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INCOME INEQUALITY AND ECONOMIC FREEDOM REVISITED: ARE FREEDOM AND EQUALITY CONFLICTING VALUES?

Evidence from the Twenty-First Century.

Dissertation under the scope of the Master in Economics with the supervision of Professor José Alberto Serra Ferreira Rodrigues Fuinhas and presented to the Faculty of Economics of the University of Coimbra in partial fulfilment of the requirements for the Degree of Master.

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To Fernando and Maria, on behalf of love.
I will always carry the touch of your sore hands.

To Francisco and Fernanda, on behalf of love.
May you always have the courage to smile.

Só direi,
Crispadamente recolhido e mudo,
Que quem se cala quando me calei
Não poderá morrer sem dizer tudo.

[José Saramago (1981)]

Resumo

Este trabalho empírico focou-se na análise de curto e longo-prazo entre liberdade económica e desigualdades de rendimento, com base num painel de 102 países entre 2000 e 2018 construído utilizando as bases de dados mais recentes disponíveis. Metodologicamente, este estudo fez uso de um modelo *Autoregressive Distributed Lag* de forma a lidar com problemas econométricos relacionados com endogeneidade e não-estacionariedade. No geral, os resultados mostram que liberdade económica impacta negativamente as desigualdades de rendimento (medida por qualquer indicador), sendo essa relação, no entanto, relativamente inelástica. Adicionalmente, esta investigação subdividiu o índice de liberdade económica nos seus 5 principais componentes. Os resultados indicaram igualmente uma relação positiva (e inelástica), à exceção da componente Regulação, que parece impactar negativamente as desigualdades de rendimento. O estudo encerra com sugestões futuras sobre o impacto da regulação na distribuição do rendimento assim como possíveis estruturas de trabalho para reimaginar se os benefícios de liberdade económica no sistema económico são superiores aos custos para as desigualdades de rendimento.

Palavras-chave: Desigualdade de Rendimentos; Liberdade Económica; Índice de Gini; Dados em Painel; Economia Política

Classificação Jel: D63; F62; H11; O15; P16

Abstract

This empirical research addresses the short- and long-run relationship between economic freedom and income inequality. This study constructed a panel of 102 countries between 2000 and 2018, employing the most recent databases available. It made use of an autoregressive distributed lag approach to deal with non-stationarity and endogeneity problems. Overall, the results showed that economic freedom has regressive impacts on income inequality measured by any of the main indicators, but that relationship is relatively inelastic. Furthermore, economic freedom was subdivided into its five subcomponents. The results still support an inelastic relationship but point towards a negative association between [de]regulation and income inequality both in the short and long run. This paper closes with future guidelines for research on the impact of regulation on income distribution as well as on reimagining if the benefits of economic freedom on the overall economic system surpass the costs of increased income inequality.

Keywords: Income Inequality; Economic Freedom; Gini index; Panel Data; Political Economics

Jel Classification: D63; F62; H11; O15; P16

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Introduction

This work revisits the empirical relationship between economic freedom and income inequality, a debate that started soon after the open release of the first measures of Economic Freedom. Although this is a contradictive discussion, economic evidence has supported the idea that economic freedom fosters economic growth, whereas economic growth reduces income inequality. But is that simple association clear? This paper tries to guide answers about whether the benefits of increases in economic freedom (and which ones) surpass the costs of overall lower government social states and policies (that typically reduce economic freedom).

The argument is constructed as follows. Part I introduces the theoretical framework needed first to understand what is being measured and how income inequality (as a concept) can have different measurement methodologies. Also, in this first part, the concept of economic freedom is explained, and the possible economic mechanisms that may impact inequality are presented, together with the literature review. Then, part II of this paper presents the empirical analysis. This research employed an error correction model through a linear transformation of an autoregressive distributed lag model (ARDL) for a panel of 102 countries in the twenty-first century to study the short- and long-run impacts of economic freedom (and its subcomponents) on income inequality. Additionally, a sensitivity analysis was made to changes in the main variable of interest and in the dependent variable to check the robustness of the empirical results. Finally, the second part of this work closes with concluding remarks.

This empirical assessment improves the economic literature on freedom-inequality nexus for three reasons. First, it employs the most recent database versions available for income inequality (SWIID version 9.0) and economic freedom (EFW 2020 chain-linked master data and IEF 2021 version), which allows constructing a balanced panel while most of the previous studies made use of unbalanced frameworks. Second, and to the best of one's knowledge, this is the first study of this matter to document a model specification test for omitted variables and the overall model specification. Third, making use of the ARDL methodology, the possible endogeneity problems that arise if income inequality impacts economic freedom and the possible spurious regression problems (caused by non-stationary variables) are explicitly accounted for.

Part I. Theoretical Framework

The first part of this work will briefly present the intellectual framework behind the empirical analysis. Some underlying concepts are first needed to truly account for the difficult task of specifying, estimating and discussing income inequality. Part I uses notable work already published to present different concepts and points of view into the most-known conflicting debate about income inequality and an explicit explanation regarding the concept of economic freedom and its foundations. At the same time, one tries to keep the theoretical simplicity of such extensive issues to assure a comprehensive approach for the rest of the paper. As (i) the author aims only to reproduce the main ideas behind the following concepts; and (ii) because issues of this magnitude deserve an extensive analysis, Part I output is sheltered by main economic literature. Note, for example, that some of the following explanations are derived from complex mathematical frameworks that are not the scope of this study and can be examined in more detail following the references outlined along the course of this paper. Hence, the usual caveats apply. Part I is concluded by presenting the literature review on the freedom-inequality nexus.

1. A brief overview of income inequality patterns: concept and measurement matter.

To begin this section, one should emphasize what income inequality means. Note first that concept matters. Income, in its essence, refers to labour income, capital earnings and welfare policy outcomes on income distribution (such as government taxes and transfers). Piketty (2015)[1] summarizes:

[1] In his book *Capital in the Twenty-First Century*, Piketty makes an interesting point that he called "The Fundamental Forces of Divergence". The author argues that when the rate of return of capital is greater than the rate of economic growth (as it was until 1900 and expected to be in the twenty-one century), concentration of wealth will continue to rise, increasing inequality of income from capital.

> By definition, in all societies, income inequality is the result of adding up these two components: inequality of income from labor and inequality of income from capital. The more unequally distributed each of these two components is, the greater the total inequality. (p. 242)

The extended discrimination between the two former concepts will not be done here. Nevertheless, it is intuitive to understand that inequality from capital derives from financial applications, investments and savings. In contrast, inequality from labour is determined by wage differences, vulnerable employment, and gender inequality. Therefore, it is once again intuitive to recognize that inequality from capital is much more unequal (and concentrated in the top shares) than inequality from labour.

Turning to inequality patterns, it was clear that economies experienced high economic growth and prosperity after World War II, where between-country income inequality decreased. Since the 1990s, however, there is evidence of an "inequality turn" in most developed and high middle-income countries due to, as argued in Palma (2019), (i) globalization, (ii) the increasing dominance of the financial sector over the non-financial sector and (iii) technological progress (job disruption). Moreover, the previous ideas also reveal themselves as the cause for a "catch-up" of Latin America and African countries in inequality values until 2010 (due to transfers of technology from developed to less developed countries).

Although relative differences[2] in inequality amongst countries are slowly declining, absolute disparities[3] are rising. Note, for example, as the United Nations (2020) points out:

> The average income of people living in the European Union is 11 times higher than that of people in sub-Saharan Africa; the income of people in Northern America is 16 times higher than that of sub-Saharan Africans. While low-income countries are growing faster than high-income countries, the absolute gap between the mean per capita incomes of high- and low-income countries increased from about $27,600 in 1990 to over $42,800 in 2018. (p. 22)

From 1990 to 2016, in 119 countries, income inequality measured by the Gini Coefficient[4] increased in 49 countries (mostly in developed countries) and decreased in

[2] That is, normalized by the current mean of the income distribution.

[3] Not normalized by the current mean of the income distribution.

[4] See the next section for inequality measures.

58 (mostly in developing ones). Therefore, one notes that relative global income inequality between countries is decreasing. However, countries that have seen increasing inequality sum up to 70 per cent of the world population (ibid, p. 26).

Although the Gini Coefficient cannot give information about changes in the shares of the income distribution, analysis under other indicators concludes that income is continuously more concentrated at "the top of the ladder". Trends in income inequality reveal that absolute differences are increasing. There is a stagnation of the income of the poor (showing a decrease in the share of the income distribution), while there has been considerable growth in the share of the richest (Gradín et al., 2021).

Yet, Ravallion (2021) points that, in the contradicting debate if inequality is, indeed, rising or decreasing, one should note:

> With sufficient ethical aversion to lack of progress by the poorest, or to steeply rising top incomes, one concludes that global inequality has been rising. A focus on the middle of the global distribution suggests that relative inequality is falling (…) Different sides in that debate appear often to hold different ideas about what 'inequality' means (…). Those who talk about the widening gap between rich and poor appear to have in mind absolute inequality, not relative inequality. Yet one cannot say that one of these concepts is right and the other wrong—the difference is solely based on the choice between two rival axioms[5] in the theory of inequality measurement. (pp. 42-43)

In conclusion, the inequality debate is divided between two rival axioms in inequality measurement theory. It is also divided into different ways of addressing the same problem, which implies different approaches to public policies. As noted above, if one believes that the key question is in the difference between "the rich" and "the poor", one may conclude that it is irrelevant to look at the middle picture since the bottom issue lies in the tails. On the other side, if one believes in the social elevator and sustainable growth, one may argue that a more equal and stronger middle-class (whatever concept that may be) is the appropriate answer to reduce disparities amongst individuals/households, populations and countries.

However, keep in mind that this is not just a question of ideology, social justice, or welfare. Generally, the richest have appropriated the biggest share of the income

[5] Scale invariance axiom (the measure of inequality does not change when all incomes are multiplied by a constant) *vis-à-vis* translation invariance (which says that the inequality measure is unaffected by adding a constant). See Cowell (2016) for a full review of income inequality measurement.

distribution, and the poorest share has stagnated. Nevertheless, income inequality seems to have decreased amongst the middle shares within and between countries.

2. Income Inequality Measures

For a long time, economists have tried to measure inequality in income distribution. This section briefly approaches the main inequality measures available for empirical research and follows the work of Amartya Sen and James Foster in Sen and Foster (1997).

Before accessing these measures, one needs to distinguish between inequality of income outcomes and inequality of opportunity in income acquisition (such as access to education, background limitations, poverty). While the latest is crucial to understand what lies beyond the veil of economic inequality, these metrics - as observable indicators - focus on measuring income outcomes in its distribution (Trapeznikova, 2019).

a) Gini Coefficient

The most cited and known measure in the literature is the Gini coefficient presented by Gini (1912) and derived from the work of Lorenz (1905). Figure 1 shows the Lorenz Curve:

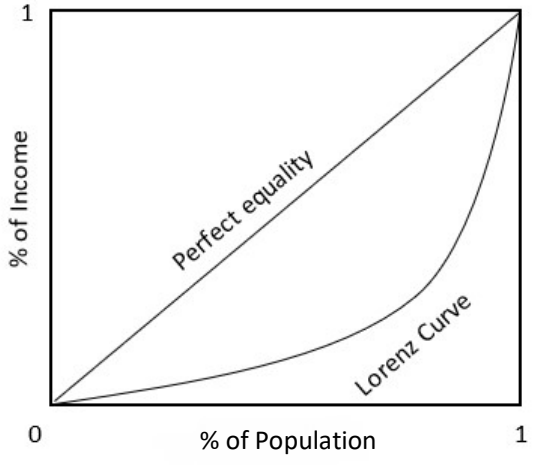

Figure 1. Lorenz Curve. Source: adapted from Sen and Foster (1997)

The diagonal line represents an even income distribution (for example, when 20% of the population gets 20% of total income); the Lorenz curve[6] represents the actual income distribution amongst the population. The further is the Lorenz curve from the diagonal line, the more unequal is the income distribution.

The Gini Coefficient varies from zero to one (a higher Gini represents an unequal distribution) and is independent of the size of the economy and population. As Sen and Foster (1997, p. 30) put it[7]:

$$Gini\ Coefficient = \frac{Area\ between\ the\ line\ of\ absolute\ equality\ and\ the\ Lorenz\ Curve}{Triangular\ area\ underneath\ the\ diagonal} \quad (1)$$

As the former notes, "one appeal of the Gini coefficient, (…) lies in the fact that it is a very direct measure of income difference, taking note of differences between every pair of incomes" (ibid, p. 31). However, constraints lie in the fact that different income distributions can have the same Gini Coefficient once this coefficient does not respond on the same basis to transfer in upper-to-lower tails as it does in the middle of the income distribution.[8]

b) Atkinson Measure

Atkinson index measure follows the work of Atkinson (1970), varies from zero to one (higher Atkinson means higher inequality), and illustrates the percentage of the total income distribution that society would need to forego to have equal shares of income. As again better explained by Sen and Foster (1997):

> Atkinson defines what he calls 'the equally distributed equivalent income' of a given distribution of a total income, and this is defined as that level of per capita income which if enjoyed by everybody would make total welfare exactly equal to the total welfare generated by the actual income distribution. (p.38)

[6] For a detailed explanation of the Lorenz Curve see Gastwirth (1971).

[7] For an extensive mathematical analysis of the Gini Coefficient see Farris (2010).

[8] Let A be an economy where half of the population gets 0% of total income and the other half gets 100% ; B an economy where two thirds of the population gets 25% of total income and one-quarter of the population gets 75%. Then, $Gini\ Coefficient_A = Gini\ Coefficient_B = 0.5$ (Trapeznikova, 2019).

We will leave the mathematical formalization of the Atkinson out of the scope of this paper.[9] However, as Sen and Foster (1997) argue, one should note that relatively different income distributions can present the same Atkinson Index due to the formalization of the welfare function used in its formula.

c) Theil's Entropy Measure

Another interesting measure is Theil's Index, proposed by Theil (1967). Theoretically, this index measures the (entropic) distance between the actual and egalitarian income distribution. It is derived from informational theory and is placed on a scale of 0 to 1 (a higher Theil indicates elevated inequality). Once more, the math behind statistical information theory and Theil's index is out of the scope of this work[10]; however, as explained by Conceição and Ferreira (2000):

> The idea is that the Theil index provides a measure of the discrepancies between the distribution of income and the distribution of population between groups. Essentially, the Theil index compares the income and population distribution structures by summing, across groups, the weighted logarithm of the ratio between each groups income and population shares. When this ratio is one for some group, then this group's contribution to inequality is zero. When all the groups have a share of income equal to their population share, the overall Theil measure is zero. (p. 13)

Nonetheless, although it was surprisingly interesting the use of entropy in social sciences, Sen and Foster (1997) argue that Theil's index is an arbitrary formula and "the average of the logarithms of the reciprocals of income shares weighted by income shares is not a measure that is exactly overflowing with intuitive sense" (p. 36).

d) Palma Ratio

The so-called Palma ratio was formulated by Cobham and Sumner (2013) and derived from the work of Palma (2011). Palma (2011) concludes that changes in income distribution in middle-income shares are relatively stable over time and countries, meaning that middle-class income shares (decile 5 to 9) appropriate roughly half of the

[9] See Atkinson (1970) for a detailed explanation or Sen and Foster (1997, p. 38).

[10] Fully explained in Sen and Foster (1997, pp. 34-36)

gross national income, while the remaining half is shared amongst the richest 10% and the poorest 40%. Palma ratio formalization is straightforward:

$$Palma\ ratio = \frac{top\ 10\%\ share\ of\ gross\ national\ income\ (GNI)}{bottom\ 40\%\ share\ of\ gross\ national\ income\ (GNI)} \quad (2)$$

Equation (2) shows that the Palma is greater when the ratio between the share of the richest 10% to the share of the bottom 40% increases (in Gross National Income: GNI). Therefore, a higher Palma ratio means that the concentration of wealth is in the richest share of the income distribution. For example, a Palma ratio of 5 means that the top 10% share appropriates five times more income than the bottom 40% share.

Palma ratio is a reliable alternative to the dominance of the Gini Coefficient in empirical practice. Policy applications are much more intuitive when working with the Palma ratio than the Gini Coefficient because researchers can access the actual change in income shares. However, as a relatively recent income inequality measure, data on Equivalized/Comparable Palma ratio still is limited.

3. The concept of Economic Freedom

Economic Freedom (EF) is a conception associated with an economically free society. It follows the [neo]liberal economic view where individuals should determine what best suits their interests and have the freedom to do so. But what does that mean? Full Economic Freedom exists when individuals can produce, consume, and trade goods and services with no constraints: oppression, government control, violence, or fraud. Its concept relies on maximum autonomy (not anarchy) in individual actions combined with minimum obstruction when pursuing their goals.

Gwartney et al. (1996) were responsible for creating the Frasier Institute measure for economic freedom, eleven years after a meeting where Milton Friedman himself noted the absolute lack of data to measure EF (Hall and Lawson, 2014). This data has been updated since. In the beginning, Gwartney et al. (1996) referred that the "central elements of economic freedom are personal choice, protection of private property, and freedom of

exchange" (p. 15). That idea has not changed but otherwise completed in the following years. The most recent definition by Gwartney et al. (2020) explains the following:

> The cornerstones of economic freedom are personal choice, voluntary exchange, open markets, and clearly defined and enforced property rights. Individuals are economically free when they are permitted to choose for themselves and engage in voluntary transactions as long as they do not harm the person or property of others. When economic freedom is present, the choices of individuals will decide what and how goods and services are produced. Put another way, economically free individuals will be permitted to decide for themselves rather than having options imposed on them by the political process or the use of violence, theft, or fraud by others. (p. 1)

Milton Friedman, in the first pages of his famous *Capitalism and Freedom*, already had introduced the idea that to preserve freedom in a broader sense, the government should have a "limited to the necessary" scope (Friedman, 1962):

> Its [the government] major function must be to protect our freedom both from the enemies outside our gates and from our fellow-citizens: to preserve law and order, to enforce private contracts, to foster competitive markets. Beyond this major function, government may enable us at times to accomplish jointly what we would find it more difficult or expensive to accomplish severally. (…) By relying primarily on voluntary co-operation and private enterprise, in both economic and other activities, we can insure that the private sector is a check on the powers of the governmental sector and an effective protection of freedom of speech, of religion, and of thought. (pp. 2-3)

In essence, the concept of economic freedom favours the idea that individuals should have the proper conditions to pursue their interests (the fewer constraints, the better), where the state should only interfere in the fundamental issues of society that are out of the scope of an individual agent (such as protection, law, justice, provision of essential public goods). Additionally, the economy should rely on individual agents' interactions (supply *vis-à-vis* demand), supported by the classic liberal idea that individuals promote social welfare by promoting their self-interest[11].

Therefore, economic freedom stresses the importance of private property, free domestic and international markets, the rule of law, and the government's limited role. Note, however, that the idea of economic freedom does not mean pure laissez-faire capitalism.

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[11] Recall that this idea was long presented by Adam Smith in 1779 (Smith, 1977):

> He is in this [in its individual action], as in many other cases, led by an invisible hand to promote an end which was no part of his intention. (…) By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. (pp. 523-524)

Hence, following Miller and Kim (2013), the conception of EF is based on five general principles:

- Rule of Law: whereby all individuals are viewed as equal in respect to the Law and Justice;
- Reduced Government Size: low impact of the government on the economy as government expenditures and fiscal policies; the idea of a strong government and not a big government;
- Market Openness: the idea of free markets that involves freedom to trade (domestically and internationally), the openness of the financial system to the economy and freedom in investments and capital markets.
- Regulatory Efficiency: flexible labour, business and financial regulation with low red tape costs.
- Access to sound Money: stable money/coin not subject to sudden depreciation or appreciation.

In the same direction as the principles noted above, Berggren (2003) already had brought the concept of Economic Freedom to a summarized conclusion:

> Economic freedom is a composite that attempts to characterize the degree to which an economy is a market economy—that is, the degree to which it entails the possibility of entering into voluntary contracts within the framework of a stable and predictable rule of law that upholds contracts and protects private property, with a limited degree of interventionism in the form of government ownership, regulations, and taxes. (p. 194)

Recall that a market economy is an economic system where pricing and economic decisions are guided by the interaction between demand and supply of individual agents. Therefore, EF exists when institutions and political systems provide (i) effective legal frameworks and (ii) economic and financial infrastructures for private ownership and voluntary exchange, preserving the freedom to choose in individual actions.

4. The measurement of economic freedom

As noted above, Gwartney et al. (1996) were responsible for creating the Economic Freedom of the World Index (EFW) of the Frasier Institute. Another much-cited measure is the Index of Economic Freedom (IEF), created roughly at the same time by The

Heritage Foundation and The Wall Street Journal. Both indicators present similarities despite different methodological frameworks.

4.1. Economic Freedom of the World (EFW)

EFW index was constructed to measure the degree to which countries' institutions and policies protect individuals and their properties from other ones' hostility. EFW index is placed on a zero-to-ten scale, having the higher scores in countries whose institutions provide infrastructures for private ownership and voluntary exchange (higher economic freedom). The overall EFW index is a composite indicator that averages five different subcomponents also placed on a zero-to-ten scale (calculated from around 42 distinct variables collected and harmonized from different sources). Following Gwartney et al. (2020), these subcomponents are[12]:

a) Size of the government: economic freedom is reduced when public decision-making substitutes individual choice. Increases in public spending, taxation and public enterprise ownership strengthen the weight of the government on the economy;
b) Legal System and Property Rights: the government should ensure the capability of the legal system to protect citizens and their rightfully acquired property;
c) Sound Money: a non-stable monetary policy erodes the rightfully earned wages, savings and investments, therefore reducing economic freedom;
d) Freedom to Trade Internationally: barriers to international markets reduce economic freedom by reducing the freedom to exchange (buying, selling, making contracts);
e) Regulation: onerous regulations and barriers to entry limit the possibility of establishing and operating a business, affecting labour demand and supply and opposing the right to exchange freely.

Additionally, as Gwartney and Lawson (2003) point out, the EFW index can be viewed as a country's position on the political spectrum (minimal *vis-à-vis* dominant state) or in the "left-right" continuum (pure socialism *vis-à-vis* laissez-faire capitalism). As global economies tend to lie somewhere between the two extreme alternative forms of economic

[12] Full methodology, data collection and indicators review can be accessed in Gwartney et al. (2020, pp. 213-225)

organization, this view describes the political positioning regarding the economy. However, as Friedman (1962) explains, economic freedom is a necessary but not a sufficient condition for political freedom:

> "Fascist Italy and Fascist Spain, Germany at various times in the last seventy years, Japan before World Wars I and II, tzarist Russia in the decades before World War I—are all societies that cannot conceivably be described as politically free. Yet, in each, private enterprise was the dominant form of economic organization. It is therefore clearly possible to have economic arrangements that are fundamentally capitalist and political arrangements that are not free." (p. 10)

4.2. Index of Economic Freedom (IEF)

The Index of Economic Freedom follows the same concept reasoning of EF described above. However, methodologically different, Heritage and Wall Street's IEF is built by averaging equally twelve components placed on a scale of zero to one-hundred, with higher scores representing higher EF. These components are also based on the five principles of Economic Freedom presented in Section 3. According to Miller et al. (2021), Table 1 presents the 12 subcomponents and their associated principles:

Table 1. Decomposition of the Overall IEF index

Principle	The 12 subcomponents of overall IEF
Rule of Law	• Property rights; Judicial Effectiveness; Government Integrity.
Government Size	• Tax burden; Government Spending; Fiscal Health.
Regulatory Efficiency	• Business Freedom; Labour Freedom; Monetary Freedom[13].
Market Openness	• Trade Freedom: Investment Freedom; Financial Freedom.

The 12 subcomponents present above are calculated using 60 (sixty) different variables collected from different sources.[14]

[13] The Principle of Access to Sound Money is embodied in Monetary Freedom.

[14] Full methodology, data collection and indicators review can be accessed in Miller et al. (2021, pp. 453-465).

5. Underlying economic mechanisms between economic freedom and income inequality

Policies that promote economic freedom necessarily impact societies' equality situation through changes in welfare policies (such as the redistribution and fiscal system) and economic mechanisms that influence income growth. This section introduces the main theoretical mechanisms (divided by the five principles exposed in Section 3) that may impact that relationship.

Principle 1. Government Size

Theoretically, it is expected that larger welfare states (higher government size) are associated with higher income equality as public transfers and subsidies usually decrease the pre-tax and transfer level of income inequality (Åberg, 1989). Those welfare policies are typically achieved by a progressive tax system in which those with higher incomes pay higher tax rates. A welfare state can also decrease inequality by equalizing opportunities for income acquisition (p.e. access to education and health care, public employment, education). On the other side, as Korpi and Palme (1998) emphasize, there is a welfare paradox. The more public policy targets lower-income individuals, the less likely a society can reduce income inequality[15].

Principle 2. Rule of Law (Property rights and legal systems)

Sonin (2003) argues that higher property protection decreases income inequality once it enables growth levels to increase (via consumption and investment) and assures higher safety against corruption and hostility. On the other side, as Wade (2006) presented, the liberal idea is that income inequality is an inevitable consequence of property rights and market economies. Moreover, property protection will benefit those who own more property by increasing their property value via tenure security (Carter, 2007).

[15] Korpi and Palme (1998, pp. 36-40) found that (i) providing earnings-related benefits to high-income agents is more effective in reducing income inequality than targeted benefits to low-income individuals; (ii) there is a trade-off between the extent of low-income targeting and the size of the redistributional system's budget; and (iii) low-income targeted redistribution seems to be more unequal than earnings-related social insurance programs. Therefore, the authors conclude that the more societies concern about reducing income inequality via public transfers, the less likely are to achieve income equality.

Principal 3. Regulation

The relationship between regulation and income inequality is theoretically ambiguous. On one side, workers' protection (wage, rights, labour conditions) is affected by labour regulation, and it seems that deregulation may increase income inequality (Tridico, 2018). On the other side, financial deregulation increases capital income by expanding household economic opportunities such as easier access to credit to invest in human capital (Agnello et al., 2012); also, business regulation (entry-barriers, fees, procedures) are harmful to income equality because it hampers job creation and the establishment of low-income individuals in many industries (Chambers et al., 2019).

Principle 4. Sound Money

Inflation is considered the worst tax on the poor and is linked to increased income inequality by eroding income (Albanesi, 2007). Sound money is not inflation but money not liable to unaccounted appreciation or depreciation (in value). By protecting money's value, sound money states seem to effectively reduce the economic consequences of inflation or deflation and their outcomes on income inequality.

Principle 5. Trade Openness

Economic debate on this theme suggests that international trade has regressive impacts on income inequality. Goldberg and Pavcnik (2004) documented that trade liberalization is associated with a negative impact on the wages of unskilled workers. Winters et al. (2004) presented a detailed argument to show that trade liberalization is harmful to the low-income share of the population. A great part of economic literature is in line with the Stolper-Samuelson theorem (Stolper and Samuelson, 1941) that states that increasing trade between developed and developing countries increases downward forces on unskilled wages and a rise in skill-wages, therefore increasing income inequality.

6. The relationship between economic freedom and income inequality: a literature review on freedom-inequality nexus.

Since the first indicators of EF were created, many scholars have assessed the impact of economic freedom on economic outputs such as economic growth, income distribution,

investment capacity, poverty, democracy and, amongst others, corruption.[16] In fact, as Hall and Lawson (2014) documented, of the 198 articles (at the time) where EF was imputed as an independent variable in an empirical model, 134 studies found that EF corresponded to a "good" economic outcome while only eight papers found a "bad" outcome associated with EF. For example, economic literature consistently supports the idea that economic freedom fosters economic growth (Barro, 1996; Carlsson and Lundström, 2002; De Haan and Sturm, 2000). However, a great part of the studies that found a "bad" outcome related to EF assess the relationship between economic freedom and income inequality.

The theoretical (as explained in the previous Section 5) and the empirical foundations of the freedom-inequality nexus are ambiguous. To the best of one's knowledge, this debate first started with the work of Berggren (1999). Using cross-series analysis with inequality data extracted from Deininger and Squire (1996) for 66 countries between 1975 and 1985 with a 10-year average (to level with the availability of EFW data), Berggren (1999) found that while increases (changes) in EF reduce income inequality, the levels of EF in 1985 were related to lower equality. The author imputes these results first because economic freedom enables the gross income of the poor, on average, to increase faster than the gross incomes of the rich, and second because higher economic freedom lowers redistribution policies and therefore promotes inequality before the changes of EF are recognized by the economic system, respectively. Hence, the author concluded that reduced progressiveness in redistribution policies increases income inequality, but the poorest's income growth improves equality.

However, Scully (2002) pointed out that Berggren (1999) failed to adjust the inequality measures unit in his study to allow comparison. Employing a multi-equation framework based on the same (improved) inequality database for 26 advanced industrial countries between 1975 and 1990, Scully (2002) found that increases in EF raise the income share of the two lowest quintiles and lower the share of income of the highest quintile while having no statistical significance on the others. Additionally, Scully (2002) found that a higher level of EF also improves the distribution of market income. The author then

[16] See, amongst others, Berggren (2003); Krieger and Meierrieks (2016); Gwartney et al. (1999); Feldmann (2017); Bengoa and Sanchez-Robles (2003); Graeff and Mehlkop (2003); Gehring (2013); Dreher et al. (2012)

concluded that Economic Freedom reduces income inequality through the factors exposed above. Nonetheless, even correcting from different units on inequality measures, Scully's work seems to suffer some problems regarding data comparability.

Interestingly, Carter (2007) joined this discussion, noting the crucial errors in both studies, aside from data and methodology. To begin, Carter (2007) showed that Berggren (1999) errs in interpreting his results since his model is mathematically equivalent to a distributed lag model, resulting in that the short-run effect of EF is to increase equality while the long-run effect is to increase inequality. Then, upon inspection, Carter (2007) argued that little confidence could be assigned to Scully's work based on his results' standard errors and t-statistics. Moreover, employing an unbalanced panel of 123 countries and six-time periods of 5 years (1975-2004) with data extracted from the World Income Inequality Database v2 and a model estimated by least squares with White's panel-robust standard errors, Carter (2007) found a U-shaped relationship between Economic Freedom and Income Inequality where the marginal effect of EF in inequality turns (from positive to negative) at an EFW of 4.028, concluding that EF increases inequality in the long-run, mainly because it reduces government redistribution, thus documenting the existence of a trade-off.

Bergh and Nilsson (2010) decomposed the EFW index into its five major subcomponents. They estimated a fixed-effect model of income inequality as a function of EF and globalization with data of inequality collected from the Standardized World Income Inequality Database (version 1) for 80 countries between 1975 and 2000. Estimating a model using a system GMM estimator, Bergh and Nilsson (2010) found that freedom to trade internationally and deregulation positively affect income inequality. Clark and Lawson (2008) employed a 2SLS model to estimate the relationship between economic growth, tax policy and EF on income inequality. Their results suggested that increases in EF are associated with decreases in income inequality.

In order to reduce the disparities that arise from the different political structures and country's institutions, Ashby and Sobel (2008) studied the impact of EF on income inequality in the United States. The authors' results suggested that increases in EF are associated with higher incomes and higher income growth for the lowest, middle and highest income quintile. In part similar to Berggren (1999), the authors concluded that increases in EF reduce relative income inequality, although, on the contrary, the level of

EF is generally insignificant. Following the same reasoning, Apergis et al. (2014) investigated the causal relationship between income inequality and EF in the United States between 1981 and 2004, employing a Granger-causal analysis within a panel error correction model. The authors' results showed bidirectional causality both in the short and the long run and suggested (i) that high-income inequality may lead the states to increase redistribution policies, therefore reducing Economic Freedom; and (ii) similar to Ashby and Sobel (2008), income inequality is reduced with increases in EF, both in short and in the long-run. Still, in the same US context, Bennett and Vedder (2013) examined the dynamic relationship between 1979 and 2004, employing a fixed-effects regression. The authors found evidence that EF reduces income inequality. However, it depended on the initial level of EF, suggesting an inverted U relationship. Additionally, the authors evidenced an existing lag between changes in EF and decreases in income inequality as the former takes time to bring into play its effects.

Pérez-Moreno and Angulo-Guerrero (2016) constructed an unbalanced panel for 28 EU members between 2000 and 2010 and examined the relationship between the decomposed EFW and income inequality. The results suggested that smaller government sizes and deregulation increase income inequality while access to sound money, legal systems and property rights have no statistical significance. Also, freedom to trade internationally is only negative and significant on the old EU-15 countries.

Turning to more recent international studies, Sturm and De Haan (2015) used data on inequality from the Standardized World Income Inequality Database (v2) to construct an unbalanced panel of 108 countries between 1971 and 2010, split into eight five-year intervals. The authors' results suggested no robust relationship between EF and income inequality. Apergis and Cooray (2017) employed both linear and non-linear cointegration analysis with an unbalanced panel of 138 countries. The authors' results on the linear baseline highlighted a negative relationship between the overall EFW and the 5 EFW subcomponents and income inequality. On the non-linear approach, the authors employed a Panel Smooth Transition Regression. They concluded that above the threshold overall EFW value of 5.428, the effect of economic freedom on income inequality is negative. Similarly, above the threshold values of 5.236, 4.435, 3.873, 4.908, 5.801 (size of the government, legal system and property rights, sound money, freedom to trade internationally, regulation, respectively), the impact of EF on income inequality is

negative, supporting the idea of an inverted U-shaped relationship. Graafland and Lous (2018) used a panel of 21 OECD countries between 1990 and 2014. They concluded that fiscal freedom, freedom to trade internationally and deregulation decrease income equality, whereas access to sound money decreases income inequality.

The extensive work of Bennett and Nikolaev (2017) showed how previous works addressing this issue are sensitive to the country and time sample as well to the inequality measure utilized by reproducing the previous studies of Bergh and Nilsson (2010) and Carter (2007) using six different inequality measures for 112 countries between 1970 and 2010. Moreover, the authors employed a dynamic system GMM to an unbalanced panel of 91 countries and inequality data extracted from the Standardized World Income Inequality Database (v5). Their results, once again, supported the idea that the relationship between economic freedom and income inequality is extremely sensitive to the inequality measure used once, in some specifications, the decomposed subcomponents of the IEF index are significant, while in others, they are not.

Karakotsios et al. (2020) used a pooled mean-group estimation method on a panel of 58 countries between 1995 and 2016 to study the causal relationship between income inequality and EF and found a positive trade-off. Finally, Saccone (2021) analyzed an unbalanced panel of 76 developed and developing countries between 1980 and 2014 and found that higher EF levels are associated with lower income shares of the bottom 80% while increasing the income shares of the top 10% and 5%. Lawson and Dean (2021) revisited Saccone's work and studied income decile levels (instead of shares), and employed a panel of 75 countries for the same time period. The authors then refuted Saccone's results by concluding that EF corresponds with higher incomes for all income decile levels (in absolute).

Part II. Empirical Analysis

The second part of this work will present the empirical findings on the freedom-inequality nexus. This empirical work a) measures relative income inequality, b) uses *Stata 15* for the econometric analysis and c) is based on cross-sectional time-series data. First, one should note that there is no standard empirical model established in the economic literature that allows to control and estimate as precisely as needed income inequality. This fact makes modelling and estimating income inequality a hard and a "shot in the dark" task. Additionally, one should be aware of the data advantages and disadvantages and the different measurement constructions explained in Part I, Section 2 once it implies different estimation results accordingly with the employed methodology. Furthermore, the author would like to stress that all the data is collected from the most recent dataset versions available for research and is independently modelled to allow for international (between countries) comparison.

1. Data

The data is available for 102 countries from 2000 to 2018. The countries chosen follow the principle of maximum information. The list of countries can be viewed in Table 2 in Appendix. The period chosen is the one that has no missing data or transformations of the variables[17].

One computed a micro panel since the number of cross series is superior to the analysis period. *Stata 15* assumes a balanced panel at first. The dependent variable is the Household Equivalized Market Gini Index (pre-taxes and pre-transfers)[18] from the latest Standardized World Income Inequality Database (SWIID) version 9.1 released in May 2021 following Solt (2020). The Gini Index equals the Gini Coefficient times 100 and

[17] Once, until 2000, the EFW index was available only in a 5-year time period.

[18] Following Grubel (1998) and the author's idea that the empirical approach is only justifiable if data of income inequality is on a pre-tax and transfer basis, once EFW includes measures of redistribution.

varies from 0 (perfect income equality) to 100 (perfect income inequality), measuring relative inequality. Solt (2020) simply defined the Gini Index as "the average difference in income between all pairs in a population, divided by twice the average income in the population" (p. 2). Following this definition, a higher Gini Index indicates that high-income individuals receive sizeable proportions of the income distribution. Therefore, an increase in the Gini Index is equivalent to an increase in income inequality. Also, note that the dependent variable is on a pre-tax and transfers basis once this study tries to address the economic system before any government intervention (i.e. market creation).

One chose data from SWIID because of its high coverage, homogeneous comparability and time availability. However, there is always a trade-off between coverage and quality of information. Nevertheless, SWIID's latest versions recognize this fact and incorporate the underlying uncertainty into the estimated Gini index parameters.

The primary independent variable for Model I will be the Economic Freedom of the World (EFW) Index 2020's version from Fraser Institute first developed, as noted in Part I, by Gwartney et al. (1996) and updated since. Data was collected from Fraser Institute.

Regarding Model II, the study variables will be the decomposed EFW index into its five major areas from the same database. These areas are also placed on a zero-to-ten scale and follow the same reasoning. It is crucial to understand the subdivision of the major areas into their subcomponents to understand the potential impacts on income inequality and possible guidelines for future research. Therefore, the five major areas and their subcomponents are summarized in Table 3.

Table 3. Decomposition of the five major subcomponents of Economic Freedom. Source: simplified from Gwartney et al. (2020)

Area 1: Size of the Government
A. Government Consumption as a percentage of total consumption
B. Transfers and subsidies as a percentage of GDP
C. Government enterprise and investment as a percentage of GDP
D. Top Marginal Tax Rate
E. State ownership of assets
Area 2: Legal System and Property Rights
A. Judicial independence: no interference by the government or parties in disputes.
B. Impartial courts: a trusted legal framework for private businesses
C. Protection of Property Rights
D. Military interference in the rule of law and politics
E. Legal system's integrity

F. Legal Enforcement of contracts G. Regulatory restrictions on the sale of real property H. Reliability of Police I. Gender Legal Rights Adjustment
Area 3: Sound Money
A. Money Growth (Average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years) B. Standard Deviation of Inflation in the last five years C. Annual Inflation in the most recent year D. Freedom to own foreign currency bank
Area 4. Freedom to Trade Internationally
A. Tariffs B. Regulatory trade barriers C. Difference between official exchange rate and black-market rate D. Controls of the movement of capital and people
Area 5: Regulation
A. Credit Market Regulation B. Labour Market Regulation C. Business Regulations

Taking a brief look into the controls, this work makes use of previous variables used in the freedom-inequality literature. Additionally, other controls were employed under economic rationality.

First, one makes use of the unemployment rate (share of the labour force without work, however available and seeking for employment) from the World Bank Database and modelled by the International Labour Organization (ILO) that provides comparable international estimates of labour statistics. The unemployment rate tries to control short-term variations in income distribution. Mocan (1999) finds "that an increase in structural unemployment increases the income share of the highest quintile, and decreases the share of the bottom sixty per cent of the population" (p.132). Jäntti (1994) found evidence that unemployment has regressive effects on income inequality.

The Real Gross Domestic Product per capita at chained Purchase Parity Power (2017 US dollars) from Penn World Table was added as a proxy for real economic growth. Famously, Kuznets (1955) theorizes that inequality increases in the first stages of economic development and then declines as this development proceeds. This framework assumes a quadratic relationship between economic growth and income inequality that was not followed in this study based (i) on the argument of Roine and Waldenström (2015) regarding the mismatch between the long-run trends in inequality and the Kuznets inverted-U relationship and (ii) the argument of Piketty (2015) who refuted Kuznets with

data for more than one century. Deininger et al. (1997) found a systematic relation between economic growth and increases in income of the poorest quintile. The Share of the Working Population in the Industry Sector was used to control the population's demographic structure. The data was extracted from World Bank, also modelled by ILO. Gustafsson and Johansson (1999) concluded that the economy's composition impacts income distribution and increases in the industrial sector promote equality. In fact, more industrialized countries show less income inequality measured by any indicator.

Last, to control for other economic and non-economic factors that may influence income inequality, one included the Human Development Index (HDI) from United Nations Development Program. The HDI is a multidimensional construction based on life expectancy, education and standards of living and it varies between 0 and 1. It is expected to reduce inequality by increasing societies' development. Table 3 summarizes our variables.

Table 4. Data, Code, and Databases

Variables	Code	Database
Household Market Gini Index	*gini_mkt*	Standardized World Income Inequality Database
Economic Freedom of the World Index	*efw*	Fraser Institute Database
- Size of the Government	*govsize*	Fraser Institute Database
- Legal System and Property Rights	*lpr*	Fraser Institute Database
- Sound Money	*money*	Fraser Institute Database
- Freedom to Trade Internationally	*trade*	Fraser Institute Database
- Regulation	*reg*	Fraser Institute Database
Unemployment Rate	*unrate*	World Bank Database
Share of the Population in Industry	*shareindustry*	World Bank Database
Real GDP per Capita at chained PPP's (in mil. 2017 US $)	*rgdp_pc*	Penn World Table
Human Development Index	*hdi*	United Nations – Human Development Data Center

2. Methodology and Research Assessment

Methodologically, this study modelled a dynamic error correction through a linear transformation of an autoregressive distributed lag model (ARDL) once it allows the decomposition of both short and long-run impacts on income inequality. Additionally, as

argued in Nkoro and Uko (2016), this specification (i) allows series to be I(0), I(1) or on the borderline between them; (ii) avoids spurious regression problems due to non-stationary variables (iii) is robust to endogeneity, that is, the correlation between explanatory variables and the error term, once all variables are assumed to be endogenous.

Variables are transformed into natural logarithms and denoted with "l". First differences are denoted with "Δ". Equations (1) and (2) show ARDL (1,1) of models (1) and (2) and equations (3) and (4) show the re-parametrized relationships[19], respectively:

$$\begin{aligned} lgini\_mkt_{it} = {} & \alpha_i + \beta_1 lgini_{mkt_{it}-1} + \beta_2 lefw_{it} + \beta_3 lefw_{it-1} \\ & + \beta_4 lrgdp\_pc_{it} + \beta_5 lrgdp\_pc_{it-1} + \beta_6 lunrate_{it} + \beta_7 lunrate_{it-1} \\ & + \beta_8 lshareindustry_{it} + \beta_9 lshareindustry_{it-} + \beta_{10} lhdi_{it} + \beta_{11} lhdi_{it-} \\ & + \epsilon_t \end{aligned} \tag{1}$$

$$\begin{aligned} lgini\_mkt_{it} = {} & \alpha_i + \beta_1 lgini_{mkt_{it}-1} + \beta_2 lgovsize_{it} + \beta_3 lgovsize_{it-1} \\ & + \beta_4 ltrade_{it} + \beta_5 ltrade_{it-1} + \beta_6 lmoney_{it} + \beta_7 lmoney_{it-1} + \beta_8 lreg_{it} \\ & + \beta_9 lreg_{it-1} + \beta_{10} llpr_{it} + \beta_{11} llpr_{it-1} + \beta_{12} lrgdp\_pc_{it} + \beta_{13} lrgdp\_pc_{it-1} \\ & + \beta_{14} lunrate_{it} + \beta_{15} lunrate_{it-1} + \beta_{16} lshareindustry_{it} \\ & + \beta_{17} lshareindustry_{it-1} + \beta_{18} lhdi_{it} + \beta_{19} lhdi_{it-1} + \epsilon_t \end{aligned} \tag{2}$$

$$\begin{aligned} \Delta lgini\_mkt_{it} = {} & \alpha_i + \beta_1 \Delta lefw_{it} + \beta_2 \Delta lrgdp_{pc_{it}} + \beta_3 \Delta lunrate_{it} \\ & + \beta_4 \Delta lshareindustry_{it} + \beta_5 \Delta lhdi_{it} + \varphi_1 lgini_{mkt_{it-1}} + \gamma_1 lefw_{it-1} \\ & + \gamma_2 lrgdp\_pc_{it-1} + \gamma_3 lunrate_{it-1} + \gamma_4 lshareindustry_{it-1} + \gamma_5 lhdi_{it-1} \\ & + \epsilon_t \end{aligned} \tag{3}$$

$$\begin{aligned} \Delta lgini\_mkt_{it} = {} & \alpha_i + \beta_1 \Delta lgovsize_{it} + \beta_2 \Delta ltrade_{it} + \beta_3 \Delta lmoney_{it} \\ & + \beta_4 \Delta lreg_{it} + \beta_5 \Delta llpr_{it} + \beta_6 \Delta lrgdp\_pc_{it} + \beta_7 \Delta lunrate_{it} \\ & + \beta_8 \Delta lshareindustry_{it} + \beta_9 \Delta lhdi_{it} + \varphi_2 lgini_{mkt_{it-1}} \\ & + \gamma_1 lgovsize_{it-1} + \gamma_2 ltrade_{it-1} + \gamma_3 lmoney_{it-1} + \gamma_4 lreg_{it-1} + \gamma_{4i5} llpr_{it-1} \\ & + \gamma_6 lrgdp\_pc_{it-1} + \gamma_7 lunrate_{it-1} + \gamma_8 lshareindustry_{it-1} + \gamma_9 lhdi_{it-1} \\ & + \epsilon_t \end{aligned} \tag{4}$$

From this point forward, equations (3) and (4) will refer to model (1) and model (2), respectively. The α_i express the constant (intercept), β_{ji} and γ_{ji} with $j = 1, \dots, 19$ represent the estimates and φ_i with $i = 1, 2$ denotes the speed of adjustment of both models.

[19] See Best (2008) for the mathematical error correction re-parametrization.

To first inspect our variables, we computed the summary statistics and performed Pesaran's CD test, under the null of cross-sectional independence, following Pesaran (2004) to test for the presence of cross-sectional dependence (CSD) amongst our series. CSD analysis is crucial when working with panel data, especially when there are large cross-series and a short time. Ignoring CSD has consequences on the first-order properties of panel estimators (Sarafidis and Wansbeek, 2012). In short, it occurs when units in the same cross-section are correlated or, in other words, when the error term is not independent and identically distributed across time and cross-series. The descriptive statistics and the CD-test are presented in Table 5 in the Appendix. The results show evidence of CSD for all variables and, therefore, further tests and estimation techniques need to account for it.

To avoid spurious regressions due to multicollinearity, one used the Variance Inflation Factor (VIF) following Belsley et al. (1980) and examined the correlation matrix of both models. Results are shown in Tables 6 and 7 in the Appendix, respectively. Although *lrgdp_pc* and *lhdi* (in levels) have relatively high values - expectable since human development is associated with economic development - none of them is superior to 10. Therefore, we assume no multicollinearity problems as the rule of thumb is fulfilled (VIF less than 10)[20].

Regarding our correlation matrix for Model (1) and (2), the only high correlation observed is, again and expected, between *lrgdp_pc* and *lhdi.* Note that both variables were employed once they were used as different proxies to control different aspects. As the goal is to analyse the variable of interest, one assumes the potentially biased estimates of these variables.

Since that, in the presence of cross-sectional dependence, first-generation unit root tests are no longer reliable (Westerlund et al., 2016), one employed the cross-sectionally augmented Im Pesaran and Shin (CIPS) test as argued in Pesaran (2007) under the null of nonstationary. In levels, regarding both models, only the aggregate and decomposed

[20] This rule of thumb is explicitly analysed in O'brien (2007). The author concludes that even with VIF values exceeding the rule of thumb of 10 (and mean VIF of 4), one can confidently derive conclusions, since the model does not suffer from multicollinearity. Although Model (1) presents a mean VIF of 4.25, one still follows the conclusions of O'brien (2007) since VIF values are inferior to 10.

indicators of economic freedom (without the time trend) seem to be stationary since the null is rejected, ruling out an ECM based on cointegration. In differences, all our variables are stationary. Results are shown in Table 8 in the Appendix. Therefore, as we are in the presence of I(0) and I(1) series, one is in condition to employ the ARDL methodology. Note that nothing in the CIPS test suggests that the use of a time trend better suits our model.

After carrying out the analysis on our variables, one now turns to panel data estimation techniques. First, following Breusch and Pagan (1980), one uses the Breusch and Pagan Lagrange-Multiplier test - under the null that the variance across entities is zero $[var(u_i) = 0]$ – to see if random effects are preferable to pooled OLS. By rejecting the null, one concludes that the Pooled OLS is not appropriate as results indicate that, in fact, panel effects exist. Therefore, to choose the appropriate estimator, the Hausman's specification Test (Hausman, 1978) between fixed and random effects estimations was employed. Hausman's specification test tests two different estimators (consistent *vis-à-vis* efficient) under the null that there are no systematic differences amongst them. In short, rejecting the null favours fixed rather than random-effects estimation. Results can be seen for both tests in Tables 9 and 10 in the Appendix. As the null is rejected, one concludes that the within-estimator better suits our model.

To test for group-wise heteroscedasticity[21] with the fixed-effects model, the modified Wald test was employed, following Greene (2000) and under the null of homoscedasticity. To confirm the presence of contemporaneous correlation[22] , one computed the Pesaran test under the null of no contemporaneous correlation. Finally, the Wooldridge test was used to check the presence of serial correlation[23] as presented in Drukker (2003) and derived from Wooldridge (2010, p. 176), under the null of no first-order serial correlation. Results can be seen in Table 11 in the Appendix.

The previous tests corroborate the presence of heteroscedasticity, cross-sectional dependence and serial correlation. Hence, the author chose the Driscoll and Kraay

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[21] Groupwise Heteroskedasticity occurs when the variance of the error process differs across units (Baum, 2001): $\sigma_i^2 \neq \sigma^2$ for some i. Homoskedasticity exists when $\sigma_i^2 = \sigma^2$ for all i.

[22] Contemporaneous Correlations is correlation between the covariates x_{it} and the idiosyncratic errors u_{it}.

[23] Serial correlation (or autocorrelation) occurs when observations of the error term are correlated with each other. Note that $\varepsilon_{it} = \rho * \varepsilon_{it-1} + \mu_{it}\ where\ -1 < \rho < 1$. If $\rho \neq 0$ there is presence of first-order serial correlation.

estimator following Hoechle (2007) and derived from Driscoll and Kraay (1998) to produce robust standard errors for coefficients estimated by fixed-effects where the error structure is assumed to be cross-sectionally dependent, autocorrelated and heteroskedastic. This estimator is also used when handling the above conditions by, amongst others, Fuinhas et al. (2017) and Marques et al. (2018).

Finally, after verifying that the error structure is autocorrelated, one employed specification tests (ResetL and ResetS) to both Model (1) and (2) for omitted variables and model specification, following DeBenedictis and Giles (1998) and DeBenedictis and Giles (1999). The null hypothesis of both tests is that the model is correctly specified (from omitted variables and overall specification). The results of both tests seem to suggest that the model presented in this paper is correctly specified, and the estimation does not suffer from omitted variable problems. The results can be seen in Table 12 in Appendix. These previous results give confidence to the estimations presented below. To the best of one's knowledge, no empirical study regarding this issue presented any specification test applied to their econometric models.

3. Estimation Results

The first estimation with Driscoll Kray standard errors can be seen in Table 13 in Appendix. Given the previous results, the author followed Occam's Razor (OR) principle applied to statistics, where simpler models are preferred over complex models. OR states that if a parameter does not improve the accuracy of the regression, a simpler model is most desirable. Indeed, as explained by Asteriou and Hall (2011), "incorporating additional coefficients will necessarily increase the fit of the regression equation (that is, the value of the R^2 will increase), but the cost will be a reduction of the degrees of freedom." (p. 276). Thus, it is argued that simpler specifications produce better estimates than overfitting models.

Accordingly to this line of thought, and following Hendry (1995) general-to-specific modelling approach, we exclude from the specifications - of both model (1) and (2) - controls that present no statistical significance. Therefore, we excluded $\Delta lhdi_{it}$ from both models. Yet, note that one preserves the main variables of interest (both short and long-run) for deriving conclusions, even when they have no statistical significance. However,

under this idea, the author removed any variable of interest that do not present statistical significance (at least at 10% significance level) in both the short and the long-run: $\Delta ltrade_{it}$ and $ltrade_{it-1}$ were excluded for Model (2), concluding that freedom of trade has not impacted income inequality in the years of study. One reason that explains this result is the sample (country and time) chosen and the unlikely chance of capturing long-term general relationships/equilibriums amongst countries. However, this result aligns with Savvides (1998), which found no statistical significance between trade liberalization and income inequality.

Therefore, Model (1) and (2) are now specified in Equations (5) and (6):

$$\begin{aligned}\Delta lgini\_mkt_{it} = {} & \alpha_i + \beta_1 \Delta lefw_{it} + \beta_2 \Delta lrgdp_{pc_{it}} + \beta_3 \Delta lunrate_{it} \\ & + \beta_4 \Delta lshareindustry_{it} + \varphi_1 lgini_{mkt_{it-}} + \gamma_1 lefw_{it-1} + \gamma_2 lrgdp\_pc_{it-1} \\ & + \gamma_3 lunrate_{it-} + \gamma_4 lshareindustry_{it-} + \gamma_5 lhdi_{it-} + \epsilon_t \end{aligned} \quad (5)$$

$$\begin{aligned}\Delta lgini\_mkt_{it} = {} & \alpha_i + \beta_1 \Delta lgovsize_{it} + \beta_2 \Delta lmoney_{it} + \beta_3 \Delta lreg_{it} + \beta_4 \Delta llpr_{it} + \beta_5 \Delta lrgdp_{pc_{it}} \\ & + \beta_6 \Delta lunrate_{it} + \beta_7 \Delta lshareindustry_{it} + \varphi_2 lgini_{mkt_{it-}} + \gamma_1 lgovsize_{it-1} \\ & + \gamma_2 lmoney_{it-1} + \gamma_3 lreg_{it-1} + \gamma_4 llpr_{it-1} + \gamma_5 lrgdp_{pc_{it-1}} + \gamma_6 lunrate_{it-} \\ & + \gamma_7 lshareindustry_{it-1} + \gamma_8 lhdi_{it-1} + \epsilon_t \end{aligned} \quad (6)$$

Although the former specifications are simpler than (3) and (4), the author should stress that these models are not parsimonious. The empirical formalization of such a difficult concept as income inequality cannot be a parsimonious specification due to omitted variable bias problems. A lot of factors can influence the dependent variable. This task would be easier if an empirical model was established in economic literature. That, however, is not the case; hence, one must cope with some loss of the degrees of freedom, especially in Model (2), to perform the current estimations.

The estimation of the adjusted model can be seen in Table 14.

Table 14. Estimation of the adjusted model

Dependent variable: $lgini_{mkt\,it}$	Model (1)	Model (2)
Constant	0.1556*** (0.0424)	0.1549*** (0.0414)
Δlefw	0.0006 (0.0040)	-
Δlgovsize	-	0.0045 (0.0028)
Δlreg	-	-0.0080** (0.0040)
Δllpr	-	0.0027 (0.0028)

Δlmoney	-	0.0007 (0.0020)
Δlshareindustry	-0.0092** (0.0038)	-0.0095** (0.0039)
Δlrgdp_pc	-0.0052** (0.0019)	-0.0052** (0.0020)
Δlunrate	0.0073*** (0.0012)	0.0072*** (0.0012)
ECM (lgini_mkt $_{t-1}$)	-0.0395*** (0.0129)	-0.0388*** (0.0123)
lefw $_{t-1}$	0.0076* (0.0037)	-
lgovsize $_{t-1}$	-	0.0057*** (0.0014)
lreg $_{t-1}$	-	-0.0059* (0.0033)
llpr $_{t-1}$	-	0.0046* (0.0024)
lmoney $_{t-1}$	-	0.0031* (0.0018)
lrgdp_pc $_{t-1}$	-0.00395*** (0.0009)	-0.0040*** (0.0010)
lhdi $_{t-1}$	-0.0111*** (0.0036)	-0.0099*** (0.0034)
lunrate $_{t-1}$	0.0029*** (0.0007)	0.0029*** (0.0007)
lshareindustry $_{t-1}$	0.0031** (0.0013)	0.0029** (0.0011)
Statistics		
Observations	1704	1699
Within R-squared	0.1318	0.1405
F	F(10,17) = 428.74***	F(16,17) = 1441.92***

Notes: Stata command *xtscc, fe* was used. ***, **, * denotes statistical significance at 1%, 5%, and 10% level, respectively. Driscoll Kray standard errors in parentheses.

In order to check structural breaks and control for outliers, one employed a box plot analysis to the residuals and added dummy variables (0 and 1) following Fuinhas and Marques (2012). Pesaran et al. (2001) supported this procedure once the authors argued that the asymptotic theory of bounds test approach (ECM) is not affected by the inclusion of zero-one dummy variables. Figure 1 shows the box plot analysis:

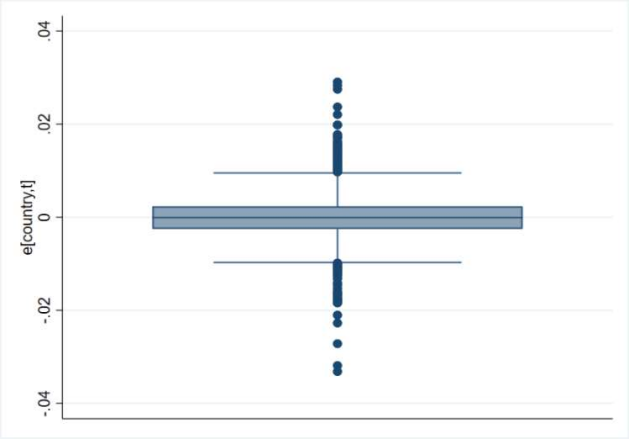

Figure 1. Box Plot of the residuals for shocks control.

Figure 2 shows that the model presents outliers problems that disturb the estimation. Therefore, one used the dummy approach explained earlier after checking which year/country was a cause of concern following the rule of a standard deviation greater than 0.01. Table 15 in the Appendix shows the included dummies and a probable explanation for the events that cause these outliers. The previous dummies are, thus, added to the adjusted model to control for shocks. Table 16 shows the estimation of both models controlled for shocks and structural breaks:

Table 16. Estimation controlled for shocks

Dependent variable: $\Delta lgini_{mkt\,it}$	Model (1)	Model (2)
Constant	0.1350*** (0.0397)	0.1310*** (0.0393)
Δlefw	-0.0017 (0.0029)	-
Δlgovsize	-	0.0045** (0.0017)
Δlreg	-	-0.0076** (0.0035)
Δllpr	-	0.0016 (0.0030)
Δlmoney	-	-0.0003 (0.0022)
Δlshareindustry	-0.0110*** (0.0031)	-0.0116*** (0.0031)
Δlrgdp_pc	-0.0052*** (0.0016)	-0.0051*** (0.0018)
Δlunrate	0.0070*** (0.0014)	0.0070*** (0.0013)
ECM (lgini_mkt $_{t-1}$)	-0.0357*** (0.0122)	-0.0353*** (0.0118)
lefw $_{t-1}$	0.0076** (0.0031)	-
lgovsize $_{t-1}$	-	0.0063*** (0.0015)
lreg $_{t-1}$	-	-0.0057** (0.0027)
llpr $_{t-1}$	-	0.0064** (0.0027)
lmoney $_{t-1}$	-	0.0026 (0.0016)
lrgdp_pc $_{t-1}$	-0.0033*** (0.0009)	-0.0032*** (0.0009)
lhdi $_{t-1}$	-0.0113*** (0.0029)	-0.0112*** (0.0037)
lunrate $_{t-1}$	0.0022*** (0.0005)	0.0022*** (0.0005)
lshareindustry $_{t-1}$	0.0035** (0.0013)	0.0032*** (0.0011)
Dummys	***	***
Statistics		
Observations	1704	1699
Within R-squared	0.3470	0.3570
F	F(33,17) = 3285.68***	F(39,17) = 5274.57***

Notes: Stata command *xtscc, fe* was used. ***, **, * denotes statistical significance at 1%, 5%, and 10% level, respectively. Driscoll Kray standard errors in parentheses.

Although the short-run elasticities are directly derived from the estimations, the long-run elasticities need to be calculated following equation (7):

$$Long\ run\ computed\ elasticities = -\frac{\gamma_{ji}}{\varphi_i} \quad (7)$$

Subscript denomination follows Section 2. Table 17 presents the short-run impacts and long-run elasticities for both adjusted and controlled for shocks Model (1) and Model (2).

Table 17. Short-run Impacts and Long-run computed Elasticities

Short-Run Impacts				
Dependent variable: $\Delta lgini_{mkt\,it}$	Model (1) adjusted	Model (1) controlled for shocks	Model (2) adjusted	Model (2) controlled for shocks
Δlefw	0.0006	-0.0017	-	-
Δlreg	-	-	-0.0080**	-0.0076**
Δlgovsize	-	-	0.0045	0.0045**
Δllpr	-	-	0.0027	0.0016
Δlmoney	-	-	0.0007	-0.0003
Δlshareindustry	-0.0092**	-0.0110***	-0.0095**	-0.0116***
Δlrgdp_pc	-0.0052**	-0.0052***	-0.0052**	-0.0051***
Δlunrate	0.0073***	0.0070***	0.0072***	0.0070***
Speed of Adjustment				
ECM	-0.0395***	-0.0357***	-0.0388***	-0.0353***
Long-Run Computed Elasticities				
lefw $_{t-1}$	0.1919* (0.1072)	0.2132** (0.0970)	-	-
lreg $_{t-1}$	-	-	-0.1515* (0.0888)	-0.1622* (0.0958)
lgovsize $_{t-1}$	-	-	0.1471** (0.0736)	0.1784** (0.0919)
llpr $_{t-1}$	-	-	0.1175*** (0.0458)	0.1805*** (0.0529)
lmoney $_{t-1}$	-	-	0.0801 (0.0523)	0.0726 (0.0531)
lunrate $_{t-1}$	0.0742** (0.0356)	0.0618** (0.0306)	0.0759** (0.0370)	0.0638** (0.0319)
lshareindustry $_{t-1}$	0.0787*** (0.0727)	0.0974*** (0.0276)	0.0753*** (0.0236)	0.0903*** (0.0307)
lrgdp_pc $_{t-1}$	-0.0998** (0.0507)	-0.0924* (0.0494)	-0.1024** (0.0515)	-0.0913* (0.0499)
lhdi $_{t-1}$	-0.2800** (0.1287)	-0.3171** (0.1330)	-0.2557** (0.1073)	-0.3180*** (0.1252)

Notes: Stata command *nlcom* was used to calculate the long-run elasticities. ***,**,* denotes statistical significance at 1%, 5% and 10% levels, respectively. Standard errors in parentheses.

4. Interpretation and discussion of the results

This section presents the discussion of the results obtained in Table 17 for the short- and long-run impacts of both the main variables of interest and the control variables on income inequality. Note that the short-run impacts can be interpreted as percentage point increases[24] in the growth rate of the dependent variable, whereas the long-run impacts are elasticities.

Adjusted and Controlled Model (1)

Taking the first look at the overall estimation of Model (1), one concludes that the composite EFW index has no impact in the short run given the lack of statistical significance. Although the coefficient of Δ*lefw* revealed to be inconclusive (once it is documented a positive signal on the adjusted model and a negative signal on the controlled model), it seems that the effect of Economic Freedom exerts some time before impacting the economic mechanisms behind income inequality. This makes sense once economic reforms depend on political decisions and institutional systems (therefore are embedded in the political system), and there is (i) a time gap between political decision-making and the associated economic adjustments and (ii) a strict dependence between economic policies and the nature of the political system (Acemoglu et al., 2015).

The control variables present robust results when facing the adjusted model against the controlled model and are in accordance with their predicted signs. The real gross domestic product per capita is statistically significant at 5% and 1% (respectively), and an increase of 1 percentage point of Δlrgdp_pc decreases income inequality by 0.0052 percentage points, all else equal. The unemployment rate is statistically significant at 1%, implying that unemployment impacts the income distribution with immediate effects of increasing income inequality. An increase of 1 percentage point in Δlunrate is associated with an increase of approximately 0.007 percentage points (in both specifications) in income inequality, all else equal. The share of the population working in the industrial sector, a proxy for countries' industrialization level, is statistically significant at a 1% level and is associated with a decrease in income inequality in the short run. *Ceteris paribus*, an increase of 1 percentage point in the share of the population working in the industrial

[24] As they are expressed in logarithmic differences.

sector, implies a decrease of 0.009 and 0.011 percentage points (respectively) in income inequality.

Turning to the long-run elasticities of Model (1), one concludes that the overall EFW index is statistically significant at 10% and 5% (adjusted and controlled model, respectively) and, all else equal, an increase of 1% in economic freedom implies an increase of 0.1979% and 0.2132% in income inequality. Although there is evidence of a positive trade-off, these results suggest a relatively inelastic relationship between economic freedom and income inequality, possibly because the economy re-structures after internalizing economic freedom effects.

The unemployment rate is statistically significant at 5%, and an increase of 1% reveals a positive impact of 0.0742% and 0.0618% (respectively) in the Gini index. Note, however, that the variable *unrate* is used to control short-run impacts on the income distribution and does not capture structural unemployment but rather the unemployment rate at a given time. Therefore, in line with Martínez et al. (2001), this result suggests that the contribution of the unemployment rate on overall inequality is limited (despite clearly affecting the preponderance of unemployed individuals in the bottom income quintiles, ibid).

Economic growth negatively impacts income inequality, which seems to be in accordance with the economic literature, although the results suggest an inelastic relationship. All else equal, an increase of 1% in economic growth decreases income inequality by approximately 0.1%. This result is in line with Gallup et al. (1998) that, although had found a robust positive relationship between economic growth and the income of the poor (both in the short and the long run), also concluded that, as the overall income grows, the income distribution can remain unchanged (depending on the initial level), meaning only that the poor "do not fall behind". Nevertheless, this is an average result that also depends on the period chosen and should not be taken for granted.

The Human Development Index is statistically significant at 5%. An increase of 1% in *hdi* reduces the Gini index by 0.28% and 0.3171%, meaning that the development of life conditions, education, and living standards are, perhaps, the most important (as policy targets) to reduce inequality. In fact, as reported by Cingano (2014), one of the major policy strategies to reduce inequality relies on increasing human capital and allowing access to income acquisition opportunities.

Perhaps the most contradictive result is the positive impact of *shareindustry* on income inequality (at a 1% significance level), which means that an increase of 1% in the number of people working in the industry increases the Gini by 0.079% and 0.097% (respectively). This possibly occurs because of the country sample; however, it is an interesting debate that future research should address regarding the causes of this phenomenon. One can advance a possible explanation: technological enhancements have allowed greater added value for the goods produced in the industrial sector (as capital substituted labour), whereas an increase of labour would ultimately lead to a decrease of productivity in industry and conduct to a stagnation (or even a decrease) of wages. Therefore, the income distribution of the industry gains would mostly favour the capital owners against the labour suppliers. We leave future research lines for this matter.

Adjusted and Controlled Model (2)

Turning one's attention to both adjusted and controlled Model (2), the estimation results suggest interesting implications. In the short run, only Δ*lgovsize* and Δ*lreg* (of the main variables of interest) seem to impact income inequality, as both are statistically significant at a 5% level. This shows that the effect of a 1 percentage point increase in *govsize* (smaller government size) will have immediate impacts of increasing income inequality by 0.0045 percentage points, perhaps mainly through lower public enterprise and public investment, as well as lower government support to allow equality of opportunity on income acquisition. On the other side, an increase of 1 percentage point in *reg* decreases income inequality by 0.008 and 0.0076 percentage points (respectively). This may be due to the impact of lower red-tape costs for businesses and an incentive to (or, at least, fewer entrance barriers costs to) entrepreneurship impact income distribution at a higher rate than the loss of labour protection, which is associated with decreases in income inequality (Checchi and García-Peñalosa, 2008). Also, easier access to the financial system or greater job mobility can be the reason for decreases in income inequality. The control variables in Model (2) follow approximately the same discussion applied to Model (1) above and remain robust to the different specifications.

Focusing on the long-run elasticities of the main variables of interest, one concludes that access to sound money does not impact the Gini index once it presents no statistical significance in both adjusted and controlled Model (2). On a contrary note, $lreg_{t-1}$, $lgovsize_{t-1}$ and $llpr_{t-1}$ are statistically significant at 10%, 5%, and 1% levels, respectively,

for both adjusted and controlled Model (2). This seems to suggest that the same short-run impacts of *reg* and *govsize* also apply in the long run, after the economy accommodates its effects. For example, all else equal, an increase of 1% in *govsize* increases income inequality by 0.1471% and 0.1784% (adjusted and controlled model, respectively). In contrast, an increase of 1% in *reg* is associated with a decrease in income inequality of 0.1515% and 0.1622% (respectively).

Another interesting result is the positive impact of *lpr* on the Gini index, where an increase of 1% in *lpr* increases the Gini index by 0.1175% and 0.1805%, respectively. As there is no theoretical background for these results, one argues, in line with Carter (2007), that the protection of property rights mostly favours the ones who have more property " (…) as this protection increases tenure security for the owner, which in turn is expected to increase the value of the property itself" (p. 489), as well as protecting the *status quo.* However, this result is not without controversy, so the author suggests another line for future research. Note also that the results presented above also suggest a relatively inelastic relationship between the independent and the dependent variable.

Again, the discussion regarding the control variables is the same as Model (1) since they present robust results and approximately the same coefficient value without any change in their signs. Finally, the speed of adjustment of both adjusted and controlled Model (1) and Model (2) are in line with the theoretical requirements for the ECM specification, as they are negative, between -1 and 0, and statistically significant at 1% level. The low value of the speed of adjustment supports the idea presented above that the economic adjustments of changes in Economic Freedom take time to exert their effects.

5. Robustness Analysis: is it a matter of data?

This section will present a robustness analysis of Model (1). Note that the previous tests employed in Section 2 are not presented to preserve space. However, all the tests and statistics used before were employed to these variables, and the same conclusions hold to employ the ARDL methodology. The same procedure applies here too. Variables are transformed into natural logarithms and first differences.

The Palma Ratio, Theil's Index and Atkinson Measure are available from 2000 to 2015 from the Global Consumption and Income Program that produces income and

consumption datasets equivalized to more than 160 countries to allow international comparisons. The Index of Economic Freedom is available from 2000 to 2018 from Heritage Foundation. Table 18 summarizes.

Table 18. Additional Variables for Robustness Analysis

Variables	Code	Database
Palma Ratio	*palma*	Global Consumption and Income Program
Theil's Index	*theil*	Global Consumption and Income Program
Atkinson Measure	*atkinson*	Global Consumption and Income Program
Index of Economic Freedom	*ief*	Heritage Foundation

The summary statistics of the previous variables are shown in Table 19 in the Appendix.

Note, however, that one should recognize that the variables employed in this analysis do not impact in the same measure all the countries, therefore limiting this robustness analysis. One tried to surpass these limitations by applying dummies to the country sample to study development levels (low-, middle-, and high-income countries). Yet, this analysis was not possible due to multicollinearity problems that arose and that this study was unable to surpass. Given the former, the usual caveats apply to the next sections.

5.1. Is it a matter of independent variable of interest?

The first robustness analysis uses the IEF index instead of the EFW index. Nevertheless, note that this new model (let it be Model (4)) maintains the same specification as Model (1) and dummy control as explained above in Section 3 [Equation (5)].

Table 20 presents the estimation with the IEF index as a primary independent variable:

Table 20. Estimation controlled for shocks with IEF as the independent variable

Dependent variable: $\Delta lgini_{mkt\,it}$	Model (4)
Constant	0. 1280*** (0.0401)
Δief	0.0091** (0.0041)
Δlshareindustry	-0.0096*** (0.0032)
Δlrgdp_pc	-0.0038*** (0.0012)
Δlunrate	0.0072*** (0.0014)

ECM (lgini_mkt $_{t-1}$)	-0.0382*** (0.0120)
lef $_{t-1}$	0.0082** (0.0033)
lrgdp_pc $_{t-1}$	-0.0035*** (0.0008)
lhdi $_{t-1}$	-0.0085*** (0.0022)
lunrate $_{t-1}$	0.0024*** (0.0005)
lshareindustry $_{t-1}$	0.0034*** (0.0011)
Dummys	***
Statistics	
Observations	1727
Within R-squared	0.3474
F	F(33,17) = 51891.53***

Notes: Stata command *xtscc, fe* was used. ***, **, * denotes statistical significance at 1%, 5%, and 10% level, respectively. Driscoll Kray standard errors in parentheses.

Based again on equation (7), and once the short-run elasticities can be directly derived from the estimation above, Table 21 shows the long-run elasticities with EIF index as an independent variable:

Table 21. Long-run Elasticities with IEF as the primary independent variable

Long-Run Computed Elasticities	
lief $_{t-1}$	0.2156** (0.0950)
lunrate $_{t-1}$	0.0628** (0.0286)
lshareindustry $_{t-1}$	0.0886*** (0.0287)
lrgdp_pc $_{t-1}$	-0.0917** (0.0403)
lhdi $_{t-1}$	-0.2224** (0.0949)

Notes: Stata command *nlcom* was used. ***, **, * denotes statistical significance at 1%, 5% and 10% levels, respectively. Standard errors in parentheses.

As noted in Table 21 above, this study's estimation results are strongly robust to changes in the independent variable of interest. The only difference is the positive and statistically significant at 5% coefficient of Δ*lief,* suggesting that economic freedom might increase income inequality in the short run. Nonetheless, these robust results also confirm that economic freedom increases income inequality in the long run (measured by both of the main indicators of EF available), while also suggesting a relatively inelastic relationship.

Note that the long-run economic freedom elasticities present the same value with both EF indexes, even when they have different methodological specifications. The other variables are also robust to changes in the EF measures, meaning that the model itself is well constructed and specified.

5.2. Is it a matter of the dependent variable?

This section estimates three different regressions using different dependent variables: Palma ratio, Theil's index, and Atkinson measure. Table 22 shows the regression results.

Table 22. Estimation controlled for shocks with different dependent variables

	Dependent Variables		
	Palma	Theil	Atkinson
Constant	0.3614*** (0.1047)	-0.2414* (0.1332)	-0.2252** (0.0807)
Δlefw	0.0029 (0.0171))	0.0083 (0.0143)	0.0216 (0.0154)
Δlshareindustry	0.0703 (0.0755)	0.0230 (0.0594)	-0.0180 (0.0418)
Δlrgdp_pc	-0.00563** (0.0755)	-0.00512** (0.0239)	-0.0295 (0.0207)
Δlunrate	0.0297** (0.0129)	0.0282** (0.0102)	0.0375*** (0.0097)
ECM (ly_{t-1})	-0.3026*** (0.0505)	-0.3569*** (0.0681)	-0.3429*** (0.0625)
$lefw_{t-1}$	0.1124*** (0.0345)	0.1055*** (0.012)	0.0835*** (0.0218)
$llrgdp\_pc_{t-1}$	-0.0506*** (0.0136)	-0.0541*** (0.0135)	-0.0306*** (0.0066)
$lhdi_{t-1}$	-0.0923** (0.0422)	-0.0233 (0.0275)	-0.0253 (0.0165)
$lunrate_{t-1}$	0.0239*** (0.0058)	0.0234*** (0.0055)	0.0182*** (0.0046)
$lshareindustry_{t-1}$	0.0334** (0.0117)	0.0259** (0.0120)	0.0094 (0.0110)
Dummies	***	***	***
Statistics			
Observations	1421	1421	1421
Within R-squared	0.2034	0.2361	0.2252
F	F(20,14) = 433.54***	F(20,14) = 1160.39***	F(19,14) = 674.68***

Notes: Stata command *xtscc, fe* was used. ***, **, * denotes statistical significance at 1%, 5%, and 10% level, respectively. Driscoll Kray standard errors in parentheses.

Again, the short-run impacts of Economic Freedom on income inequality are directly seen in Table 22 above. In these models, again, there is no statistical relationship in the short-run, therefore the results are inconclusive. However, one still holds the conclusion

that changes in Economic Freedom take their time to affect the economy. The rest of our variables keep their signs and approximated values, which reveal that the former model is robust to changes in the primary variable of interest and changes in the dependent variable.

Turning to the long-run impacts of EF on income inequality, Table 23 summarizes.

Table 23. Long-Run Elasticities for different dependent variables

Long-Run Elasticities			
	Palma	Theil	Atkinson
lefw $_{t-1}$	0.3715*** (0.0873)	0.2956*** (0.0709)	0.2436*** (0.0580)
lunrate $_{t-1}$	0.0791*** (0.0196)	0.0656*** (0.0172)	0.0532*** (0.0098)
lshareindustry $_{t-1}$	0.1104*** (0.0408)	0.0726** (0.0360)	0.0274 (0.0335)
lrgdp_pc $_{t-1}$	-0.1672*** (0.0500)	-0.1515*** (0.0375)	-0.0892*** (0.0335)
lhdi $_{t-1}$	-0.3051*** (0.1008)	-0.0652 (0.0733)	-0.0739* (0.0436)

Notes: Stata command *nlcom* was used. ***, **, * denotes statistical significance at 1%, 5% and 10% levels, respectively.

This sensitivity analysis again shows that the long-run relationship between Economic Freedom and income inequality is positive, implying a positive trade-off, measured by any inequality measures employed above. Furthermore, the controls used in this paper reveal themselves to be robust in the long run, leaving possible lines of research.

6. Conclusion and Future Guidelines

This work revisited the relationship between economic freedom and relative income inequality using the most recent databases available for research. This contradictive debate had flaws regarding non-stationarity and endogeneity problems. This study explicitly addressed those problems by employing an error correction model (derived from an autoregressive distributed lag model) robust to these data characteristics. Additionally, this study constructed a balanced panel while a great part of the previous discussion was based on unbalanced frameworks without explicitly debating randomly or non-randomly missing data questions.

The results presented above illustrate that there exists a positive relationship between economic freedom and income inequality. On the one hand, one theorizes, in line with Cingano (2014), that increases in economic freedom seem to drive the concentration of wealth mainly (i) because of reduced government support, directly on the income distribution or indirectly by fewer income acquisition opportunities and, to a lower extent, (ii) by increasing properties' value, which directly benefits the ones who own more property. On the other hand, despite the channels through which deregulation impacts income inequality are unclear, the evidence shows that lower regulation helps to improve income equality. The impact of sound money on income inequality follows the results of Jäntti and Jenkins (2010), which found no statistical significance. In closing, this empirical research dismantles the routes through which the subcomponents of EF aggregate into the general conclusion that economic freedom positively impacts income inequality.

This paper, however, does not advocate that economic freedom should or should not be pursued. The relationships found between changes in economic freedom (and its subcomponents) and income inequality (measured by 4 different indicators) are positive but relatively inelastic. In essence, if this empirical assessment adds anything is that this economic discussion (in the terms in which it has been discussed) adds few solutions for dealing with income inequality, once the relationships presented above seem to be somewhat rigid.

As mentioned, despite its regressive impacts on income inequality, the relationship found suggests that, if otherwise, economic freedom triggers other economic mechanisms that may promote income equality (such as human capital increases, economic development or investment capacity), policy guidelines are not as straightforward as completely rejecting freedom benefits. Nevertheless, this study concludes that policies that aim to increase economic freedom need to account for the harmful effects of smaller government sizes on income inequality outputs as well as on income acquisition opportunities.

Therefore, the author suggests that future research work address the impact on the income distribution of lower regulation on labour/business/financial markets employing a quantile approach on income distribution to specifically address the income shares. Also, future research should reimagine the possible interactions between economic freedom, income inequality and (amongst others) economic growth within a multi-equation

framework to test if the benefits of economic freedom on the overall economic system surpass the costs of increased income inequality.

Appendix

Table 2. List of Countries

Albania	Cote d'Ivoire	Honduras	Luxembourg	Peru	Thailand
Angola	Croatia	Hong Kong	Malaysia	Philippines	Tunisia
Argentina	Cyprus	Hungary	Malta	Poland	Turkey
Armenia	Czech Republic	Iceland	Mauritius	Portugal	Ukraine
Australia	Denmark	India	Mexico	Romania	United
Austria	Dominican Republic	Indonesia	Moldova	Russia	Kingdom
Bangladesh	Ecuador	Iran	Mongolia	Rwanda	United States
Belgium	Egypt	Ireland	Morocco	Serbia	Uruguay
Bolivia	El Salvador	Israel	Mozambique	Sierra Leone	Venezuela
Botswana	Estonia	Italy	Namibia	Singapore	Vietnam
Brazil	Fiji	Jamaica	Netherlands	Slovakia	Zambia
Bulgaria	Finland	Japan	New Zealand	Slovenia	Zimbabwe
Cameroon	France	Jordan	Nicaragua	South Africa	
Canada	Gabon	Kazakhstan	Niger	South Korea	
Chile	Germany	Kenya	Norway	Spain	
China	Ghana	Latvia	Pakistan	Sweden	
Colombia	Greece	Lesotho	Panama	Switzerland	
Costa Rica	Guatemala	Lithuania	Paraguay	Tanzania	

Table 5. Descriptive statistics and cross-sectional dependence

Variable	Descriptive Statistics					Cross-Sectional Dependence		
	Obs	Mean	SD	Min	Max	CD test	Corr	Abs (corr)
lgini mkt	1858	3.838	0.147	3.086	4.282	5.03***	0.018	0.748
lefw	1900	1.945	0.149	0.982	2.208	48.96***	0.169	0.463
lgovsize	1900	1.906	0.168	1.382	2.245	20.27***	0.066	0.345
llpr	1900	1.713	0.297	0.801	2.197	45.75***	0.149	0.428
lmoney	1895	2.098	0.247	-0.368	2.295	34.81***	0.116	0.357
ltrade	1900	1.975	0.200	0.606	2.278	13.02***	0.043	0.429
lreg	1900	1.941	0.161	0.915	2.244	86.79***	0.282	0.426
lrgdp pc	1919	9.475	1.077	5.935	11.624	230.23***	0.786	0.821
lunrate	1919	1.842	0.699	-1.561	3.563	29.05***	0.099	0.099
lshareindustry	1919	2.984	0.429	0.936	3.702	21.72***	0.068	0.614
lhdi	1938	-0.328	0.230	-1.339	-.0449	276.13***	0.945	0.947
Δlgini_mkt	1756	-0.001	0.007	-0.040	0.030	13.17***	0.045	0.297
Δlefw	1797	0.003	0.050	-0.446	0.449	15.84***	0.055	0.230
Δlgovsize	1797	0.0005	0.083	-0.711	0.723	21.47***	0.071	0.220
Δllpr	1797	0.004	0.053	-0.423	0.454	42.28 ***	0.142	0.250
Δlmoney	1792	0.007	0.086	-1.029	1.169	17.93***	0.059	0.220
Δltrade	1797	0.002	0.074	-0.700	0.861	17.38***	0.058	0.313
Δlreg	1797	0.005	0.071	-0.671	0.675	36.58***	0.122	0.267

Δlrgdp pc	1818	0.031	0.074	-1.659	0.586	63.70***	0.223	0.322
Δlunrate	1818	-0.012	0.151	-1.016	1.919	64.48***	0.228	0.309
Δlshareindustry	1818	-0.002	0.040	-0.237	0.310	21.55***	0.074	0.240
Δlhdi	1836	0.008	0.008	-0.032	0.082	25.37***	0.087	0.253

Notes: Stata command *sum* and *xtcd* were used, respectively. *** denotes statistical significance at 1%.

Table 6. Correlation Matrix for Model (1) and Model (2)

	lgini_mkt	lefw	lrgdp_pc	lunrate	lshareindustry	lhdi
lgini_mkt	1.0000					
lefw	0.1561	1.0000				
lrgdp_pc	0.0114	0.6321	1.0000			
lunrate	0.2949	0.0433	0.1884	1.0000		
lshareindustry	-0.1454	0.3053	0.6077	0.2921	1.0000	
lhdi	-0.0801	0.6257	0.9256	0.2303	0.6943	1.0000
	Δgini_mkt	Δlefw	Δlrgdp_pc	Δlunrate	Δlshareindustry	Δlhdi
Δgini_mkt	1.0000					
Δlefw	0.0050	1.0000				
Δlrgdp_pc	-0.0661	0.0447	1.0000			
Δlunrate	0.1771	-0.0305	-0.1847	1.0000		
Δlshareindustry	-0.0871	0.0189	0.2155	-0.1845	1.0000	
Δlhdi	0.0006	0.0664	-0.3007	-0.0748	0.2414	1.0000

Notes: Postestimation Stata command *pwcorr* was used (after *reg*).

Table 6 (Continued)

	lgini_mkt	lgovsize	lreg	llpr	lmoney	ltrade	lrgdp_pc	lunrate	lshareindustry	lhdi
lgini_mkt	1.0000									
lgovsize	-0.1053	1.0000								
lreg	0.1097	0.0301	1.0000							
llpr	0.1723	-0.2557	0.6942	1.0000						
lmoney	0.1762	0.0248	0.5856	0.5306	1.0000					
ltrade	0.1596	0.0277	0.6368	0.6863	0.6761	1.0000				
lrgdp_pc	0.0114	-0.3004	0.5427	0.7671	0.4485	0.6040	1.0000			
lunrate	0.2949	-0.1574	0.0207	0.1017	0.0366	0.0366	0.1884	1.0000		
lshareindustry	-0.1454	-0.0984	0.1869	0.3399	0.1962	0.1962	0.6077	0.2921	1.0000	
lhdi	-0.0801	-0.2130	0.5079	0.7189	0.4119	0.4119	0.9256	0.2303	0.6943	1.0000

	Δl gini_mkt	Δl govsize	Δl reg	Δl lpr	Δl money	Δl ltrade	Δl rgdp_pc	Δl unrate	Δlshare industry	Δl hdi
Δlgini_mk	1.0000									
Δlgovsize	-0.0107	1.0000								
Δlreg	-0.0146	0.6727	1.0000							
Δllpr	-0.0010	0.6356	0.6656	1.0000						
Δlmoney	0.0198	0.1201	0.2007	0.1658	1.0000					
Δltrade	0.0131	0.5035	0.4945	0.4980	0.1078	1.0000				
Δlrgdp_pc	-0.0661	0.0241	0.0455	0.0390	0.1104	-0.006	1.0000			
Δlunrate	0.1771	-0.0761	-0.0224	-0.019	0.0071	-0.006	-0.185	1.000		
Δlshare industry	-0.0871	0.0250	0.0186	0.0371	0.0000	0.0142	0.2155	-0.185	1.0000	
Δlhdi	0.0006	0.0229	0.0348	0.0716	0.1007	0.0261	0.3007	-0.075	0.2414	1.0000

Notes: Stata command *pwcorr* was used.

Table 7. Variance Inflation Factor

Model (1)			Model (2)		
Variables	VIF	1/VIF	Variables	VIF	1/VIF
lhdi	8.961	0.112	lhdi	9.528	0.105
lrgdp pc	7.408	0.135	lrgdp_pc	9.383	0.107
lshareindustry	2.031	0.492	llpr	4.137	0.242
lefw	1.767	0.566	ltrade	3.126	0.32
lunrate	1.103	0.907	lreg	2.452	0.408
Mean VIF	4.254		lshareindustry	2.143	0.467
Δlrgdp pc	1.157	0.865	lmoney	2.082	0.48
Δlhdi	1.146	0.872	lgovsize	1.362	0.734
Δlshareindustry	1.115	0.897	lunrate	1.122	0.891
Δlunrate	1.066	0.938	**Mean VIF**	3.926	
Δlefw	1.005	0.995	Δlreg	2.439	0.41
Mean VIF	1.098		Δlgovsize	2.421	0.413
			Δllpr	2.286	0.437
			Δltrade	1.557	0.642
			Δlrgdp pc	1.168	0.856
			Δlhdi	1.153	0.867
			Δlshareindustry	1.117	0.895
			Δlunrate	1.078	0.928
			Δlmoney	1.06	0.943
			Mean VIF	1.587	

Notes: Postestimation Stata command *vif* was used (after *reg*)

Table 8. CIPS unit root test for both Models

	Model (1)	
	Without Trend	With Trend
lgini_mkt	10.121	8.156
lefw	-5.726***	-1.938**
lrgdp_pc	8.845	8.096
lunrate	4.493	6.773
lshareindustry	6.589	3.540
lhdi	7.001	3.128
Δlgini_mkt	-5.974***	-4.957***
Δlefw	-21.820***	-16.342***
Δlrgdp_pc	-10.326***	-7.343***
Δlunrate	-12.308***	-9.100***
Δlshareindustry	-14.396***	-11.460***
ΔlHDI	-16.487***	-12.832***
	Additional variables of Model (2)	
	Without Trend	With Trend
lgovsize	-4.406***	-2.857***
lreg	-5.757***	-3.010***
llpr	-1.972**	0.257
lmoney	-6.332***	-1.954**
ltrade	-1.313***	-0.942
Δlgovsize	-22.657***	-18.975***
Δlreg	-25.278***	-20.469***
Δllpr	-18.441***	-14.288***
Δlmoney	-22.204***	-17.857***
Δltrade	-11.142***	-20.328***

Notes: Stata command *multipurt* was used. ***, ** denotes statistical significance at 1% and 5% level, respectively.

Table 9. Breusch and Pagan Lagrangian multiplier test for random effects

Model (1)	Model (2)
1404.20***	1262.90***

Notes: Postestimation Stata command *xttest0* was used (after xtreg). *** denotes statistical significance at 1% level.

Table 10. Hausman Test: fixed-effects *versus* random effects

	Model (1)	Model (2)
	$X^{2\,(11)} = 121.21$***	$X^{2\,(11)} = 121.21$***
With sigmamore option	$X^{2\,(11)} = 121.21$***	$X^{2\,(19)} = 95.08$***
With sigmaless option	$X^{2\,(11)} = 129.71$***	$X^{2\,(11)} = 99.65$ ***

Notes: Postestimation command *hausman, hausman sigmamore (sigmaless)* was used (after *xtreg, fe* and *xtreg, re*). Sigmamore and Sigmaless options were employed to correct the situations where the covariance matrix is not positively defined. Sigmamore (Sigmaless) specifies that the covariance matrices be based on the estimated disturbance variance from the efficient (consistent) estimator. *** denotes statistical significance at 1% level.

Table 11. Specification Tests

	Model (1)	Model (2)
Modified Wald test for groupwise heteroskedasticity	79614.68 ***	67184.63***
Pesaran's test of cross-sectional independence	6.094***	6.493***
Wooldridge test for autocorrelation	119.992***	119.556***

Notes: Postestimation Stata command *xttest2* and *xtcsd, pesaran* were used (after *xtreg*); Stata command *xtserial* was employed, respectively. *** denotes statistical significance at 1% level.

Table 12. DeBenedictis-Giles Specification Reset Test

DeBenedictis-Giles Specification Reset Test	**Model (1)**
DeBenedictis-Giles ResetL1 Test = 2.304	P-Value > F(2, 1642) (0.1001)
DeBenedictis-Giles ResetL2 Test = 2.150	P-Value > F(4, 1640) (0.0724)
DeBenedictis-Giles ResetL3 Test = 1.641	P-Value > F(6, 1638) (0.1321)
DeBenedictis-Giles ResetS1 Test = 2.304	P-Value > F(2, 1642) (0.1414)
DeBenedictis-Giles ResetS2 Test = 2.150	P-Value > F(3, 1641) (0.0775)
DeBenedictis-Giles ResetS3 Test = 1.641	P-Value > F(4, 1640) (0.1444)
	Model (2)
Debenedictis-Giles ResetL1 Test = 1.740	P-Value > F(2, 1631) (0.1758)
Debenedictis-Giles ResetL2 Test = 1.468	P-Value > F(4, 1629) (0.2094)
Debenedictis-Giles ResetL3 Test = 1.270	P-Value > F(6, 1627) (0.2682)
Debenedictis-Giles ResetS1 Test = 1.526	P-Value > F(2, 1631) (0.2178)
Debenedictis-Giles ResetS2 Test = 1.120	P-Value > F(3, 1630) (0.3397)
Debenedictis-Giles ResetS3 Test = 0.845	P-Value > F(4, 1629) (0.4967)

Notes: Stata command *resetxt* was used.

Table 13: First estimation of Model (1) and Model (2)

Dependent variable: $\Delta lgini_{mkt\,it}$	Model (1)	Model (2)
Constant	0.1559*** (0.0425)	0.1524*** (0.0406)
Δlefw	0.0007 (0.0040)	
Δlgovsize		0.0040 (0.0026)
Δltrade		0.0025 (0.0018)
Δlreg		-0.0085** (0.0040)
Δllpr		0.0020 (0.0027)
Δlmoney		0.0011 (0.0020)
ΔlHDI	-0.0101 (0.0149)	-0.0171 (0.0166)
Δlshareindustry	-0.0090** (0.0038)	-0.0091** (0.0038)
Δlrgdp_pc	-0.0050** (0.0020))	-0.0049** (0.0022)
Δlunrate	0.0073*** (0.0012)	0.0071*** (0.0012)
ECM (lgini_mkt $_{t-1}$)	-0.0397*** (0.0130)	-0.0387*** (0.0124)
lefw $_{t-1}$	0.0077* (0.0038)	
lgovsize $_{t-1}$		0.0061*** (0.0015)
lreg $_{t-1}$		-0.0057 (0.0035)
ltrade $_{t-1}$		-0.0008 (0.0021)
llpr $_{t-1}$		0.0048* (0.0023)
lmoney $_{t-1}$		0.0034** (0.0016)
lrgdp_pc $_{t-1}$	-0.0039*** (0.0009)	-0.0039*** (0.0012)
lHDI $_{t-1}$	-0.0115*** (0.0037)	-0.0112*** (0.0036)
lunrate $_{t-1}$	0.0029*** (0.0007)	0.0030*** (0.0007)
lshareindustry $_{t-1}$	0.0031** (0.0013)	0.0031** (0.0011)
Statistics		
Observations	1704	1699
Within R-squared	0.1319	0.1417
F	F(11,17) = 431.03***	F(19,17) = 9473.59***

Notes: Stata command xtscd, fe was used. ***, **, * denotes statistical significance at 1%, 5%, and 10% level, respectively. Driscoll Kray standard errors in parentheses.

Table 15. Plausible events that might explain outliers and/or structural breaks, description and dummy code.

Country	code	Description
Poland	*po2003* *po2004* *po2017*	**2003:** June – Referendum voted in favour of joining the European Union. **2004:** Poland adheres to the European Union. Prime Minister Miller resigns. **2017:** Anti-Muslim Elk riots; political and military instability also involving the US.
Uruguay	*ur2004* *ur2011*	**2004:** First time a party other than the Colorado Party or National Party had held power since the formations of both (1830).

	ur2012	**2011:** In January 2011, the government issued and sold new bonds in national currency for the equivalent of more than $1.25 billion, placing the local currency share of the public debt at about 40%.
Slovenia	*slo2006*	**2006:** The employers revoked the General Collective Agreement for the Private Sector (GCAPS). The Slovenian parliament adopted the Law on Collective Agreements (LCA).
Iceland	*ice2009*	**2009:** Strong public pressure resulting from the 2009 financial crisis anticipated the parliamentary elections.
Spain	*sp2010* *sp2011*	**2010:** Highest unemployment rate in 13 years (over 20%). **2011:** Parliamentary elections won by Conservative Popular Party which announced new policies of austerity.
Paraguay	*pa2012*	**2012:** President Fernando Luga impeached.
Brazil	*br2016*	**2016:** President Dilma Roussef impeached.
Chile	*ch2013*	**2013:** Michelle Bachelet (Socialist candidate) is elected.
All	*id2009*	**2009:** Lehman Brothers triggered an international financial crisis that spread around the world and froze the international monetary system
Other included dummies:		United Kingdom in 2011; Canada in 2018; Slovakia in 2016, Chile in 2001; Spain in 2001; Paraguay in 2018; Norway in 2002 and 2006.

Table 19. Descriptive statistics (robustness analysis)

Variable	Descriptive Statistics				
	Obs	Mean	SD	Min	Max
lef	1924	4.1329	0.1718	3.0633	4.0520
lpalma	1569	0.9405	0.6757	-0.2213	2.6697
ltheil	1569	-1.1578	0.5937	-2.4425	0.0398
latkinson	1569	-0.8124	0.4225	-1.8521	-0.1195
Δlef	1819	0.0022	0.0324	-0.2620	0.2161
Δlpalma	1470	-0.0056	0.0783	-0.7548	0.9147
Δltheil	1470	-0.0029	0.0764	-0.7207	1.1370
Δlatkinson	1470	-0.0011	0.0612	-0.5330	0.9041

Notes: Stata command *sum* and *xtcd* were used, respectively.

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