PANOECONOMICUS, 2019, Vol. 66, Issue 2, pp. 145-163
Received: 20 February 2016; Accepted: 02 July 2018.

UDC 330.1:330.564
https://doi.org/10.2298/PAN160220031M
Original scientific paper

Robin Maialeh

Masaryk Institute of Advanced Studies, Czech Technical University in Prague, Czech Republic

✉ robin.maialeh@cvut.cz

Why Market Imperatives Invigorate Economic Inequality? Cobb-Douglas Utility Remodelled

Summary: The aim of the article is to demonstrate on a familiar example of Cobb-Douglas utility function principles of intertemporal resource allocation under general market conditions. The enormous increase of data availability and progress in data analysis in recent decades caused that empirical inequality research has created a robust base of results. On the other hand, researchers face serious interpretation difficulties. Empirical results do not speak for themselves but only through interpretative theory. Hence, the article provides a theoretical scheme which clarifies fundamental inequality-driving forces and which reveals economic inequalities as the intrinsic feature of market economies.

Key words: Cobb-Douglas utility, Economic inequality, Market forces.

JEL: D01, D30, D60, D41.

The broad issue of economic inequality is determined by many converging and diverging factors. The present article demarcates the issue through an idea that modified Cobb-Douglas utility function assigned to rational economic agents in market environment make the result of their interaction unequal over time. The research thus provides a general analytically-logical scheme that can be considered as a driver of inequality in market economies.

First of all, the development of global income inequality is grasped. This section is intended to depict the state of global inequality which is mainly based on the Gini coefficient, but other methods are considered as well. As a part of reviewing empirical studies, the focus is also put on the development of top shares. This part clarifies how concentration of wealth has developed over the past decades and describes dynamics of appropriation of resources on the market. Beside these empirical findings, the paper considers theoretical advances on the issue. But in spite of novelty of the reviewed papers, general interlinkages between market mechanism and economic inequality are rather overshadowed by a particular field of research interest.

The subsequent part therefore explains economic inequalities under general market conditions. Considered conditions are constituents of market itself and respect the main principles of market operationalization – utility maximization which reflects reproductive consumption and certain level/form of competition for appropriable resources. The article contributes to current discussions because it applies traditional theoretical frames and methods of mainstream economics; nonetheless, neoclassical modelling is regularly used to prove converging tendencies of both economic agents and national states. The uniqueness of the article therefore lies in employing neoclassical approach in order to demonstrate right the opposite – divergence and inequality.

Henceforth, we consider widely recognized Cobb-Douglas utility function to model agent's behavior. In addition, neoclassical emphasize on savings as the source of agent's competitiveness is taken into account in a remodeled way where future resource appropriation is a function of today's resource allocation. The presented model aims to overcome neoclassical stationarity and related questionable convergence of economic rational agents. This is done through dynamization of the process of appropriation of resources which results, on the contrary, in diverging tendencies.

1. Empirical Findings on Economic Distribution

1.1 Quantification of Global Inequality

Most researchers throughout the world would agree that global income inequality is high. Estimates and calculations nevertheless exhibit ambiguous results; or at least, there is no simple answer as to whether global inequality is increasing or decreasing. Despite the fact that most papers incline toward increasing inequality, it would require tremendous effort to conjure highly confident research on global inequality. Considering recent and widely discussed works of e.g. Joseph E. Stiglitz (2012), Thomas Piketty (2014), Anthony Atkinson (2015) or Branko Milanović (2016), we rather focus on the most respected academic papers which have remarkably contributed to the issue of measuring global income inequality in the recent two decades. The aim is to provide an influential sample of what the development of inequality is; it is not meant to be a complete review of the subject.

Global inequality itself is the product of converging and diverging factors. From the first group, we might name catch-up growth in developing countries, migration from poor to rich countries or diffusion of technologies through trade. On the other hand, the rise in top-end inequality within countries, international tax competition and evasion or rising inherited wealth are supposed to cause greater divergence on global scale. Research results are structured according to method – Gini results based on purchasing parity power and Gini results based on market exchange rates. Researches are then sum up according to interpretation of inequality: (1) increasing; (2) constant or ambiguously interpreted; and (3) decreasing.

Steve Dorwick and Muhammad Akmal (2005) deal with the question whether inequality values based on PPP and market exchange rates converge since globalization makes national states trade a bigger fraction of their GDP. By using Klaus Deininger and Lyn Squire's (1996) data for within-country inequality and GDP PPPs from Penn World Table (PWT 5.6). Authors present that global Gini coefficient decreased from 0.659 in 1980 to 0.636 in 1993 when using standard PPP conversion factors (Geary-Khamis method) for measuring relative incomes. On the contrary by using their own "Afriat" conversion factors the inequality slightly rose from 0.698 to 0.711.

Milanović (2005) used his own dataset of household surveys for within-country inequality and PWT and World Bank data for PPP. He informs about increasing Gini coefficient from 0.622 to 0.641 between 1988 and 1998. Milanović (2005) comes out with other calculations – as if he used GDP *per capita* instead of household surveys, Gini coefficient would increase almost by 2 percentage points. In his previous work Milanović (2002) observed an increase from 0.628 to 0.660 between 1988 and 1993 as the result based on household surveys for 91 countries. Between-country inequality explains 75% - 88% of overall inequality, depending on whether the author uses Gini or Theil index. Real incomes of the bottom 5% of the world population decreased by one-fourth, while the richest quintile went up. The world top 1% receive as much as the bottom 57%, which means that 50 million of the richest receive as much as 2.7 billion poor. Milanović (2002) continues, that the ratio between average income of the world top 5% and world bottom 5% increased from 78:1 in 1988, to 114:1 in 1993. A study of the United Nations Development Programme (UNDP 1999) adds that the ration of GDP *per capita* in the richest and the poorest country rose from 35:1 in 1950 to 44:1 in 1973 and finally 72:1 in 1992.

Milanović (2013) also uses Theil's mean log deviation. Such analysis is easily decomposable and at the same time the importance of each component does not depend on the rest of the decomposition. This attitude is also shared by Sudhir Anand and Paul Segal (2008). It allows measuring global inequality by the index value and decomposing the aggregate value into two main factors – location and social class. His results show that the importance of location prevails class affiliation over time, which subsequently confirms that between-country inequality has become decisive in explaining global inequality.

Xavier Sala-i-Martín (2006) used Deininger and Squire's (1996) and United Nations University - World Institute for Development Economics Research data (UNU-WIDER) for within-country inequality; GDP PPPs from PWT 6.0. Based on these datasets the author found a decrease of the Gini coefficient from 0.660 to 0.637 between 1980 and 2000. Sala-i-Martín (2006) therefore presents that countries were converging. However, he reminds, if China is excluded from the sample, we would get results that sign economic divergence on the interpersonal level. In this particular case, Gini coefficient would increase from 0.620 to 0.648 which represents an increase of global interpersonal inequality by 4.4% (Sala-i-Martín 2006, p. 388). When computing logarithm of income, the method also used e.g. by Paul Schultz (1998), inequality in 2000 is higher than in 1970.

Surjit Bhalla (2002) used his own data for within-country inequality; as a source of GDP PPPs he used World Development Indicators and PWT 5.6. Bhalla (2002) recorded a reduction from 0.686 in 1980 to 0.651 in 2000. This means that median person in the developing world is slightly catching up world richer counterparts.

Francois Bourguignon and Christian Morrisson (2002) found no change in the Gini coefficient between 1980 and 1992, which remained at 0.657. Authors also used their own data for within-country inequality and Angus Maddison's data (1995) for GDP PPPs. Bourguignon and Morrisson (2002) found in their sample of 33 countries that from 1820-1920 inequality grew according to every method. Income share of the top quintile grew from 1970 to 1992. From 1820 to 1992 the Gini coefficient grew by 30% and Theil index grew by 60%. Their results also show that higher social mobility decreases inequality. Authors further claim that inequality in the early 19th century was mainly due to within-country disparities, while later on the driver was between-country inequality.

Yuri Dikhanov and Michael Ward (2001) came up with an increase in Gini from 0.683 to 0.668 during the period of 1970-1999. They used Milanović's (2002) data for within-country inequality and World Bank data for PPPs.

The previous researches above were calculated by using PPPs. The second option is to compare national incomes through market exchange rates. Dorwick and Akmal (2005) argue with increasing Gini from 0.779 to 0.824 between 1980 and 1993. Milanović (2002) had recorded an increase as well, concretely from 0.782 to 0.805 between 1988 and 1993. Three years later Milanović (2005) presented an increase from 0.778 to 0.794 between 1988 and 1998. Finally, Roberto Korzeniewicz and Timothy Moran (1997) identified an increase of Gini from 0.749 to 0.796 between 1965 and 1992. Authors also use the Theil index to prove that between-country inequality is the most important in capturing global interpersonal income inequality, while between-country inequality explains roughly 90% of interpersonal global inequality.

Among other influential empirical researches, we might find Giovanni Cornia and Sampsa Kiiski (2001) whose research covers 80% of the world population and 91% of the world GDP. Authors claim that 59% of the world population lived in countries where inequality is increasing, meanwhile only 5% of the world population lived in countries where inequality is decreasing (Cornia and Kiiski 2001, p. 21). The research shows that since the 1980s there has been a significant increase in inequality in both developing and developed countries. To be adequate, their analysis shows that liberalization of domestic financial and job markets led to the increase in inequality, as well as privatization did.

Schultz's (1998) research covers 93% of the world population. The variance in the logarithms of *per capita* GDP PPPs increased worldwide between 1960 and 1968; and decreased since the mid 1970s. Schultz also argues that subsequent convergence in intercountry incomes offset any increase in within-country inequality. In contrast to Korzeniewicz and Moran (1997) and Milanović (2002), Schultz (1998) assigns two-thirds of world inequality to inter-country differences. Further, three-tenths to inter-household within-country inequality, and one-twentieth to between-gender differences in education. If China is excluded from the world sample, the decline in world inequality after 1975 is not evident. Schultz's (1998) research also proves the intuitive fact that the bigger the sample is, the higher the chance of estimate errors is.

Camelia Minoiu (2007) analyzes poverty based on kernel density estimates for 94 countries. Minoiu's (2007) outcomes show that global poverty rates are highly sensitive to the choice of smoothing parameter. As the result, the estimated proportion of people who live for 1 USD/day in 2000 varies by a factor of 1.8, while the estimated number of people who live for 2 USD/day in 2000 varies by 287 million people. According to Minoiu's (2007) research, 23-27% of the world population lived for 2 USD/day in 1990, whereas Sala-i-Martín (2006) identifies only 16% of the world population. This can be explained by using income clusters in case of Minoiu's (2007) research, the difference might also reveal why Sala-i-Martín (2006) identified decreasing global inequality. As the author admits, there exists serious concern about the validity and robustness of poverty analysis based on kernel density estimation on grouped data.

In summary, it can be claimed that increasing inequality in recent decades was detected by Korzeniewicz and Moran (1997), Cornia and Kiiski (2001), Dikhanov and Ward (2001) and Milanović (2002, 2005). Constant or ambiguously interpreted inequality was detected by Schultz (1998), Bourguignon and Morrisson (2002) and Dorwick and Akmal (2005). Decreasing inequality was detected by Bhalla (2002) and Sala-i-Martín (2006). Still, most researchers agree with increasing global inequality since the 1980s. An eloquent in this regard is Milanović (2013) who reliably demonstrates rapidly increasing economic inequality measured by Gini coefficient since 1980s. His sample includes 144 countries and each country/year represents one observation. It must be also noted that both Bhalla (2002) and Sala-i-Martín (2006) use quintile shares which most likely explains their results; whereas Dikhanom and Ward (2001) and Milanović (2002, 2005) calculate PPPs for consumption. Further details on variances in income and consumption inequality can be seen in well-known Dirk Krueger and Fabrizio Perri (2006) or the newer study of Mark Aguiar and Mark Bils (2011).

1.2 Top Income Shares: The Case of the United States

When referring to economic distribution, it is worth to mention the question of income shares. The increase in the top 1% income is too relevant to be omitted, especially in the context of the United States as the leading market economy of the world. Decomposition of labor income of the top 1% over the past century in the United States shows that the labor component of mixed income as a share on national income is stagnating, while other compensations has grown significantly since 1970’s. In case of capital income of the top 1% we observe an increase as a share on national income (Piketty, Emmanuel Saez, and Gabriel Zucman 2018).

In order to capture wealth inequality, researchers have to overcome many methodological difficulties related to estate tax multiplier method, capitalization of investment income or survey data with top-end correction. Uncertainty also arises when considering offshore wealth (Zucman 2015). One of the most insightful studies on the topic was written by Saez and Zucman (2016). In the case of the United States, authors come up with the following numbers.

Particularly interesting is the development of top wealth shares. Table 1 depicts the share of total household wealth held by the top 0.1% as estimated by capitalizing income tax returns. A rapid increase of wealth of the top 0.01% is particularly observed since late 1970’s. Conversely, the magnitude of wealth held by the bottom 90% is declining since the same time period. The inverted development between top and bottom wealth holders is also observable in income. Put together, we see that the share of income and wealth of the bottom 90% wealth holders have been declining since 1980’s and conversely the share of income and wealth of the top 1% wealth holders have been rising since the same time period (Saez and Zucman 2016). The same trend is confirmed by many others, e.g. Gérard Duménil and Dominique Lévy (2011). Further, average growth rate of GDP per person for the top 0.1% was 0.72%; and 2.3% for the bottom 99.9% between 1950 and 1980; between 1980-2010 average growth rate of

GDP per person for the top 0.1% was 6.86% and 1.83% for the bottom 99.9% (Charles I. Jones 2005).

Table 1 Thresholds and Average Wealth in Top Wealth Groups (USA, 2012)

Wealth group	Number of families	Wealth threshold (USD)	Average wealth (USD)	Wealth share
A. Top wealth groups				
Full population	160 700 000		343 000	100.0%
Top 10%	16 070 000	660 000	2 560 000	77.2%
Top 1%	1 607 000	3 960 000	13 840 000	41.8%
Top 0.1%	160 700	20 600 000	72 800 000	22.0%
Top .01%	16 070	111 000 000	371 000 000	11.2%
B. Intermediate wealth groups				
Bottom 90%	144 600 000		84 000	22.8%
Top 10-1%	14 463 000	660 000	1 310 000	35.4%
Top 1-0.1%	1 446 300	3 960 000	7 290 000	19.8%
Top 0.1-0.01%	144 600	20 600 000	39 700 000	10.8%
Top .01%	16 070	111 000 000	371 000 000	11.2%

Source: Saez and Zucman (2016).

Authors often attribute these changes to saving rate. While the average saving rate has been 9.8% over 1913-2013, the saving rate at the top was fold higher and at the bottom oscillates around zero in the recent decades. In concrete, during last two decades, the saving rate of the top 1% was between 30% and 40%, while the saving rate of the bottom 90% was about 0% and even negative (Saez and Zucman 2016).

The view of the top 1% was confronted by Daron Acemoglu and James A. Robinson (2015) who oppose general Piketty's conclusions, summarized in Piketty (2014). Beside the role of the top 1% also formula "$r > g$" which purportedly does not explain historical patterns of inequality, authors point at imperfect elasticity between labor and capital, which might be also identified in Piketty's work. Acemoglu and Robinson (2015) argue with the example of South Africa and Sweden for which they run statistical regression. According to their analysis, the development of the top 1% went through the same pattern in both countries, however their national inequalities were substantially different. Empirical challenge of Piketty's (2014) work was also held by Phillip W. Magness and Robert P. Murphy (2015), however their corrections are rather formal with no change in general trends.

In spite of partial uncertainties, the dynamics of production process allows basal conclusions. Firstly, aggregate wealth has increased enormously during the last century. The data showing continuous increase of global GDP does not require any deeper analysis, since we do not observe long-run declining tendencies of economic performance in any of the world regions which can be demonstrated e.g. by the latest PWT 9.0. A deeper analytical insight is also provided by Robert C. Feenstra, Robert Inklaar, and Marcel P. Timmer (2015). Despite contradictory results in global inequality quantifications, which depend mainly on used data and adopted methods, it is also apparent that changes affecting inequality the most are placed in late 1970s and early 1980s. Wealth and income shares of the bottom social strata is declining while wealth and income shares of the top strata are rising. Wealth share of the top 0.01 % in the United States is six times larger than in late 1970s; saving rate at the top wealth shares is significantly higher than for the bottom 90% (especially Jones 2005 and Saez and Zucman 2016).

2. Microeconomic Foundations of Economic Inequality

Researches presented in the previous part have been placed in the empirical field. The next part attempts to uncover inclinations toward deepening inequality under market conditions theoretically and it attempts to explain why inequalities captured above do not decline with increasing global wealth. For this purpose, we make use of neoclassical evergreen – Cobb-Douglas utility function – which, in combination with Schumpeterian approach advanced by Philippe Aghion and Peter Howitt (2009), is supposed to serve as unique research tool. By using it, we do not face difficulties concerning particular influences on inequality, e.g. national state policy, global economy constellation, differences in individual preferences, etc. The inequality thus can be explained strictly by general market principles.

Theoretical contributions to inequality issues rarely aim at general explanation of observed dynamics since most of studies are rather particularized into a few possible drivers (e.g. technology, education, etc.). Recently, the most famous exception is Piketty's general formula "$r > g$". Older theoretical contributions include Stiglitz (1969), whose article presents implications for the distribution of wealth and income based on alternative assumptions about savings, reproduction or inheritance policies, which are investigated in the context of a neoclassical growth model. Despite the author isolates different economic forces in order to evaluate which of those forces tend to make the distribution of wealth in the long-run equalitarian and which tend to make wealth unevenly distributed, the presented model is too narrow and do not expose general market logic. A broader theoretical context of economic distribution is seen in Nicolas Kaldor (1955), who researched alternative theories of redistribution through Ricardian (classical) theory, Marxian theory, neo-classical (marginalist) theory and Keynesian theory.

More recently, some of the general theoretical papers are in contrast with a former neoclassical approach which – due to its stationarity – leads to convergence. Namely, Jonathan B. Baker and Steven C. Salop (2015) examined the relationship between inequality and market mechanism with the conclusion that markets tend to raise the return to capital and hence contribute to the progression and perpetuation of inequality. In a similar fashion we read papers of Jason Furman and Peter Orszag (2015), Matthew Rognlie (2015) or Sean Ennis and Yunhee Kim (2016) who based their study on William S. Comanor and Robert H. Smiley (1975). A positive relationship between market power and inequality was however detected earlier, e.g. by John Creedy and Robert Dixon (1999). Ennis, Pedro Gonzaga, and Chris Pike (2017) further composed a model that signifies diverging tendencies of market mechanism. An innovative approach to theorize inequality is seen in Xavier Gabaix et al. (2016). In contrast to renowned studies dedicated to random growth theories of the wealth distribution, especially Jones (2005), Jess Benhabib, Alberto Bisin, and Shenghao Zhu (2011, 2015, 2016), or Acemoglu and Robinson (2015), Gabaix et al. (2016) overcome stationary distributions and focus on transition dynamics. At the same time, their model analytically advanced results of Shuhei Aoki and Makoto Nirei (2015), whose research, despite the focus on transition dynamics, uses purely numerical analysis with a particular focus on the influence of tax changes, i.e. with a loss of theoretical generality. Authors come up with a finding that unlike parsimonious deviations from the basic model a simple Gibrat's law for income dynamics cannot explain rapid changes in inequality.

2.1 Context of the Cobb-Douglas Utility Model

The presented model considers market as a mechanism permanently driven by utility/profit maximization. This is so due to a certain form/level of competitive struggle among agents. Therefore, every single agent whose reproduction depends on resources appropriable on the market is forced to, for the sake of his survival, continually strengthen his market position. In order to built-up his competitiveness, the agent uses unconsumed resources. If the agent has no unconsumed resources left and others do, then the agent is unable to strengthen his competitiveness and competitive pressure impedes him further appropriation of resources on the market. Further, the agent uses only his own resources. Not only because of broad literature dedicated to "credit constraints", covered also by e.g. Aghion, Eve Caroli, and Cecilia García Penalosa (1999), Rafael Gomez and David Foot (2003) or Oded Galor (2009) such market barriers should be eliminated mainly because creditworthiness and imperfectness on capital markets, in this case, might intensified diverging tendencies.

Variables used in the proposed model follows up the general model of inequality (Robin Maialeh 2017) and are described as follows: by τ we understand total resources in various forms as the result of both labor and capital which agent has before any consumption. Further, δ is assigned to all resources essential for agent's reproduction on a given economic level; the lowest costs that ensure agent's survival on a given market. In other words, δ is a reference point for the "price" of consumption; vulgarly put – a depreciation of agent's existence. The following use of the term "reproductive consumption" is to emphasize the necessity to persist in the production process. Donald J. Harris (1978, p. 55) similarly defines necessary consumption as a "quantity required for consumption in order that a unit of labour may be maintained in production". The term is also used in feminist theory (e.g. Ruth Fletcher 2006). Above that, C is the actual consumption, while $\delta \subseteq C$. ς is determined by the difference between τ and C. It basically represents how much agent has at a disposal after securing his reproduction and actual consumption given by propensities to consume and to invest. By ς we understand all remaining activities which are supposed to strengthen agent's competitiveness. ξ^{TOTAL} is total amount of resources available on the market for which all agents compete and ξ^{SHARE} is a share of ξ^{TOTAL} which agent is able to appropriate on the market. In addition, we assume that agent does not lose any resources in allocation

– agent i can only gain ξ_{it}^{SHARE} in addition to τ_{it-1} or stay with the previous level of total resources; the latter assumes that $\tau_{it} = \tau_{it-1} \Leftrightarrow \xi_{it}^{SHARE} = 0$.

It is necessary to understand that τ, δ and ς do not correspond to traditional income, consumption and savings. Despite similarities between our reformulation and the traditional concept, outlined variables require different treatment in order to capture isolated market mechanism. This is also the reason why e.g. Satyajit Chatterjee (1992), who concludes that neoclassical growth model does not necessarily imply convergence, is not taken into account. Despite Chatterjee researches two identical economies and dynamics of wealth distribution, his neoclassical model contains further specifications that would significantly distort the core idea of the proposed model. The model is therefore rather inspired by Schumpeterian infinite innovation stimuli which eliminate neoclassical steady-states. For similar reasons, also Deaton's theory of consumption, which aspires to clarify poverty issues, cannot be broadly incorporated since the role of subjective/individual factors is constitutive for his theory. The model is easily interpretable also in the theory of the firm where utility maximization is substituted by profit maximization.

2.2 Formulation of the Cobb-Douglas Utility Model

Let us start with the algebraic expression of already outlined relationships. The ordinary Cobb-Douglas utility $u(x_1, x_2) = x_1^{\alpha} x_2^{\beta}$, which – except discussions on dynamic modelling with Cobb-Douglas production function in macroeconomics – works with static forms, is therefore reformulated (and dynamized in the end) as follows: agent i maximizes his Cobb-Douglas utility in time t given by actual consumption and investments to strengthen his position on the market. Investments thus serves as a "guarantor" of future consumption. The share of actual consumption and investments on final utility is given by propensities to consume $PROP(C)$ and to invest $PROP(\varsigma)$.

$$\max_{C,\varsigma} u\,(C, \varsigma) = {C_{it}}^{PROP(C)_{it}} {\varsigma_{it}}^{PROP(\varsigma)_{it}} \\ \text{s.t.} p_{C_{it}} C_{it} + p_{\varsigma_{it}} \varsigma_{it} = \tau_{it}, \tag{1}$$

where $p_{C_{it}} = f(\rho(\delta_{it}; \tau_{it}))$; $p_{\varsigma_{it}} = 1/f(p_{C_{it}})$ with ρ as the Euclidean distance between reproductive consumption and disposable total resources; while still $\delta \subseteq C$. The idea is that bigger difference in the Euclidean distance determines lower weight of actual consumption, which is therefore burdened by a higher "price" – by the function value of the distance. Also, bigger difference in the Euclidean distance signifies that the agent has quite enough total resources. However, in order to keep such amount of resources the agent needs more resources for competition. A smaller Euclidean distance on the other hand means that the agent has a lower amount of total resources. This generates lower "price" of consumption and therefore makes consumption – which is in that particular case mainly composed of reproductive consumption δ – more likely to happen. The reason is that the agent inclines to consume a bigger fraction of total resources when total resources are smaller. $PROP(C)$ denotes propensity to consume measuring dynamized shares of actual consumption on changing total resources; $PROP(\varsigma)$ denotes propensity to invest measuring dynamized shares of unconsumed resources on changing total resources. These propensities say what fraction of total resources is dedicated to consumption and what fraction is left unconsumed for enhancing competitiveness when changing total resources over time. Additionally, changes in $PROP(C)$ and $PROP(\varsigma)$ derive from marginal propensities, i.e. from what fraction of additional unit of resources is consumed and what fraction of additional unit is invested to competition struggle in the next period. Therefore, dynamized propensities, changing with any additional unit of resources, should not be defined as average propensities neither as marginal propensities. For any case, propensities change proportionally and inversely, thus:

$$PROP(C)_{it} + PROP(\varsigma)_{it} = 1, \tag{2}$$

and further,

$$\begin{gathered} PROP(C)_{it} = \frac{\partial C_{it}}{\partial \tau_{it}}; PROP(\varsigma)_{it} = \frac{\partial \varsigma_{it}}{\partial \tau_{it}} \\ \Rightarrow \Delta C_{it}; \Delta \varsigma_{it} < \Delta \tau_{it}; 0 \leq \frac{\Delta C_{it}}{\Delta \tau_{it}}, \frac{\Delta \varsigma_{it}}{\Delta \tau_{it}} \leq 1. \end{gathered} \tag{3}$$

In order to reflect the core idea of mentioned propensities, it redirects us to dynamic forms. When considered a very low level of total resources, let us say $C_{it} \rightarrow \tau_{it} \Leftrightarrow \delta_{it} \rightarrow C_{it}$, the agent tends to consume all of them. In this case, propensity to consume $PROP(C)$ is approaching to 1. It follows that $PROP(\varsigma)$ is approaching to 0 proportionally as $PROP(C)$ is approaching to 1. With a higher amount of total resources agent assesses which fraction of the resources to consume and which to keep for strengthening his position. Further, we standardly assume that consumption is an increasing function of income. In spite of statistical estimation of Simon Kuznets (1946, p. 53) and Raymond Goldsmith (1955, pp. 47-88) regarding long-run constancy of the propensity to consume and redefinitions by James Duesenberry (1949) or Milton Friedman (1957), the Keynesian assumption is, at this place, re-formulated in a different sense with the emphasize on *necessity* to consume represented by δ as a fraction of C. Such a theorizing is, therefore, closer to the current research: for instance, Christopher D. Carrol, Jiri Slacalek, and Kiichi Tokuoka (2014) find a wide dispersion in the *MPC* across the wealth distribution. Mostly, less wealthy households have much higher *MPCs* than wealthier households. According to them the ratio between wealth and income is the key determinant of the *MPC* changes which contradicts former statistical estimations (Kuznets 1946; Duesenberry 1949; Goldsmith 1955 or Friedman 1957). Theoretical aspects of these determinations were also researched in the context of the neoclassical model (Chatterjee 1992). Such a dynamic formulation requires following conditions for one of the propensities; for assumed continuous function $PROP(\varsigma)$: $(0, \infty) \rightarrow (0, 1)$ we have:

$$(H) \begin{cases} PROP(\varsigma) \; is \; increasing \; (0,1) \\ \lim\limits_{\tau_{it} \rightarrow \infty} PROP(\varsigma)(\tau_{it}) = 1 \\ \exists \varepsilon_{const} \in (0, \infty) : \; PROP(\varsigma) \; is \; convex(0, \varepsilon_{const}); \; PROP(\varsigma) \; is \; concave(\varepsilon_{const}, \infty) \end{cases}$$

where ε_{const} is an inflex point, which is equal to a certain level of total resources where propensities are equal, respectively have values = 0.5. As a general solution for dynamized forms of propensities is the set of functions $\mathfrak{M}$ which follows H conditions:

$$\mathfrak{M} = \{PROP(\varsigma) \in C((0,\infty),(0,1)|(H)holds\}.$$

From this we deduce that a constantly bigger fraction of additional units of total resources is becoming a component of unconsumed and hence invested resources.

Further, we continue with standard constraint maximization through Lagrangean function, Equation (4), which is interpreted as:

$$\mathfrak{L} = C_{it}{}^{PROP(C)_{it}}\varsigma_{it}{}^{PROP(\varsigma)_{it}} + \lambda\left(p_{C_{it}}C_{it} + p_{\varsigma_{it}}\varsigma_{it} - \tau_{it}\right), \tag{4}$$

$$\frac{\partial\mathfrak{L}}{\partial C} = PROP(C)C^{PROP(C)-1}\varsigma^{PROP(\varsigma)} - \lambda p_C = 0, \tag{5a}$$

$$\frac{\partial\mathfrak{L}}{\partial \varsigma} = PROP(\varsigma)C^{PROP(C)}\varsigma^{PROP(\varsigma)-1} - \lambda p_\varsigma = 0, \tag{5b}$$

$$\frac{\partial\mathfrak{L}}{\partial \lambda} = p_C C + p_\varsigma \varsigma - \tau = 0, \tag{5c}$$

with FOC (5a), (5b) and (5c). Assuming $0 < C; 0 < \varsigma$, the unique solution for C^* and ς^* is:

$$\frac{PROP(C)C^{PROP(C)-1}\varsigma^{PROP(\varsigma)}}{p_C} = \lambda, \tag{6}$$

$$\frac{PROP(\varsigma)C^{PROP(C)}\varsigma^{PROP(\varsigma)-1}}{p_\varsigma} = \lambda, \tag{7}$$

which naturally gives $PROP(C)C^{PROP(C)-1}\varsigma^{PROP(\varsigma)}/p_C = PROP(\varsigma)C^{PROP(C)}\varsigma^{PROP(\varsigma)-1}/p_\varsigma$. Both terms divided by $C^{PROP(C)-1}\varsigma^{PROP(\varsigma)-1}$ are simplified to $PROP(C)\varsigma/p_C = PROP(\varsigma)C/p_\varsigma$, alternatively $p_\varsigma\,\varsigma = PROP(\varsigma)p_C C/PROP(C)$. Then we substitute $p_\varsigma\,\varsigma$ back into the third FOC to obtain $p_C C + PROP(\varsigma)p_C C/PROP(C) - \tau = 0$. This implies $p_C C = PROP(C)/(PROP(C) + PROP(\varsigma))\tau$; for C^* we get:

$$C^* = \frac{PROP(C)}{PROP(C)+PROP(\varsigma)}\frac{\tau}{p_C} = PROP(C)\frac{\tau}{p_C}, \tag{8}$$

and according to $p_\varsigma\,\varsigma = PROP(\varsigma)p_C C/PROP(C)$ it follows that:

$$\varsigma^* = \frac{PROP(\varsigma)}{PROP(C)+PROP(\varsigma)}\frac{\tau}{p_\varsigma} = PROP(\varsigma)\frac{\tau}{p_\varsigma}, \tag{9}$$

while the unique solution in $\mathbb{R} > 0$ is satisfied as long as $0 < PROP(\varsigma), 0 < PROP(C), 0 < p_\varsigma, 0 < p_C, 0 < \tau$. To check the constrained maximum, the bordered Hessian is:

$$H = \begin{pmatrix} 0 & -p_C & -p_\varsigma \\ -p_C & PROP(C)(PROP(C)-1)(C^*)^{PROP(C)-2}\varsigma^{*PROP(\varsigma)} & PROP(C)PROP(\varsigma)(C^*)^{PROP(C)-1}(\varsigma^*)^{PROP(\varsigma)-1} \\ -p_\varsigma & PROP(C)(PROP(\varsigma)C^{*PROP(C)-1}(\varsigma^*)^{PROP(\varsigma)-1} & PROP(\varsigma)(PROP(\varsigma)-1)(C^*)^{PROP(C)}(\varsigma^*)^{PROP(\varsigma)-2} \end{pmatrix},$$

where the determinant is:

$$\begin{aligned}\det(H) = & p_C\left[-p_C PROP(\varsigma)(PROP(\varsigma)-1)(C^*)^{PROP(C)}(\varsigma^*)^{PROP(\varsigma)-2} + p_\varsigma PROP(C)PROP(\varsigma)(C^*)^{PROP(C)-1}(\varsigma^*)^{PROP(\varsigma)-1}\right] \\ & - p_\varsigma\Big[-p_C(PROP(C)PROP(\varsigma)(C^*)^{PROP(C)-1}(\varsigma^*)^{PROP(\varsigma)-1} \\ & + p_\varsigma PROP(C)(PROP(C)-1)(C^*)^{PROP(C)-2}\varsigma^{*PROP(\varsigma)}\Big] \\ & = C^{PROP(C)-2}\varsigma^{PROP(\varsigma)-2}\big[-PROP(\varsigma)(PROP(\varsigma)-1)p_C^2(C^*)^2 + 2PROP(C)PROP(\varsigma)p_C p_\varsigma C\varsigma \\ & - PROP(C)(PROP(C)-1)\,p_\varsigma^2(\varsigma^*)^2\big].\end{aligned}$$

It is clear, given the assumptions $PROP(C) + PROP(\varsigma) = 1; 0 < PROP(C) < 1; 0 < PROP(\varsigma) < 1$, that the determinant is positive. Hence, the stationary point (C^*, ς^*) is a maximum.

Additionally, comparative statics is used to explain logically consistent variations of p_C, p_ς and τ. The following term:

$$\frac{\partial C^*}{\partial p_C} = -\frac{PROP(C)}{PROP(C)+PROP(\varsigma)}\frac{\tau}{p_C^2} < 0, \tag{10}$$

proves that as the difference between reproductive consumption and total resources increases, the quantity of actual consumption tends to decrease. However, actual consumption remains to be an increasing function of total resources – an increase in the difference between reproductive consumption and total resources is possible only when increasing total resources. The fact that increasing total resources relates to increasing actual consumption is proven followingly:

$$\frac{\partial C^*}{\partial \tau} = \frac{PROP(C)}{PROP(C)+PROP(\varsigma)}\frac{1}{p_C} > 0. \tag{11}$$

Further, the model ought to be formulated in a way that $C^*$and ς^* are neither substitutes nor complements. In other words, actual consumption is not affected by changes in unconsumed resources and *vice versa*, but both are determined by changes in total resources. This is simply verified through $\partial C^*/\partial p_\varsigma = 0$.

The envelope theorem is also used to look at the effects on the utility of the agent at the optimum. Hence, we calculate the situation $du(C^*(p_C, p_\varsigma, \tau), \varsigma^*(p_C, p_\varsigma, \tau))/dp_C$ which equals to:

$$\frac{\partial(C^{PROP(C)}\varsigma^{PROP(\varsigma)})}{\partial p_C} - \frac{\lambda\partial(p_C C + p_\varsigma\varsigma - \tau)}{\partial p_C}. \tag{12}$$

The utility function does not depend directly on p_C which implies that the first term is zero. Therefore, we get $du(C^*(p_C, p_\varsigma, \tau), \varsigma^*(p_C, p_\varsigma, \tau))/dp_C = -\lambda^* C^*$. From the Lagrangean equation we see that $0 < \lambda^*$. In a regular Cobb-Douglas utility case this would imply that increasing Euclidean distance between reproductive consumption and disposable total resources indirectly decreases utility, which would be logically inconsistent. Therefore, in the present case, as stated above on the relation between p_C and p_ς, an increase in the Euclidean distance inversely and proportionally decreases p_ς, which eases to allocate agent's resources in the form of investment (unconsumed resources). This consequently strengthen his competitiveness when increasing the distance between reproductive consumption and total resources. In other words, the effect of increasing p_C is in terms of maximized utility counterbalanced by the effect of decreasing p_ς. Moreover, an increase in p_C is the result of increasing τ which has a positive effect on agent's utility. This is derived similarly as above – we get $du(C^*(p_C, p_\varsigma, \tau), \varsigma^*(p_C, p_\varsigma, \tau))/d\tau$ equal to:

$$\frac{\partial(C^{PROP(C)}\varsigma^{PROP(\varsigma)})}{\partial\tau} - \frac{\lambda\partial(p_C C + p_\varsigma \varsigma - \tau)}{\partial\tau} = +\lambda^*, \quad (13)$$

which confirms that the effect of an increase in total resources is positive on agent's utility. λ^* hence captures the effect of changes in total resources on utility at the optimum.

In this Cobb-Douglesian reformulation it can be seen that the agent is, according to presented calculations, exclusively motivated to increase his total resources. Therefore, it is crucial to capture the process of resource appropriation. The process is simultaneously behind the issue of economic inequality which is, simply put, a result of operating market laws of economic distribution. For this purpose, it is assumed Schumpeterian theory advanced by Aghion and Howitt (2009). The probability μ_t that the innovation is successful at t is positively related to the amount of resources R_t allocated to the innovation process – the process of building-up competitiveness. Further, the probability μ_t is inversely related to γA_{t-1} which represents a new level of innovation productivity. In other words, the higher the level of competitiveness the agent strive for, the more difficult it is to implement the innovation. The probability is then captured as:

$$\mu_t = \phi\left(\frac{R_t}{\gamma A_{t-1}}\right). \quad (14)$$

From (14) it is thus seeable that the differentiating factors of inequality are the amount or resources R_t allocated to the innovation and γA_{t-1} representing the new level of innovation productivity (A_{t-1} is the technological parameter, $\gamma - 1$ is the growth rate since $\gamma > 1$). Assuming constant γA_{t-1} for all agents, i.e. equal competitiveness-building ambitions in order to isolate market differences among agents, then can be said that the bigger the amount of invested resources the agent has at t, the higher the probability to innovate and to strengthen his competitiveness the agent has at $t + 1$. At this time, it is crucial to understand that the amount of resources R_t represents unconsumed resources transformed into investments of the i's agent. Therefore, it is claimed that $R_{it} = \varsigma_{it}$.

The probability-based appropriation of additional resources – the aim of the agent i defined by his utility function – is therefore defined as:

$$\xi_{it}^{SHARE} = \xi_t^{TOTAL} \frac{\sum_{t_0}^{t-1} \varsigma_i}{\sum_{t_0}^{t-1} \sum_{j=1}^{n} \varsigma_j}, \quad (15)$$

where $\sum_{t_0}^{t-1} \varsigma_i$ denotes sum of all invested resources of agent i from t_0 to t for $t_0 \to t$, whilst $\sum_{t_0}^{t-1} \sum_{j=1}^{n} \varsigma_j$ represents all invested resources of all agents from t_0 to t for $t_0 \to t$. ξ_t^{TOTAL} denotes the total amount of resources available on the market. Accordingly, ξ_{it}^{SHARE} is the share of total resources which belongs to i given by the relation of his and total invested resources.

The divergence among agents is captured by the intertemporal extension of the basic model; assuming again $\tau_{it} = \tau_{it-1} \Leftrightarrow \xi_{it}^{SHARE} = 0$ we deduce:

$$\max_{C,\varsigma} u\,(C,\varsigma) = C_{it}{}^{PROP(C)_{it}}\varsigma_{it}{}^{PROP(\varsigma)_{it}}; \\ \text{s.t.} p_{C_{it}} C_{it} + p_{\varsigma_{it}} \varsigma_{it} = \tau_{it-1} + \xi_{it}^{SHARE}, \tag{16}$$

where total resources in t are the sum of total resources in t - 1 and appropriable resources gained on the market in t. The latter derives according to (14) from the amount of investments allocated by the agent in t - 1.

In sum, Cobb-Douglas preferences of agents give the solution (8) and (9). Market environment orders to strengthen agent's competitiveness through competitive pressure. A part of total resources is consumed according to $PROP(C)$ with regards to p_C. The remaining part of total resources is invested according to $PROP(\varsigma)$ in order to strengthen agent's competitiveness. As it is shown in (15), an agent appropriates a share of the total amount of resources available on the market according to the amount of investments allocated to the competition struggle; in other words, agents appropriate resources according to their market power. Therefore, each solution for maximizing agent's utility drives the agent to increase his total resources. If we run a simulation of two agents with slightly different initial levels of total resources (or even equal for the first round), competing on a perfectly competitive market under the same conditions and assuming homogeneous preferences, we would observe – according to the set of assumptions and outlined relationships – steadily diverging amounts of total resources which agents have at a disposal in time $t + n$.

The model elucidates fundamental market powers as a diverging factor of economic distribution. However, it does not say that in any case and under any conditions market measures will lead to economic inequality in our real world. However, what will be always present when market measures are employed is this diverging tendency.

The model is easily transformable into the theory of the firm which allows to be elaborated further e.g. in a sense of Almarin Phillips (1966) who identified the principle "success breeds success" in the aircraft industry; as well as the following research accomplished by Henry Grabowski (1968) and his adaptation on chemical, petrochemical and pharmaceutical industries. Additionally, we might find common denominators with Myrdal-Kaldor's cumulative causation.

3. Conclusion

The article theoretically confronts the claim that economic inequality is primarily a result of market imperfections. Such a claim is frequently demonstrated on traditional neoclassical approach incorporating Cobb-Douglas production/utility function which results in economic convergence of agents. In order to empirically challenge the mainstream view, the first part deals with quantitative findings on economic inequality. Global inequality research is structured according to used method and data source. In sum, the majority of authors tends to conclude global inequality as rather increasing, however this significantly depends on the used method. In case of top income shares the situation is clearer. On the example of the United States it is demonstrated how increasing wealth is distributed in the society. It is evident that the vast majority of the wealth/income increase is appropriated by top shares while the bottom deciles experienced stagnation or even decline in their economic power in recent decades.

Theoretical confrontation of converging arguments is the matter of the second part. In spite of fruitful and pioneering researches in the field, most of the research focuses on partial drivers of inequality (savings, taxes, inheritance etc.) where abstract market mechanism as a whole is not researched as a central category. Based on the previous analysis, the composed model presents a modified theoretical frame of Cobb-Douglas utility function which is supposed to reveal diverging tendencies among interacting economic agents. As explained in the text, the elaborated frame specifies that agents divide their utility between actual consumption, which contains reproductive consumption, and investments securing their future consumption, while maximizing utility is constrained by the amount of total resources at agent's disposal. Agents under market conditions face the pressure to invest, otherwise they will lose their competitiveness and their reproduction is threatened. Hence, if we assigned the Equation (15) to *identical, freely and rationally acting* agents using their own resources to compete, we would observe continually deepening resource gap between the agents. Another characteristic of the formal scheme is the fact that it includes accelerating effect which is based on dynamized propensities. Intertemporal asymptotic modification of propensities contributes to the fact that wealthier agents enjoying the same conditions as others will be able to use steadily more resources to defeat the rest within competition struggle. The conclusion that can be drawn from this paper is that agents defined by modified Cobb-Douglas utility function and who interact on a perfectly competitive market tend to economically diverge in terms of their total resources τ over time $t + n$. Thus, on the contrary to the general postulate of neoclassical convergence, it follows that upon given conditions economic inequality is driven by isolated, perfectly functioning market forces.

References

Acemoglu, Daron, and James A. Robinson. 2015. "The Rise and Fall of General Laws of Capitalism." *Journal of Economic Perspectives*, 29(1): 3-28. http://dx.doi.org/10.1257/jep.29.1.3

Aghion, Philippe, Eve Caroli, and Cecilia García Penalosa. 1999. "Inequality and Economic Growth: The Perspective of the New Growth Theories." *Journal of Economic Literature*, 37(4): 1615-1660. http://dx.doi.org/10.1257/jel.37.4.1615

Aghion, Philippe, and Peter Howitt. 2009. *The Economics of Growth*. Cambridge, MA: MIT Press.

Aguiar, Mark, and Mark Bils. 2011. "Has Consumption Inequality Mirrored Income Inequality?" National Bureau of Economic Research Working Paper 16807. http://dx.doi.org/10.1257/aer.20120599

Anand, Sudhir, and Paul Segal. 2008. "What Do We Know about Global Income Inequality?" *Journal of Economic Literature*, 46(1): 57-94. http://dx.doi.org/10.1257/jel.46.1.57

Aoki, Shuhei, and Makoto Nirei. 2015. "Zipf's Law, Pareto's Law, and the Evolution of Top Incomes in the U.S." Munich Personal RePEc Archive Paper 73896.

Atkinson, Anthony. 2015. *Inequality: What Can Be Done?* Cambridge, MA: Harvard University Press. http://dx.doi.org/10.4159/9780674287013

Baker, Jonathan B., and Steven C. Salop. 2015. "Antitrust, Competition Policy, and Inequality." American University Washington College of Law Working Paper 41.

Benhabib, Jess, Alberto Bisin, and Shenghao Zhu. 2011. "The Distribution of Wealth and Fiscal Policy in Economies with Finitely Lived Agents." *Econometrica*, 79(1): 123-157.

Benhabib, Jess, Alberto Bisin, and Shenghao Zhu. 2015. "The Wealth Distribution in Bewley Economies with Capital Income Risk." *Journal of Economic Theory*, 159(Part A): 489-515. http://dx.doi.org/10.1016/j.jet.2015.07.013

Benhabib, Jess, Alberto Bisin, and Shenghao Zhu. 2016. "The Distribution of Wealth in the Blanchard-Yaari Model." *Macroeconomic Dynamics*, 20(2): 466-481. http://dx.doi.org/10.1017/S1365100514000066

Bhalla, Surjit. 2002. *Imagine There's No Country: Poverty, Inequality, and Growth in the Era of Globalization.* Washington, DC: Peterson Institute.

Bourguignon, Francois, and Christian Morrisson. 2002. "Inequality among World Citizens: 1820-1992." *American Economic Review*, 92(4): 727-744. http://dx.doi.org/10.1257/00028280260344443

Carrol, Christopher D., Jiri Slacalek, and Kiichi Tokuoka. 2014. "The Distribution of Wealth and the Marginal Propensity to Consume." European Central Bank Working Paper 1655. http://dx.doi.org/10.3982/QE694

Chatterjee, Satyajit. 1992. "Transitional Dynamics and the Distribution of Wealth in a Neoclassical Growth Model." *Journal of Public Economics*, 54(1): 97-119. http://dx.doi.org/10.1016/0047-2727(94)90072-8

Comanor, William S., and Robert H. Smiley. 1975. "Monopoly and the Distribution of Wealth." *Quarterly Journal of Economics*, 89(2): 177-194. http://dx.doi.org/10.2307/1884423

Cornia, Giovanni, and Sampsa Kiiski. 2001. "Trends in Income Distribution in the Post-World War II Period Evidence and Interpretation." United Nations University Discussion Paper 2001/89.

Creedy, John, and Robert Dixon. 1999. "The Distributional Effects of Monopoly." *Australian Economic Papers*, 38(3): 223-237. http://dx.doi.org/10.1111/1467-8454.00053

Deininger, Klaus, and Lyn Squire. 1996. "A New Dataset Measuring Income Inequality." *World Bank Economic Review*, 10(3): 565-591.

Dikhanov, Yuri, and Michael Ward. 2001. "Evolution of the Global Distribution of Income in 1970-99. Paper presented at the 4th Meeting of the Expert Group on Poverty Statistics, Rio de Janeiro, Brazil.

Dorwick, Steve, and Muhammad Akmal. 2005. "Contradictory Trends in Global Income Inequality: A Tale of Two Biases." *Review of Income and Wealth*, 51(2): 201-229. http://dx.doi.org/10.1111/j.1475-4991.2005.00152.x

Duesenberry, James. 1949. *Income, Saving and the Theory of Consumer Behavior*. Cambridge, MA: Harvard University Press.

Duménil, Gérard, and Dominique Lévy. 2011. *Marxistická ekonomie kapitalismu*. Prague: Grimmus.

Ennis, Sean, and Yunhee Kim. 2016. *A Step Ahead: Competition Policy, Shared Prosperity and Inclusive Growth*. Washington, DC: World Bank Publishing.

Ennis, Sean, Pedro Gonzaga, and Chris Pike. 2017. "Inequality: A Hidden Cost of Market Power." Organisation for Economic Co-operation and Development Discussion Paper 2017. http://dx.doi.org/10.2139/ssrn.2942791

Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review*, 105(10): 3150-3182. http://dx.doi.org/10.1257/aer.20130954

Fletcher, Ruth. 2006. "Reproductive Consumption." *Feminist Theory*, 7(1): 27-48. http://dx.doi.org/10.1177/1464700106061453

Friedman, Milton. 1957. *Theory of the Consumption Function.* Princeton, NJ: Princeton University Press. http://dx.doi.org/10.2307/j.ctv39x7zh

Furman, Jason, and Peter Orszag. 2015. "A Firm-Level Perspective on the Role of Rents in the Rise in Inequality." Paper presented at Just Society Centennial Event in Honor of Joseph Stiglitz at Columbia University, New York. http://dx.doi.org/10.7312/guzm18672-003

Gabaix, Xavier, Jean-Michel Lasry, Pierre-Louis Lions, and Benjamin Moll. 2016. "The Dynamics of Inequality." *Econometrica*, 84(6): 2071-2111. http://dx.doi.org/10.3982/ECTA13569

Galor, Oded. 2009. *Inequality and Economic Development: The Modern Perspective*. Cheltenham: Edward Elgar. http://dx.doi.org/10.4337/9781784712808

Goldsmith, Raymond. 1955. *A Study of Saving in the United States*. Princeton, NJ: Princeton University Press.

Gomez, Rafael, and David Foot. 2003. "Age Structure, Income Distribution and Economic Growth." *Canadian Public Policy*, 29(Supplement: The Linkages between Economic Growth and Inequality): S141-S161. http://dx.doi.org/10.2307/3552280

Grabowski, Henry. 1968. "The Determinants of Industrial Research and Development: A Study on Petroleum Industries." *Journal of Political Economy*, 76(2): 292-306.

Harris, Donald J. 1978. *Capital Accumulation and Income Distribution*. Stanford: Stanford University Press.

Jones, Charles I. 2005. "The Shape of Production Functions and the Direction of Technical Change." *The Quarterly Journal of Economics*, 120(2): 517-549. http://dx.doi.org/10.1093/qje/120.2.517

Kaldor, Nicholas. 1955. "Alternative Theories of Distribution." *The Review of Economic Studies*, 23(2): 83-100. http://dx.doi.org/10.2307/2296292

Korzeniewicz, Roberto, and Timothy Moran. 1997. "World-Economic Trends in the Distribution of Income, 1965-1992." *American Journal of Sociology*, 102(4): 1000-1039. http://dx.doi.org/10.1086/231038

Krueger, Dirk, and Fabrizio Perri. 2006. "Does Income Inequality Lead to Consumption Inequality? Evidence and Theory." *The Review of Economic Studies*, 73(1): 163-193. http://dx.doi.org/10.1111/j.1467-937X.2006.00373.x

Kuznets, Simon. 1946. *National Income: A Summary of Findings*. New York: National Bureau of Economic Research.

Maddison, Angus. 1995. *Monitoring the World Economy, 1820-1992.* Paris: OECD Development Centre.

Magness, Phillip W., and Robert P. Murphy. 2015. "Challenging the Empirical Contribution of Thomas Piketty's Capital in the 21st Century." *Journal of Private Enterprise*, 30(1): 1-34.

Maialeh, Robin. 2017. "Persisting Inequality: A Case of Probabilistic Drive towards Divergence." *Acta Oeconomica*, 67(2): 215-234. http://dx.doi.org/10.1556/032.2017.67.2.4

Milanović, Branko. 2002. "True World Income Distribution, 1988 and 1993: First Calculation Based on Household Surveys Alone." *Economic Journal*, 112(476): 51-92. http://dx.doi.org/10.1111/1468-0297.0j673

Milanović, Branko. 2005. *Worlds Apart: Measuring International and Global Inequality*. Princeton, NJ: Princeton University Press. http://dx.doi.org/10.1515/9781400840816

Milanović, Branko. 2013. "The Two Faces of Globalization: Against Globalization as We Know It." *World Development*, 31(4): 667-683. http://dx.doi.org/10.1016/S0305-750X(03)00002-0

Milanović, Branko. 2016. *Global Inequality: A New Approach for the Age of Globalization*. Cambridge, MA: Belknap Press of Harvard University Press. http://dx.doi.org/10.4159/9780674969797

Minoiu, Camelia. 2007. "Poverty Analysis Based on Kernel Density Estimates from Grouped Data." Columbia University Institute for Social and Economic Research and Policy Working Paper 07-07.

Phillips, Almarin. 1966. "Patents, Potential Competition, and Technical Progress." *American Economic Review*, 56(1/2): 301-310.

Piketty, Thomas. 2014. *Capital in the Twenty-First Century*. Cambridge, MA: Belknap Press of Harvard University Press. http://dx.doi.org/10.4159/9780674982918

Piketty, Thomas, Emmanuel Saez, and Gabriel Zucman. 2018. "Distributional National Accounts: Methods and Estimates for the United States." *The Quarterly Journal of Economics*, 133(2): 553-609. http://dx.doi.org/10.1093/qje/qjx043

Rognlie, Matthew. 2015. "Deciphering the Fall and Rise in the Net Capital Share." *Brookings Papers on Economic Activity*, 46(1): 1-69.

Saez, Emmanuel, and Gabriel Zucman. 2016. "Wealth Inequality in the United States since 1913: Evidence from Capitalized Income Tax Data." *Quarterly Journal of Economics*, 131(2): 519-578. http://dx.doi.org/10.1093/qje/qjw004

Sala-i-Martín, Xavier. 2006. "The World Distribution of Income: Falling Poverty and …Convergence, Period." *The Quarterly Journal of Economics*, 121(2): 351-397. http://dx.doi.org/10.1162/qjec.2006.121.2.351

Schultz, Paul. 1998. "Inequality in the Distribution of Personal Income in the World: How It Is Changing and why." *Journal of Population Economics*, 11(3): 307-344.

Stiglitz, Joseph E. 1969. "Distribution of Income and Wealth among Individuals." *Econometrica*, 37(3): 382-397. http://dx.doi.org/10.2307/1912788

Stiglitz, Joseph E. 2012. *The Price of Inequality: How Today's Divided Society Endangers Our Future*. New York: W. W. Norton & Company.

United Nations Development Programme (UNDP). 1999. *Human Development Report*. New York: Oxford University Press.

Zucman, Gabriel. 2015. *The Hidden Wealth of Nations: The Scourge of Tax Havens*. Chicago: University of Chicago Press. http://dx.doi.org/10.7208/chicago/9780226245560.001.0001

THIS PAGE INTENTIONALLY LEFT BLANK