's trade liberalization is an important factor that aggravates income inequality among Indian states. In both countries, direct foreign investment inflows are seen to increase regional inequalities. That is, a trade opening between two developing countries is not beneficial to either or is beneficial to one and is not beneficial to another. This suggests that the effect of trade liberalization on regional inequalities depends on the country studied and on the composition of trade.

Along the same line of reasoning, using a panel of 47 countries in the period 1990-2007 and a measure of globalization that distinguishes the different dimensions of economic integration. Ezcurra and Rodríguez-Pose (2013) investigate the relationship between economic globalization and regional inequality. The authors showed that countries with greater degree of economic integration with the rest of the world tend to register higher levels of regional inequality; and that the spatial impact of economic globalization is greatest in low- and middle-income countries whose regional disparity levels are on average significantly higher than in high-income countries. Thus, there have been contradictory results on the impact of trade on the level of income.

The dynamics that impact inter-country trade are multifaceted. Many studies highlight the pivotal role of various factors such as geographic distance, trade convenience, complementarity, competitiveness, national economic size, and infrastructure conditions. Borchert and Yotov (2017) found that globalization reduced the impact of distance on trade while increasing the importance of proximity and

regional trade agreements, reflecting the growing importance of regional economic ties.

Trade facilitation is another crucial factor in inter-country trade. Hoekman and Nicita (2011) explored trade costs and policies, emphasizing the enduring significance of traditional trade policies, while acknowledging the increasing importance of non-tariff measures and domestic trade expenses, particularly for developing countries. Porto, Canuto and Morini (2015) used a gravity model to demonstrate the positive impact of trade facilitation measures on global trade performance. Chimilila, Sabuni and Amos (2014) found that the East African Community (EAC) Customs Union improved Tanzania's trade performance, Foreign Direct Investment (FDI) inflows, and trade tax revenues through trade facilitation measures. However, non-tariff barriers, poor transport infrastructure, limited human resources, and insufficient automation remain significant challenges, making trade facilitation more important than natural geographical differences between countries.

Chen, Dabo and Aiping (2020) assessed the impact of trade competitiveness and complementarity on China's trade along the Belt and Road. They discovered that factors such as land area, trade complementarity, common languages, and free trade agreements bolstered trade with these nations. Conversely, geographic distance and trade competitiveness acted as substantial barriers to trade development between China and Belt and Road countries.

Ribeiro (2014) delineated the static and dynamic gains from trade openness, unveiling the positive effects of trade liberalization on Brazil's welfare during the 1990s. Aboubacari *et al*. (2020) emphasized the beneficial prospects of establishing a free trade area between Brazil, the European Union, the US, and China.

Our study stands out from previous research because of its unique and focused approaches. First, we established a significant connection between a developing country (Brazil) and a developed country (US). Additionally, we analyzed the relationship between two developing countries, Brazil, and China. To accomplish this, we utilize a specific general equilibrium model of the Brazilian economy, dividing the country into five macro-regions and categorizing households into ten income groups based on their respective regions. This meticulous methodology enabled us to assess the impact of our proposed policy accurately.

Data and Research Methods

The analytical approach used is an applied general equilibrium model. By general equilibrium it is understood as a tool that allows understanding of the economy as a completely interdependent system, then, a change in any component of the economy has repercussions in all the others, and knowing how to understand this unfolding is of fundamental importance for the analysis. By applied it is understood that the primary objective is to provide a quantitative analysis of the problems encountered in the economy. Therefore, as well as a strong theoretical framework, a structure is needed that allows solutions of numerical models Pearson *et al*. (2014).

Model description

The General Equilibrium Analysis Project of the Brazilian Economy (PAEG)[9], is a static, multiregional, and multisectoral general equilibrium model developed using the GTAPinGAMS framework by Rutherford and Paltsev (2000) and Rutherford (1995). We used version 4.0 of PAEG for 2014 relies on the GTAP 10 database, representing the global economy. Brazil's regions in the model are presented in Table 1.

The model is tailored for comparative-static simulations, where its assumptions, equations, and variables implicitly pertain to the economy at a future period. As a static-comparative model, it presupposes that the shock modifies the initial equilibrium, computing the disparities between the post-shock and pre-shock states. The initial equilibrium database of the model serves as the reference point before the shock (Wolf, 2021).

Table 1 – Brazilian regions in the model and other regions

Brazilian Regions	Other Regions
North (N)	Rest of Mercosur (RMS)
Northeast (NE)	United States (US)
Midwest (CE)	Rest of NAFTA (RNF)
Southeast (SE)	Rest of America (ROA)
South (SUL)	Europe (EUR)
-	China (CHN)
-	Rest of the world (ROW)

Source: Gurgel, Pereira, and Teixeira (2013).

The model represents the production and distribution of goods and services in the world economy, keeping GTAP data intact for other regions of the world, and data from flows between Brazil and the other regions as well. Besides that, the model split the representative household into ten classes of income and consumption in each Brazilian region. The sector aggregation and the household's income classes are presented in Table 2.

To determine the income of households[10] in each region, the POF 2008-2009 files were utilized. The data were broken down by income class, updated to 2011, and further categorized into capital income, labor income, transfers, retirement, and savings. This disaggregation ensured that the original net households' income by region remained intact. The components of net households' income included income from primary factors, government-family transfers, and household savings (negative indicating households lending to the financial system and positive implying households being owed). The income classes in the model follow those used by IBGE in the POF.

The approach involved distributing the PAEG data for each income source (Capital, Labor, and Transfers) based on the share of each source in the total income formation of households in the region. These shares were derived from the breakdown of income formation in the POF 2008-2009. After applying these shares to calculate

[9] See Gurgel, Pereira, and Teixeira (2013).

[10] See Wolf *et. al* (2018).

the income for each household, the gross income of households was determined by summing the incomes from all sources.

To ensure net income equaled total consumption, the difference between consumption and gross income was computed, representing the savings or debt of each household. Household consumption data for each region (North, Northeast, South, Southeast, and Midwest) and income class were extracted from POF 2008-2009, covering 110 products, and organized in the PAEG database, considering the sectors of the GTAP.

Table 2 – Aggregation between manufactures, services and agricultural sectors in PAEG

Agricultural	**Manufacturing**	**Services**
Rice	Clothing	Trade
Corn and cereals	Textiles	Transport
Oil seeds	Food	Public admin.
Sugar industry	Paper and publish	Construction
Meat and live animals	Other Manufactured	Electr./gas/water distrib
Milk and dairy	Wood and furniture	
Other agriculture	Chem., rubber/plastic	

Brazilian Households Income Categories	
F1 – under Reais$239,52	F6 – more than of R$958,08 to R$1197,60
F2 – more than of R$239,52 to R$359,28	F7 – more than of R$ 1197,60 to R$1796,41
F3 – more than of R$359,28 to $598,80	F8 – more than of R$1796,41 to R$2395,21
F4 – more than of R$598,80 to R$718,56	F9 – more than of R$2395,21 to R$3592,81
F5 - more than of R$718,56 to R$958,08	F10 – above R$3592,81

Source: Gurgel, Pereira, and Teixeira (2013).

Each region is represented by a final demand structure composed of public and private expenditure on goods and services. The model is based on behavioral optimization, when consumers seek to satisfy their needs (maximization of welfare, subject to budget constraints).

The activity levels

The productive sectors problem is based on a CES (Constant Elasticity Function) aiming to minimize its costs, subjects to technological restrictions. The firm's optimization problem combines domestic intermediate inputs ($vdfm_{jir}$), imported inputs ($vifm_{jir}$ and primary factors(vfm_{fir}), to produce Y_{ir}. The costs involve taxes: $rtfd_{jir}$ on domestic inputs prices (py_{jr}), ($rtfi_{jir}$) on imported inputs prices (pm_{jr}) and factors prices (pf_{fr}). The optimization problem is given by[11]:

[11] All flows presented on optimization problems are the initial equilibrium taxes.

$$min_{vdfm,vifm,vfm} \; C_{ir}^{D} + C_{ir}^{M} + C_{ir}^{F}, \qquad (1)$$
$$Subject \;\; to \;\; : \;\; C_{ir}^{D} = \sum_{j} py_{jr}(1 + rtfd_{jir})vdfm_{jir};$$
$$C_{ir}^{M} = \sum_{j} pm_{jr}(1 + rtfi_{jir})vifm_{jir};$$
$$C_{fr}^{F} = \sum_{j} pf_{jr}(1 + rtf_{jir})vfm_{fir};$$
$$Y_{ir} = F_{ir}(vdfm, vifm, vfm)$$

Intermediate inputs (*vdfm* + *vifm*) and added value (*vfm*) are combined through Leontief function (elasticity equals zero), in a fixed proportion to produce vom_i. Domestic and imported inputs are combined using a Cobb-Douglas function, with an elasticity of substitution equals $esubd_i$, while primary factors components are combined considering an elasticity of substitution equal $esubva_j$.

Each imported good is an aggregation of goods from different regions of the model. It is considered the Armington assumption, i.e., the goods are imperfect substitutes. The imports include taxes ($rtms_{isr}$), from *i* to *s*. The transport costs ($vtwr_{jisr}$), priced at *ptj* are added to imports for other regions (exports) ($vxmd_{isr}$), priced at py_{is}. The exports subsidies (or *tariffs*) are represented by ($rtxs_{isr}$). The optimization problem for bilateral imports is:

$$min_{vxmd,vtwr} \; \sum_{s}(1 + rtms_{i,s,r}).[py_{is}(1 - rtxs_{isr})vxmd_{isr} + \sum_{j} pt_j vtwr_{jisr}] \qquad (2)$$
$$Subject \;\; to \;\; : \;\; A_{ir}(vxmd, vtwr) = M_{ir}$$

The substitution imported goods from different origins is determined by the esubmi elasticity. The imports taxes are collected by the regional government, and the exports tariffs are paid by the region that is exporting.

The representative agent minimizing the aggregated cost (domestic consumption - $vdpm_{jr}$; and imported consumption - $vipm_{ir}$) considering the taxes on domestic consumption ($rtpd_{ir}$) and taxes on imported consumption ($rtpi_{ir}$):

$$min_{vdpm,vipm} \; \sum_{j} py_{jr}(1 + rtpd_{jr})vdpm_{jr} + pm_{ir}(1 + rtpi_{jr})vipm_{jr} \qquad (3)$$
$$Subject \;\; to \;\; : \;\; H_r(vdpm, vipm) = C_{ir}$$

The government also minimize the costs considering domestic ($rtgd_{ir}$) and imported ($rtgi_{ir}$) taxes, dividing its consumption in domestic ($vdgm_{jr}$) and imported ($vdgi_{jr}$):

$$min_{vdgm,vigm} \; \sum_{j} py_{jr}(1 + rtgd_{jr})vdgm_{jr} + pm_{ir}(1 + rtgi_{jr})vigm_{jr} \qquad (4)$$
$$Subject \;\; to \;\; : \;\; P_r(vdgm, vigm) = G_{ir}$$

The final demand considers a Cobb-Douglas function, with elasticity of substitution equals *esubdi*. The different composite goods for the government consumption are not interchangeable (Leontief), however, domestic, and imported components of each good respond to prices (taking into account $esubd_i$).

International transport services (vst_{ir}) are used as an aggregation of transport services exported by several countries and regions in the model. The aggregation of

transport services is represented by a minimization problem. A unitary elasticity of substitution (Cobb-Douglas function) is used to substitute between transport from different sources:

$$min_{vst} \sum_r py_{ir} vst_{ir} \qquad (5)$$
$$Subject \ \ to \ \ : \ \ T_i(vst) = YT_i$$

The flows

The domestic production for each sector is distributed between exports, international transport, intermediate demand, private consumption, investment[12] and government consumption. The domestic production, considering the market prices, is represented by:

$$vom_{ir} = \sum_s vxmd_{irs} + vst_{ir} + \sum_j vdfm_{ijr} + vdpm_{ir} + vdgm_{ir} + vdim_{ir} \qquad (6)$$

The total good *i* exports by region *r* will be the same to the total imports from other regions (*s*) of the same good:

$$vxm_{ir} = \sum_s vxmd_{irs} \qquad (7)$$

The imported goods, are totally consumed in intermediate consumption, private consumption and government consumption:

$$vim_{ir} = \sum_j vdfm_{ijr} + vipm_{ir} + vigm_{ir} \qquad (8)$$

The aggregated transport services consider the value of exports transport and will equals to the flows of transport services acquired with imported goods:

$$vt_j = \sum_r vst_{jr} = \sum_{irs} vtwr_{jisr} \qquad (9)$$

Factor rent (capital and labor) is paid to households (representative agents):

$$\sum_i vfm_{fir} = evom_{fr} \qquad (10)$$

All households (representative agents) income, discounted the direct taxes on income, is spent on private consumption and private investment:

$$\sum_f evom_{fr} - R^{hh} = vpm_r + vim_r \qquad (11)$$

The tax revenue, charged on production (R^Y), consumption (R^C), imports (R^M), on government consumption (R^G) form the government consumption restriction, which includes the direct tax (R^{hh}) and foreign transfers (vb_r) as well:

[12] The model considers the Neoclassical approach where investments are equal domestic savings (I=S).

$$vgm_r = \sum_i R_{ir}^Y + R_r^C + R_r^G + \sum_i R_{ir}^M + R_r^{hh} + vb_r \quad (12)$$

Equilibrium conditions and closures

In the PAEG model net income equals expend. Besides that, it is important to observe that there are perfect competition and constant returns to scale, that is intermediate input costs must be the same of production factors:

$$\begin{aligned}
&Y_{ir} : \sum_f vfm_{fir} + \sum_j (vifm_{jir} + vdfm_{jir}) + R_{ir}^Y = vom_{ir};\\
&M_{ir} : \sum_s (vxmd_{isr} + \sum_j vtwr_{jisr}) + R_{ir}^M = vim_{ir};\\
&C_r : \sum_i (vdpm_{ir} + vipm_{ir}) + R_{ir}^C = vpm_r;\\
&G_r : \sum_i (vdgm_{ir} + vigm_{ir}) + R_{ir}^G = vgm_r;\\
&I_r : \sum_i vdim_{ir} = vim_r;\\
&FT_{fr} : \sum_i vfm_{fir} = evom_{fr};\\
&YT_j : vst_{jr} = vt_k = \sum_{irs} vtwr_{jirs}.
\end{aligned} \quad (13)$$

The model closures consider the factors supply fixed, and mobile between sectors inside the same region. There is no unemployment, i.e., the factor prices are flexible. Investments and capital flows are kept fixed as well, thus, changes in exchange rate are necessary to accommodate exports and imports flows after the shocks. The government consumption could change with changes in prices, as well as the tax revenue is subject to activity and consumption levels.

The analyzed scenarios

For the present study, the households are split into ten different income classes on Brazilian regions, there is no factors mobility among regions. Thus, it is possible to observe the impact of a trade liberalization on family's income and consumption.

The applied shocks consider an elimination on imports taxes between Brazil and China and between Brazil and the United States. The *rtms* (*i, r, s*) parameter represents the import taxes, so it must be set equal zero between the regions analyzed. There are two scenarios:

A - Trade liberalization between Brazil and China:

$$\begin{aligned}
&rtms(i, bra, "chn") = 0\\
&rtms(i, "chn", bra) = 0
\end{aligned} \quad (14)$$

B - Trade liberalization between Brazil and USA:

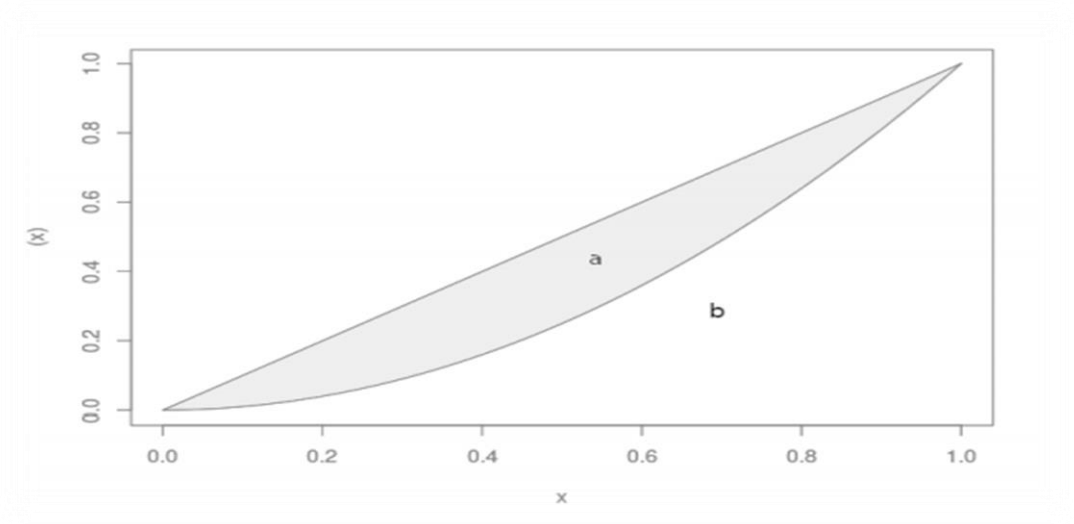
$$\begin{aligned}
&rtms(i, bra, "usa") = 0\\
&rtms(i, "usa", bra) = 0
\end{aligned} \quad (15)$$

These shocks will enable us to capture the direct effects of trade liberalization on inequality in Brazil, once it is possible to evaluate the factors prices changes in each region. It is known that low-income classes receive more from labor factor as income, while the higher-income classes receive mainly income from the capital factor. Therefore, changes factors prices should tell us the inequality between the different types of families. If the simulated policy increases the labor price, so the impact on poor households would be better. On the other hand, increase on capital price would be better for richer households.

Gini index

To better visualize the impact of a simulated change by the model, the Gini index was calculated. One way of summarizing the concept of the Gini coefficient is to say that it is simply the ratio between the area under the 45-degree straight line and the area between the Lorenz curve and the 45-degree line. In Figure 1 this is represented by the ratio (a/(a+b)) and its values is constrained between zero and one.

Figure 1 – Gini coefficient



Source: Authors.

The 45-degree line represents a perfect income distribution, which means that if this line were divided into equal proportions, each piece of that line would have the same proportion of people and income. In other words, 40% of this line would have 40% population and 40% income (considering accumulated values). The Lorenz curve indicates the cumulative income by cumulative population given the data. Thus, the Gini coefficient indicates the difference between a perfect income distribution and an uneven distribution, so it can be considered as a measure of variability. The closer its value is to zero, the smaller is darkened area in Figure 1.

PAEG's output is an average for each income class by region and with the frequency of household we calculated the Lorenz curve and Gini coefficient[13]. The Gini is a simple calculation that can give indications of how the trade liberation can influence

[13] There was used a package in R, namely ineq, written by Yitzhaki and Schechtman (2013).

income inequality. According to Neri and Souza (2012), one of the factors responsible for reducing income inequality in Brazil between 2001 and 2011 was the increase in income from the labor factor. A simulation of the removal of trade barriers will affect the revenue of the factors in the model and thus impact household income, which consequently will modify the income inequality.

Results and Discussion

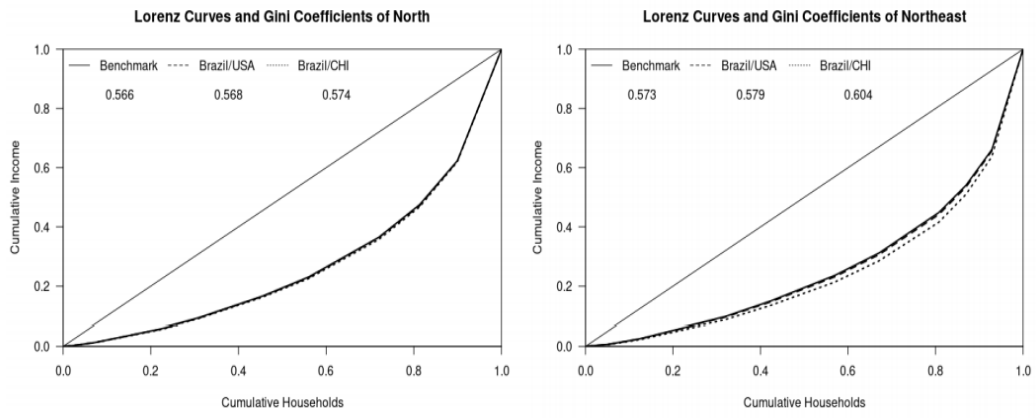
Income Inequality

Take the most usual measure of income inequality. The Gini index ranges from zero to one. When the result of the Gini index is higher, the more unequal the society is, that is, the more unequal the trade relationship between Brazil and the interested country generates.

In a utopian situation, in which everyone's income was the same, the Gini index would be zero. At the opposite extreme, if a single individual concentrated all of society's income, that is, everyone else would have zero income, the Gini index would be one. Thus, for the calculation of the Gini index, we consider the number of people as income class frequency to calculate how many families received a certain salary, as shown by Góes and KarpowICz (2019).

Figure 2 shows the Gini coefficient of the North and Northeast of a trade liberalization agreement between Brazil and the US, and between Brazil and China. In order to understand the unacceptable extension of 0.568 between Brazil/US, 0.574 between Brazil/China, with a difference of -0.6 %; 0.579 between Brazil/US and 0.604 between Brazil/China, with a difference of -2.5 %; corresponding to our Gini for the North and Northeast respectively, need not be genius: we are closer to perfect inequality than to perfect equality. That is, possible trade liberalization between Brazil and these two countries would be responsible for increasing income inequality in the North and Northeast. Note that, there is a greater increase in income inequality in these two regions, with possible trade liberalization between Brazil and China. These results corroborate the results of Castilho, Menéndez and Sztulman (2012).

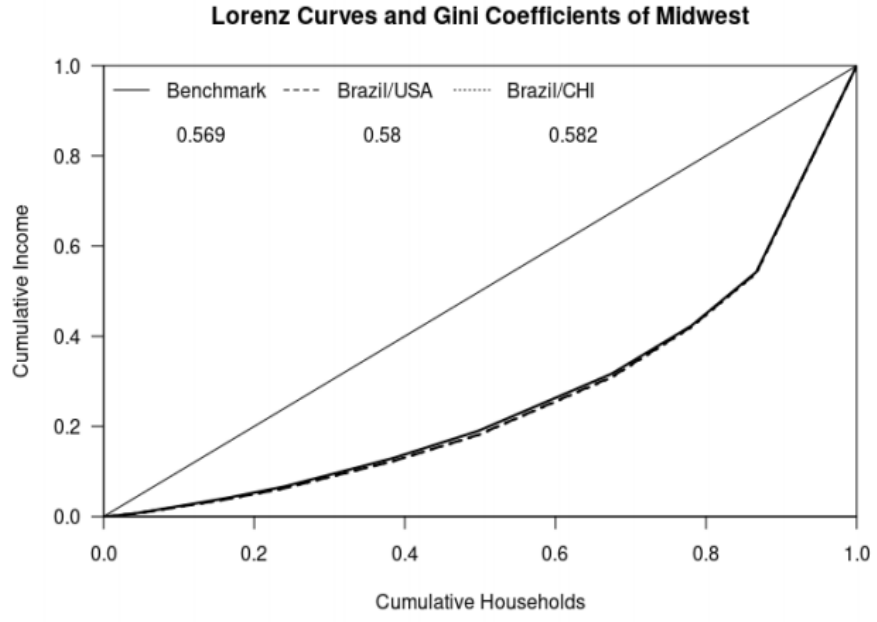
Figure 2 – Lorenz Curves and Gini coefficients of the North and Northeast regions class of import tariffs elimination between Brazil and the USA and Brazil and China



Source: Research Results

Figure 3 presents the Gini coefficient of the Midwest region. In both of scenarios simulated (Brazil/US and Brazil/China) there was an approximately the same increase in income inequality. The difference in income inequality in the two scenarios is minimal. But even so, trade liberalization between Brazil and China shows an increase of 0.2% more.

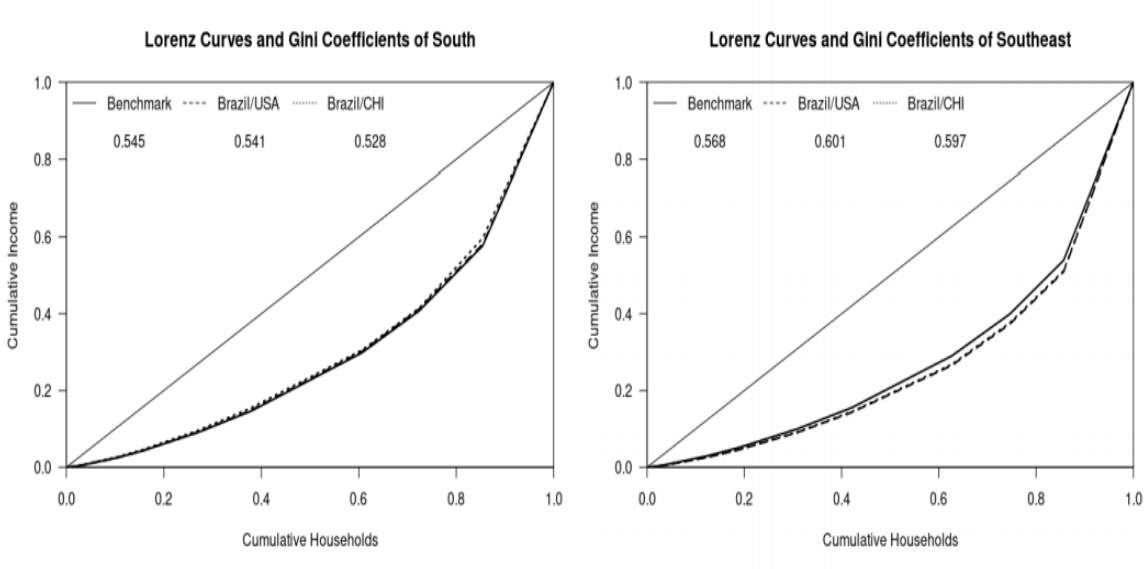
Figure 3 – Lorenz Curves and Gini coefficients of the Midwest regions class of import tariffs elimination between Brazil and the USA and Brazil and China



Source: Research Results

Regions South and Southeast Gini coefficient are represented in Figure 4. These regions seem to show an opposite trend of income inequality found in the North and Northeast regions. Trade liberalization between Brazil/US and between Brazil/China presents the respective Gini 0.541 and 0.528 for the South region, with a difference of 1.3%; 0.601 and 0.597 for the Southeast region, with a difference of 0.4%. There is a clear increase in income inequality with a trade agreement between Brazil/US in the South and Southeast regions.

Figure 4 – Lorenz Curves and Gini coefficients of the South and Southeast regions class of import tariffs elimination between Brazil and the USA and Brazil and China



Source: Research Results

When comparing the results obtained in the North and Northeast regions with the results in the South and Southeast regions, we can say that the underdeveloped regions of Brazil tended to register an increase in income inequality with a trade agreement between Brazil/China, while the developed regions of Brazil tended to register a decrease in income with this same trade agreement. The opposite result is observed with a trade agreement between Brazil/US. These results corroborate the results of Kahai and Simmons (2005).

In general, the results show an increase in income inequality with a trade agreement between Brazil/China. These results are similar to the results found by Chakrabarti (2000) and Daumal (2013), but different from the work of Edwards (1997). The Table 3 resumes the benchmark of Gini coefficients in all five regions.

Table 3 – Gini coefficients of all regions

Regions	Benchmark	Brazil/USA	Brazil/China
North	0.566	0.568	0.574
Northeast	0.573	0.579	0.604
Midwest	0.569	0.58	0.582
South	0.545	0.541	0.528
Southeast	0.568	0.601	0.597

Source: Research Results.

Benchmarks are similar for all regions showing an increase in income inequality both with trade liberalization between Brazil/US and between Brazil/China. However, the South region would be the only one to present the lowest Gini coefficient, being the

only region in which income inequality would have decreased both with trade liberalization between Brazil/USA and between Brazil/China.

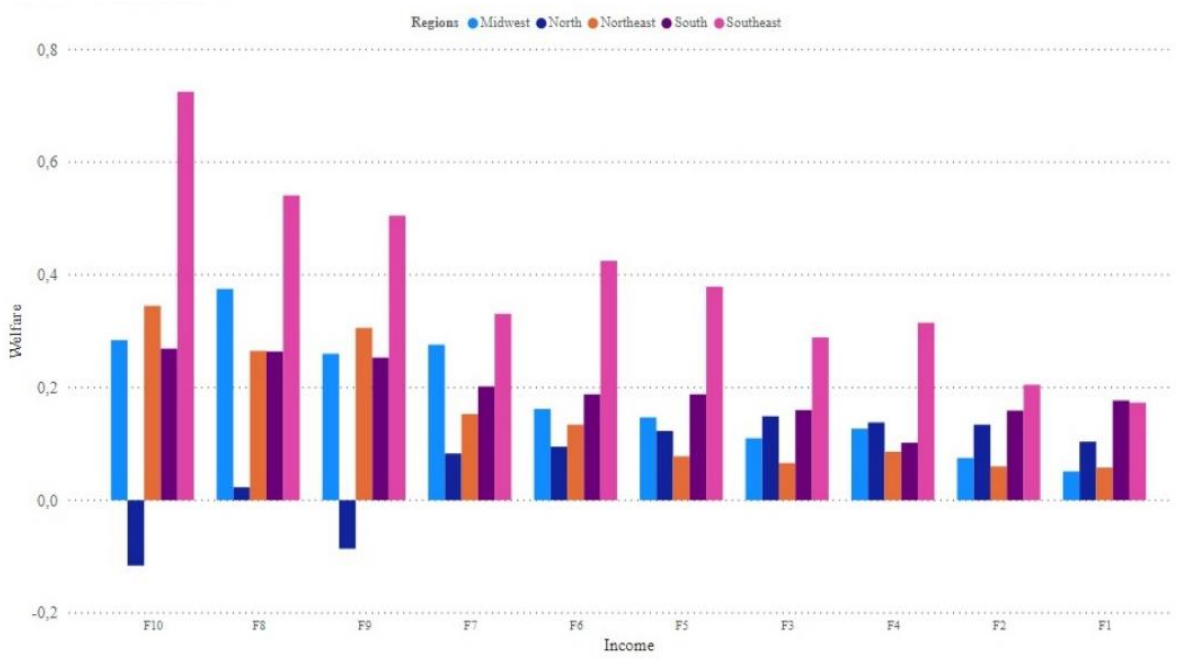
Welfare Inequality by income class

In this subsection, we will discuss the impacts of trade liberalization between Brazil and China and between Brazil and the US on the welfare inequality[14] of Brazilian households, considering income classes for each Brazilian region. We consider income inequality as a factor that reduces welfare. So, the higher welfare gains for a region explains the inequality of the policy.

Figure 5 shows the impact of import tariff elimination between Brazil and China on variations in welfare by income class in Brazilian regions. By observing the results of the North region, we can note an increasing variation of welfare that depend on the household's income class. High-income households recorded a decrease in the variation in welfare compared to low-income households, with a loss in the welfare of income-class households F9 and F10.

That is, this region has a decrease in the variation of welfare with this trade liberalization for high-income households. The opposite result of the North region can be observed in the Northeast, Midwest, and Southeast regions, where the variation in the welfare is better for high-income households can be observed in relation to low-income households, mainly in the Southeast region. Welfare increases for all in the South, but the increase is a little higher for the higher income groups with this policy.

Figure 5 – Variation in households' welfare by income class of import tariffs elimination between Brazil and China



Source: Research Results.

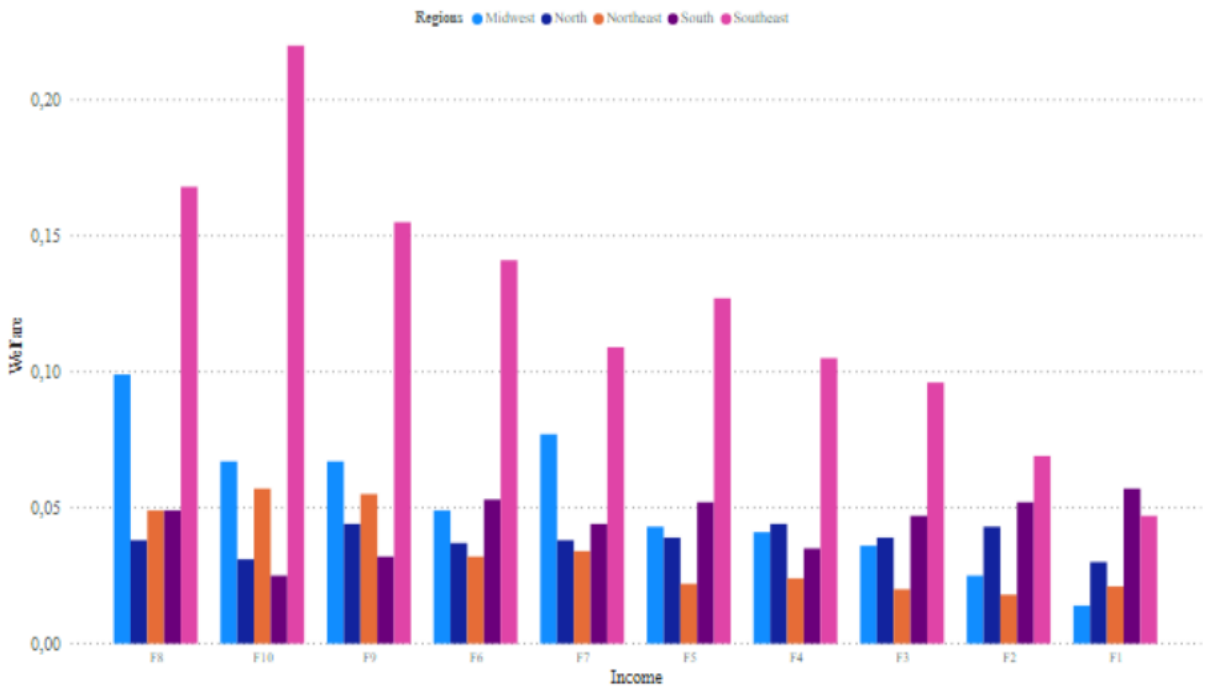
[14] We consider welfare inequality the difference in welfare gains between households.

Overall, high-income households have a higher gain in welfare than low-income households with this policy. This difference in welfare gains is even greater in the Southeast.

So, trade liberalization between Brazil/China generates inequalities in welfare gains of households in the underdeveloped regions of Brazil. These results corroborate the results of Kahai and Simmons (2005) and Ezcurra and Rodríguez-Pose (2013).

Figure 6 shows the impact of import tariff elimination between Brazil and US on variation in welfare by income class in Brazilian regions. The results of this scenario are totally different from those discussed in the previous scenario (results of Figures 5). Regardless of the household income class, all regions benefited from this policy. Households with high incomes in the Southeast have higher welfare gains. The differences in the results can probably be explained by the larger economic size of the Southeast and the stronger economic structure of that region.

Figure 6 – Variation in households' welfare by income class of import tariffselimination between Brazil and US



Source: Research Results.

The welfare gains of low-income households in the North and South regions are proportional to the welfare gains of high-income households. Midwest and Northeast regions have minimal differences in welfare gains between low- and high-income households. With this policy, the Southeast region is the only one where there is an increase in the difference in welfare between low-income and high-income households.

High-income households have a higher welfare gain than low-income households in this region.

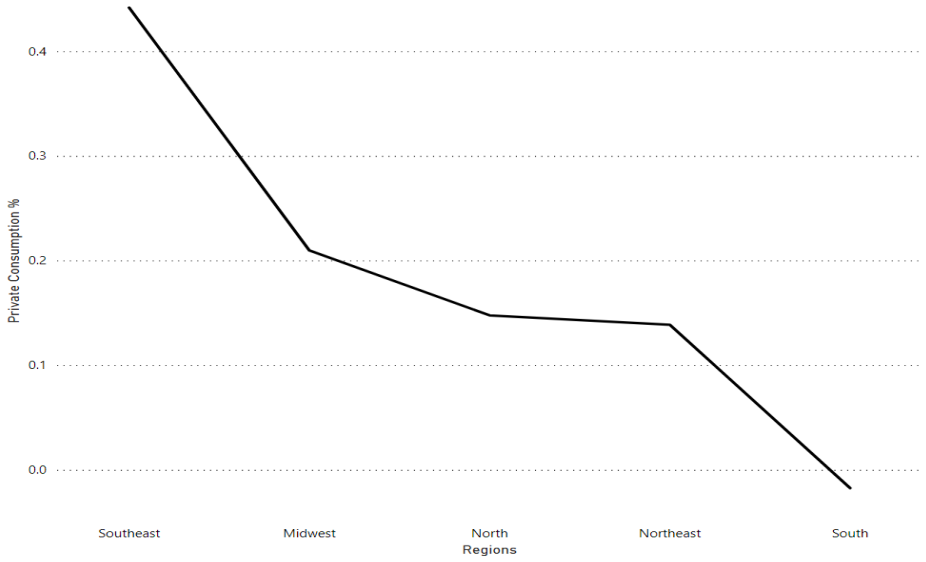
In general, there is a marked decrease in inequality in the welfare gains of households with this policy. In all Brazilian regions, the welfare gains of the low-income households increase in relation to the wealthier, excluding the Southeast region where there is a smaller difference in inequality between high and low-income households. These results corroborate the results of Chakrabarti (2000) and Aboubacari *et al*. (2020).

When comparing the results found in the Brazil/China scenario with those found in the Brazil/US scenario; the results indicate that high-income households have higher welfare gains than low-income households in the Brazil/China scenario, excluding the South region. In the Brazil/US scenario, the results indicate that low-income households have welfare gains proportional to the welfare gains of high-income households, excluding the Southeast region.

Household Consumption Inequality

Figure 7 shows the impact of import tariff elimination between Brazil and China on household consumption inequality[15]. There is a percentage variation in household consumption of -0.017% for the South region. This region is the only one to present a negative value in the variation of household consumption with such import tariff elimination, thus evidencing a loss in household consumption in this region.

Figure 7 – Household consumption of import tariffs elimination between Brazil and China



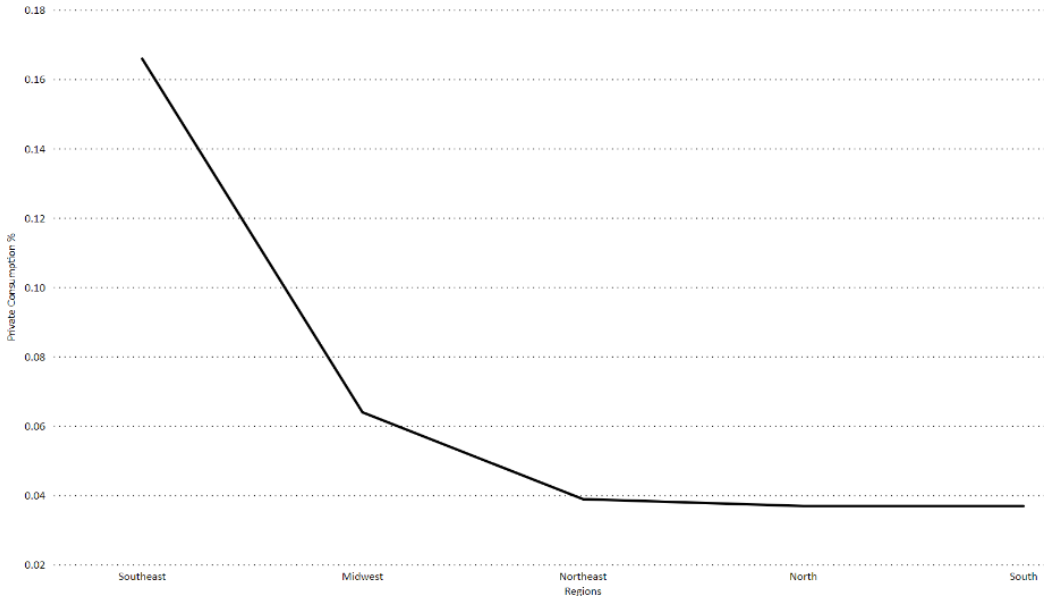
Source: Research Results.

[15] We consider household consumption inequality the difference in household consumption gains between Brazilian regions.

In the Southeast, Midwest, Northeast, and North regions, there are consumption gains of 0.44%, 0.21%, 0.14%, and 0.15%, respectively. These four regions record gains in private consumption from such import tariff elimination between Brazil and China with a smaller gain for the North and Northeast regions. The Southeast is the region with a higher variation of household consumption.

Figure 8 shows the impact of import tariff elimination between Brazil and the US on Brazilians' household consumption variation. Notice that in this figure, we have a positive variation in consumption in all regions, 0.04%, 0.04%, 0.06%, 0.17%, and 0.04%, respectively, in the North, Northeast, Midwest, Southeast, and South regions. This result is completely different from the results of figure 7.

Figure 8 – Household consumption of import tariffs elimination between Brazil and the US



Source: Research Results.

The Southeast continues to be the region with higher household consumption gains, both with import tariff elimination between Brazil and China, as well as with import tariff elimination between Brazil and US.

These results are due to the Southeast region being the center of the development of the country and more developed. This allows the Southeast region to have influence over the other regions. The concentration of the productive activity in its interior made the companies installed there control the economic space or the market in extra-regional scope. The problem with such logic is increasing variation in households' consumption in relation to other regions. In general, the results of import tariff elimination between Brazil and the United States show a much smaller variation in household consumption gains between Brazilian regions. These results corroborate with the investigation of (Daumal, 2013).

Conclusion

This research evaluated the effects of the possible import tariffs elimination between Brazil and the US, and between Brazil and China on income inequality, welfare inequality, and on consumption inequality of Brazilian households.

The results presented in this study demonstrate that the elimination of import tariffs between Brazil and the US reduces income inequality in the underdeveloped regions of Brazil, and a slight increase in income inequality in the Brazil regions developed. The opposite result is encountered with the elimination of import tariffs between Brazil and China, where we note income inequality increases in underdeveloped regions and a decrease in developed regions in income inequalities.

A general observation of the results shows that income inequality, welfare inequality, and household consumption inequality tend to increase with the trade agreement between Brazil and China and tend to decrease with the elimination of import tariffs between Brazil and the US.

The results of this study are important to participate in the solution research of the ongoing debate on the directional relationship between trade liberalization and income inequality, welfare inequality, and household consumption inequality in Brazil.

The main limitation of this study is that it is based on a general equilibrium model of the Brazilian economy. This means that the results of this study may not be perfectly accurate for other economies. Additionally, the research does not consider all the potential effects of the elimination of import tariffs, such as the effects on employment, investment, and economic growth. Another limitation of this study is that it only considers the effects of the elimination of import tariffs on Brazil.

As future research extensions, it is imperative to investigate the reasons behind the observed increase in income, welfare, and household consumption inequalities with the trade agreement between Brazil and China. Additionally, the effects of other trade agreements on income, welfare, and household consumption inequality in Brazil must be analyzed. It is also necessary to examine the impact of import tariff elimination between Brazil and other countries on income, welfare, and household consumption inequality.

Regarding policy implications, policymakers must consider the potential impact of trade agreements on income, welfare, and household consumption inequality in different regions of Brazil. They should thoroughly evaluate the potential benefits and drawbacks of import tariff elimination in different countries, considering the impact on income inequality, welfare inequality, and household consumption inequality in Brazil.

To mitigate the negative impact of trade agreements on income inequality, welfare inequality, and household consumption inequality in the underdeveloped regions of Brazil, policymakers must implement measures such as providing financial assistance to underdeveloped regions and vulnerable sectors of the economy to help them adjust to the elimination of import tariffs, investing in education and training programs to help workers develop the skills they need to compete in the global economy, and negotiating trade agreements with the US and China, including provisions to protect the environment and promote social welfare.

The Brazilian government must carefully consider the potential effects of eliminating import tariffs on the competitiveness of Brazilian industries. To support Brazilian industries, the government could provide tax breaks, R&D subsidies, and other forms of assistance.

This study has critical implications for policymakers in Brazil, the US, and China. It is crucial for policymakers to carefully consider the potential effects of eliminating import tariffs on all stakeholders, including workers, businesses, consumers, and the environment.

References

ABOUBACARI, A.; WOLF, R.; TROTTER, I. M.; MATTOS, L. B. Impact d'une possible libéralisation commerciale entre le Brésil, les États-Unis, l'Union Européenne et la Chine sur l'économie brésilienne: une analyse d'équilibre général calculable. **Brazilian Journal of International Relations**, Marília, v. 9, n. 2, p. 254-271, 2020. DOI 10.36311/2237-7743.2020.V9n2.P254-271.

ALVAREDO, F.; CHANCEL, L.; PIKETTY, T.; SAEZ, E.; ZUCMAN, G. **World inequality report 2018**. Cambridge: Harvard University Press, 2018. DOI: https://doi.org/10.4159/9780674984769

ARBACHE, J. S. Wage differentials in Brazil: theory and evidence. **Journal of Development Studie**s, London, v. 38, n. 2, p. 109-130, 2001. DOI: https://doi.org/10.1080/00220380412331322281

ATTANASIO, O.; GOLDBERG, P. K.; PAVCNIK, N. Trade reforms and wage inequality in Colombia. **Journal of Development Economics**, Amsterdam, v. 74, n. 2, p. 331-366, 2004. Available in: https://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FS0304-3878%2804%2900018-5;h=repec:eee:deveco:v:74:y:2004:i:2:p:331-366. Access in: 1 Nov. 2023.

AUTOR, D.; DORN, D.; HANSON, G. When work disappears: manufacturing decline and the falling marriage market value of young men. **American Economic Review**, Pittsburgh, v. 1, n. 2, p. 161-178, 2019. DOI: https://doi.org/10.1257/aeri.20180010

BORCHERT, I.; YOTO, V. Y. Distance, globalization, and international trade. **Economics Letters**, Amsterdã, v. 153, p. 32-38, Apr. 2017. DOI: https://doi.org/10.1016/j.econlet.2017.01.023

BUENO, E. U.; FEIJÓ, F. T. A entrada da Venezuela no mercosul: uma análise de equilíbrio geral computável sobre os impactos setoriais no Brasil. **Pesquisa e Planejamento Econômico**, Rio de Janeiro, v. 44, n. 1, p. 169-212, Apr. 2014. Available in: http://hdl.handle.net/10183/256208. Access in: 1 nov. 2023.

CASTILHO, M.; MENÉNDEZ, M.; SZTULMAN, A. Trade liberalization, inequality, and poverty in Brazilian states. **World Development**, Amsterdã, v. 40, n. 4, p. 821-835, Apr. 2012. DOI: https://doi.org/10.1016/j.worlddev.2011.09.018

CHAKRABARTI, A. Does trade cause inequality?. **Journal of Economic Development**, Seoul, v. 25, n. 2, p. 1-22, 2000. Available in: https://scholar.google.com/scholar?hl=pt-

br&as_sdt=0%2c5&q=chakrabarti%2c+avik+et+al.+%282000%29%2c+“does+trade+cause+inequality%3f”+in%3a+journal+of+economic+development%2c+25%282%29%2c+daejeon%2c+korea%2c+pp.+1–22.+&btng=. Access in: 1 Nov. 2023.

CHEN, J.; DABO, C.; AIPING, Y. Trade development between China and countries along the belt and road: a spatial econometric analysis based on trade competitiveness and complementarity. **Pacific Economic Review**, Hoboken, v. 25, p. 205-227, June 2020. DOI: https://doi.org/10.1111/1468-0106.12329

CHIMILILA, C.; SABUNI, C.; AMOS, B. Trade facilitation in EAC customs union: its achievement and implementation in Tanzania. **Journal of Economics and Sustainable Development**, [*s. l.*], v. 5, n. 25, p. 1-14, 2014. Available in: https://www.iiste.org/Journals/index.php/JEDS/article/view/17522. Access in: 1 Nov. 2023.

DAUMAL, M. The impact of trade openness on regional inequality: the cases o India and Brazil. **The International Trade Journal**, Abingdon, v. 27, n. 3, p. 243-280, 2013. DOI: https://doi.org/10.1080/08853908.2013.796839

EDWARDS, S. Trade policy, growth, and income distribution. **American Economic Review**, Pittsburgh, v. 87, n. 2, p. 205-210, May 1997. Avalaible in: https://www.jstor.org/stable/2950914. Access in: 1 Nov. 2023.

EZCURRA, R.; RODRÍGUEZ-POSE, A. Does economic globalization affect regional inequality?: a cross-country analysis. **World Development**, Amsterdã, v. 52, p. 92-103, 2013. DOI: https://doi.org/10.1016/j.worlddev.2013.07.00

FERREIRA, A. Convergence in Brazil: recent trends and long-run prospects. **Applied Economics**, Abingdon, v. 32, n. 4, p. 479-489, 2000. DOI: https://doi.org/10.1080/000368400322642

FERREIRA, F. H. G.; WALTON, M. **World development report 2006**: equity and development. Washington, DC: World Bank, 2005. v. 28. DOI 10.1596/978-0-8213-6249-5

FISHLOW, A. Brazilian size distribution of income. **American Economic Review**, Pittsburgh, v. 62, n. 1/2, p. 391-402, 1972. Avalaible in: https://www.jstor.org/stable/1821573. Access in: 1 Nov. 2023.

FRANKEL, J. A.; ROMER, D. H. Does trade cause growth? **American Economic Review**, Pittsburgh, v. 89, n. 3, p. 379-399, 1999. DOI 10.1257/Aer.89.3.379

GÓES, C.; KARPOWICZ, I. Inequality in Brazil: a closer look at the evolution in states. *In*: SPILIMBERGO, A.; SRINIVASAN, K. **Brazil**: boom, bust, and the road to recovery. Washington, DC: International Monetary Fund, 2019. p. 127-137.

GOÑI, E.; LÓPEZ, J. H.; SERVÉN, L. Fiscal redistribution and income inequality in Latin America. **World Development**, Amsterdã, v. 39, n. 9, Sept. 2011. DOI: https://doi.org/10.1016/j.worlddev.2011.04.025

GURGEL, A. C.; PEREIRA, M. W. G.; TEIXEIRA, E. C. **PAEG**: a estrutura do PAEG. Viçosa: Universidade Federal de Viçosa, 2013. Avalaible in:

http://arquivo.ufv.br/der/paeg/technical%20paper%20n.1_06dez2011.pdf. Access in: 1 nov. 2023.

HAMMAD, S. Brazil: current trade patterns with China threaten the promise of re-industrialization. **BNP Paribas**, Paris, 5 Apr. 2023. Available in: https://economic-research.bnpparibas.com/pdf/en-us/brazil-current-trade-patterns-china-threaten-promise-industrialization-4/5/2023,48437. Access in: 1 Nov. 2023.

HAP, S. **Trade liberalization and social welfare**: evidence from Cambodia. 2013. Thesis (Doctorate in Policy Studies) − National Graduate Institute for Policy Studies, Tokyo, 2013. DOI 10.13140/RG.2.1.2380.4325

HOEKMAN, B.; NICITA, A. Trade policy, trade costs, and developing country trade. **World Development**, Amsterdã, v. 39, n. 12, p. 2069-2079, 2011. DOI: https://doi.org/10.1016/j.worlddev.2011.05.013

HORRIDGE, M.; SOUZA, J. B. Would trade liberalization help the poor of Brazil? **World Bank**, Washington, DC, n. 106, June 2009. Avalaible in: http://hdl.handle.net/10986/28171license:ccby30igo. Access in: 1 Nov. 2023.

KAHAI, S. K.; SIMMONS, W. The impact of globalisation on income inequality. **Global Business and Economics Review**, Genebra, v. 7, n. 1, p. 1-15, Apr. 2005. DOI: https://doi.org/10.1504/gber.2005.006915

LANGONI, C. G. Distribuição da renda e desenvolvimento econômico no Brasil: uma afirmação. **Estudos Econômicos**, São Paulo, v. 8, n. 38, p. 5-88, Oct. 1974. Avalaible in: https://www.revistas.usp.br/ee/article/view/143252/137981. Access in: 1 Nov. 2023.

MENEZES FILHO, N. A.; RODRIGUES JR., M. Openness, technology and skills: evidence from the brazilian manufacturing. *In*: WORKSHOP ON TRADE LIBERALIZATION AND THE LABOR MARKET IN BRAZIL, 2001, Brasília, DF. **Proceedings** [...]. Brasília, DF: Universidade de Brasília: IPEA, 2001.

NERI, M. C.; SOUZA, P. H. G. F. **A década inclusiva (2001-2011)**: desigualdade, pobreza e políticas de renda. Brasília, DF: IPEA, 2012.

PEARSON, K. R.; PARMENTER, B. R.; POWELL, A. A.; WILCOXEN, P. J.; DIXON, P. B. **Notes and problems in applied general equilibrium economics**. Haarlem: North Holland, 2014.

PORTO, P. C. S.; CANUTO, O.; MORINI, C. **The impacts of trade facilitation measures on international trade flows**. Washington, DC: The World Bank, 2015.

RIBEIRO, G. L. **Outras globalizações**: cosmopolíticas pós-imperialistas. Rio de Janeiro: EDUERJ, 2014.

RODRIGUEZ, F.; RODRIK, D. Trade policy and economic growth: a skeptic's guide to the cross-national evidence. **NBER Macroeconomics Annual**, Chicago, v. 15, p. 261-325, 2000. DOI: https://www.journals.uchicago.edu/doi/pdf/10.1086/654419.

RUTHERFORD, T. F. Extension of GAMS for complementarity problems arising in applied economic analysis. **Journal of Economic Dynamics and Control**, Amsterdam, v. 19, n. 8, p. 1299-1324, 1995. DOI: https://doi.org/10.1016/0165-1889(94)00831-2.

RUTHERFORD, T. F.; PALTSEV, S. V. **Gtapingams and GTAP-EG**: global datasets for economic research and illustrative models. Boulder: University of Colorado, 2000.

SACCONATO, A. L.; MENEZES FILHO, N. A diferença salarial entre os trabalhadores americanos e brasileiros: uma análise com micro dados. *In*: ENCONTRO NACIONAL DE ECONOMIA, 29., 2001, Niterói. **Anais** [...]. Niterói: ANPEC, 2001. Avalaible in: https://www.researchgate.net/profile/naercio-menezes-filho/publication/4730064_a_diferenca_salarial_entre_os_trabalhadores_americanos_e_brasileiros_uma_analise_com_micro_dados/links/56efd73908ae01ae3e70de40/a-diferenca-salarial-entre-os-trabalhadores-americanos-e-brasileiros-uma-analise-com-micro-dados.pdf. Access in: 1 nov. 2023.

SILVEIRA NETO, R. D. M.; AZZONI, C. R. Non-spatial government policies and regional income inequality in Brazil. **Regional Studies**, Abingdon, v. 45, n. 4, p. 453-461, 2011. DOI: https://doi.org/10.1080/00343400903241485.

SKIDMORE, T. E. Policy issues Brazil's persistent income inequality: lessons from history. **Latin American Politics and Society**, Cambridge, v. 46, n. 2, p. 133-150, 2004. DOI: https://doi.org/10.1111/j.1548-2456.2004.tb00278.x.

TAYLOR, L.; BACHA, E. L.; CARDOSO, E. A.; LYSY, F. J. **Models of growth and distribution for Brazil**. Washington, DC: World Bank, 1980. Avalaible in: https://scholar.google.com/scholar?hl=pt-br&as_sdt=0%2c5&q=taylor%2c+lance+et+al.+%281980%29%2c+"models+of+growth+and+distribution+for+brazil"%2c+in%3a+world+bank+research+publication%2c+ibrd%2802%29%2ft2%2c+oxford+university+press%2c+c1980%2c+oxford%2c+england+xii%2c+355+p.&btng=. Access in: 1 nov. 2023.

TOLIPAN, R.; TINELLI, A. C. **A controvérsia sobre distribuição da renda e desenvolvimento**. Rio de Janeiro: Zahar, 1975.

UNITED STATES OF AMERICA. Office of The United States Trade Representative. Countries and regions: Western Hemisphere, Brazil. **USTR**, Washington, DC, 2023. Avalaible in: https://ustr.gov/countries-regions/americas/brazil. Access in: 16 Mar. 2023.

WINTERS, L. A. Trade liberalization and poverty: what are the links? **World Economy**, Hoboken, v. 25, n. 9, p. 1339-1367, 2002. DOI: https://doi.org/10.1111/1467-9701.00495.

WOLF, R. **Assessing the impacts of labour skill improvement in Bolsa Família Program beneficiaries**: a computable general equilibrium model analysis. 2021. 164 f. Tese (Doutorado em Economia Aplicada) – Universidade Federal de Viçosa, Viçosa, 2021. Avalaible in: https://locus.ufv.br//handle/123456789/28807. Access in: 1 Mar. 2023.

WOLF, R.; TEIXEIRA, E. C.; PEREIRA, M. W.; GURGEL, A. C.; MARQUES, H. L. T. **Effects of the bolsa família program on income and consumption in Brazilian macroregions**. West Lafayette: Purdue University, 2018.

YITZHAKI, S.; SCHECHTMAN, E. The Lorenz Curve and the concentration curve. *In*: YITZHAKI, S.; SCHECHTMAN, E. **The gini methodology**: a primer on a statistical methodology. New York: Springer, 2013. p. 75–98.

ZHAO, S.; CHANG, T.; NI, Y.; ZHOU, P. An empirical study of trade in goods between China and Brazil: analysis of competitiveness and complementarity. **Economies**, Basel, v. 11, n. 9, p. 224, 2023. DOI: https://doi.org/10.3390/economies11090224.