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Understanding Inequality Throughout Production and Financial Activities

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ABSTRACT

The relationships between inequality and economic activities with a financial system as a financing source is analyzed. An endogenous growth model with human, physical, and financial capitals, diminishing returns, constant scale effects, and heterogeneous agents is outlined. Heterogeneity comes from capital endowments in agents, allowing to introduce a financial system into the economy. Macroeconomic equilibrium, distributional dynamics, and long-run shocks due to the interaction between economic growth, inequality, and financial system are characterized. An empirical study is conducted to test the theoretical findings using LS Panel Data techniques with fixed and random effects estimations. The econometric model is fed with information drawn from the Penn World Table for 81 countries during 1970 – 2019. Main results are: a) in the absence of a financial system, poor households will allocate less time to leisure if they want to consume more, increase human capital or both; b) physical and human capital ratio of the economy relies only in one sector when there is none financial system. Consequently, economic growth rate is lower since only one sector performs production activities; c) increases in output lead to increases in inequality; d) inequality decreases when human capital goes up; e) physical capital generates small and positive changes in inequality; f) financial capital causes positive impacts on inequality; g) inequality decreases if total factor productivity increases; h) empirical evidence verifies theoretical findings.

INTRODUCTION

Income inequality has been a very important issue within economic theory, particularly the relationship with economic growth. Kuznets (1955) performed one of the first papers addressing this topic; he argued that the economic growth rate and income inequality connection could be described as an inverted-U shape. Nevertheless, several other studies have found different types based on the theoretical economy setting. One thing is certain; the relation between economic growth and inequality is dynamic. There is a significant positive relationship between financial inclusion and economic growth (Raza, Tang, Rubab, Wen, 2019). In that sense, the Ramsey (1928) model has become a standard framework for analyzing

macro dynamics and growth theory, in where all agents are treated as identical because there are the same endowments and preferences across agents.

Nonetheless, inequality and economic growth studies must feature heterogeneity in agents as Piketty and Saez (2014), Krusell and Smith (2015), Carroll and Young (2018) papers claim. The Ramsey model can incorporate heterogeneity if preferences remain homothetic as Chatterjee (1994), and Krusell and Smith (1998) stand. From the empirical point of view, the connection between inequality and growth has been studied by Alesina and Rodrik (1994), Persson and Tabellini (1994), and Perotti (1996) with findings that prove a negative link. On the other hand, Sorger (2000), Ehrlich and Kim (2007), and Turnovsky (2015) found a positive relationship.

What these studies have in common is the notion of inequality been generated within companies exclusively, but the objective of the present research is to analyze the relationships between inequality and economic activities along with a financial system as a financing source. The reason is that the financial system could be another source of inequality. The existing financial system structure is, for various reasons, a determinant for growing inequality (de Vries, 2019). The way the financial system is introduced into the economy is as simplest as possible, all financial instrument types, services or investments nowadays exist are not considered in the analysis, since this research wants to highlight that by the very essence of the financial system as a reallocator of resources, could be more than enough to affect inequality. Based on this idea, one can perfectly expect that the more developed a financial system could be, the greater the impact on inequality is. Introducing the financial system modifies macroeconomic dynamics and especially the distributional kind, and more specifically the shares of earned output, which are the input to define inequality. More even, it is empirically tested the distance between the shares as an inequality measurement. The last two ideas represent the difference between the way inequality is usually analyzed and this research.

To be more precise, most studies use Gini coefficient as inequality measurement since incorporates income distribution across households. This coefficient has two versions: the gross and the net one, the latter measures income after taxes. The gross Gini coefficient allows analyzing inequality by not considering the distributional effects of taxes and government spending, and according to Hann and Sturm (2017) it is the better proxy variable for inequality. At the same time, Gini coefficient captures income inequality across percentiles, across regions, etc. In consequence, a decomposition technique could be applied when analyzing inequality through Gini coefficient, particularly when households are classified by income; which represents a disaggregated approach, see Azam and Bhatt (2018), Gradin (2018) and Mansouri et al. (2018).

This research differs from those two perspectives. First, it is proposed that the distance between the shares of output is another possibility for measuring inequality as well, and simultaneously it keeps the property of avoiding distributional effects due to transfers and taxes. This reason relays on the fact that shares of output are defined when investment and production decisions generate output, which occurs before paying taxes. Second, the measure proposed is the result of shares of output that reflect the domestic market conditions for an entire economy, therefore allows an aggregated analysis. Now, the dynamics of investment, production, human capital and financial system are affecting both shares of output and, therefore inequality.

In this sense, the present research deals with the relationship between financial development and income inequality according to Hann and Sturm (2017), since it is assumed that an increase in the volume of financial activity is affecting economic growth and, therefore, income inequality. For instance, miss information, high transaction costs and credit constraints that could be generated by the financial development, may inhibit economic activities in poor sectors and so capital accumulation, this idea is the opposite to what Beck et al. (2007) stand for. In consequence, financial services are only improving quality of life in rich sectors, which is consistent with Greenwood and Jovanovic (1990) ideas.

Empirically speaking, studies have shown that there are always two sides of the history. On one side, Beck et al., (2007), Kunieda et al., (2014) and Naceur and Zhang (2016) prove a positive relationship between the financial development and income inequality. On the other side, Denk and Courneade (2015), Jaumotte et al., (2013), Li, and Yu (2014), show a negative relationship, in which the present research inserts itself.

To analyze the link between income inequality and the financial development throughout economic growth, an endogenous growth model with human, physical and financial capitals, diminishing returns, constant scale effects and heterogenic agents is outlined. Heterogeneity comes from capital endowments in agents, which also allows introducing the financial system into the economy. First, an economy without financial system is examined and then the financial system is introduced. Macroeconomic equilibrium, distributional dynamics and long-run shocks due to the interaction between economic growth, inequality and financial system are characterized. At the same time, an empirical study is conducted in order to test the theoretical findings by using LS Panel Data techniques with fixed and random effects estimations; these techniques have advantages for estimating relations between finance, real economic variables and inequality. Several studies have analyzed inequality determinants by using panel data techniques, see Bahmani-Oskooee and Zhang (2015), Hann and Sturm (2017), Beck et al, (2007), Bumann and Lensink (2016). The econometric model is fed with information drawn from the Penn World Table for 81 countries during the time interval 1970 – 2019.

Main results are:

- in the absence of a financial system, poor households will allocate less time to leisure if they want to consume more or increase human capital or both;
- physical and human capital ratio of the economy relies only upon one sector when there is none financial system. Consequently, the economic growth rate is lower since only one sector performs production activities;
- increases in output lead to increases in inequality;
- inequality decreases when human capital goes up;
- physical capital generates small and positive changes in inequality;
- financial capital causes positive impacts on inequality;
- inequality decreases if total multifactorial productivity increases;
- empirical evidence verify theoretical findings.

1. MODELLING INEQUALITY

Consider a closed economy where there is no uncertainty, physical and human capital are accumulated, with heterogeneous households and total population normalized, so $N = 1$, which remains constant over time. Since the economy is closed, production is intended either to invest or to consume according to equation (1); for simplicity in notation sub-index t is not considered:

$$y = k + c. \quad (1)$$

Where y , k and c measure production, physical capital and consumption respectively. Taxation is not considered in this economy since the objective is to analyze inequality dynamics before having modifications because of taxes and transfers. Which allows keeping the same property when Gini coefficient is taken into account at empirical studies.

1.1 Heterogeneous households

Heterogeneity on households comes from different physical capital endowments; there are two types of households: rich (R) and poor (P), so the total population is $N = n_R + n_P$. Rich households possess enough physical capital for the production process and a share of capital as a surplus (ϕk), the latter being as a result of economic activities in previous periods, or it was inherited, etc. Poor households do not possess enough capital to produce, thus capital satisfies:

$$K = k^R + k^P, \quad K_0 > 0 \quad (2)$$

$$k^R = k + \phi k, \quad 0 < \phi < 1 \quad (3)$$

$$k^P < k. \quad (4)$$

Households seek to maximize their utility based on the consumption of a perishable commodity and on leisure l , at any time t , in the presence of decreasing marginal yields on both. Utility can be measure by:

$$u^i = \int_0^\infty [\ln c + \theta \ln l] e^{-\rho t} dt, \quad (5)$$

for $i = R, P$, with ρ as the subjective discount rate and θ the share of utility due to leisure. If poor households want to increase their economic activities, they need to allocate less time to leisure in order to consume more or to produce.

1.2 Industry

The industry is to produce a perishable commodity. Production is performed by using physical capital, k , and human capital, $h = 1 - l$ in the presence of constant returns to scale in both factors. All firms face identical competitive production conditions while satisfying the following given technology:

$$y = \alpha k^\beta h^{1-\beta}, \quad (6)$$

where α is the total factor marginal productivity and β a technological parameter. From a macroeconomic point of view, the consumer sector owns all production means.

1.3 Human capital dynamics

All households have the same initial allocation of human capital, $H_0 > 0$. Accumulation of human capital follows the dynamic:

$$\dot{h} = \gamma h. \quad (7)$$

In this equation γ symbolizes the growth rate of human capital. The higher the amount of physical capital is allocated, the higher γ will be. The stock of human capital in the economy, therefore, is $H = h^R + h^P$. Not investing in production activities is the opportunity cost of increasing human capital.

1.4 Financial system

Rich households can allocate their capital surplus to loans or spend it on education to increase human capital. These options create a financial system in this economy so idle resources are reassigned, thus allowing households to ask for credit so production process or human capital accumulation can be performed. Let δ be the cost of credit and an additional income to rich households. Assume credits are the only financial instrument households can access to, therefore:

$$\phi k = k(1 + \delta - \gamma). \quad (8)$$

Equation (8) shows possible allocations for capital surplus since it is assumed there are no savings in the economy, hence entire physical capital must be engaged in economic activities. Poor households lack enough capital to produce, but they can use the capital they possess to increase human capital this means they can decide not to ask for credits. Another option is getting additional capital within the credit market to produce or to increase human capital or both:

$$k^P + k = -\delta k - \gamma k. \quad (9)$$

The previous equation indicates that there is always a cost for poor households if they want to accumulate any type of capital. By setting a closed economy, the cost avoids from suffering high volatility

episodes produced within international financial systems, since the main objective is to isolate the effects from the domestic financial system on inequality.

1.5 Investment decisions

Investment, I , can be considered as the allocation of resources to increase either human capital or physical capital by households, so:

$$I = k + h. \quad (10)$$

Returns of investment are marginal productivity of physical capital and salary according to the following market-clearing conditions:

$$\frac{\partial y^i}{\partial k^i} = \alpha \beta k^{\beta-1} h^{1-\beta} = r, \quad (11)$$

$$\frac{\partial y^i}{\partial h^i} = \alpha(1 - \beta)k^\beta h^{-\beta} = w. \quad (12)$$

When combining equations (11)-(12) and clearing for w , the equilibrium salary is obtained, which is $hw\beta = r(1 - \beta)k$. The latter express that salary is directly tied to human capital: the more human capital an individual possesses, the higher the salary is. Therefore, total salaries in the economy can be defined as:

$$\sum W^i = h^i w^i. \quad (13)$$

Consequently, the cost of accumulating human capital defined in equations (8) and (9) will be compensated by salaries of future periods.

1.6 Macroeconomic equilibrium

In this economy, physical capital accumulation relies on production, salary, credit market and consumption conditions. Because heterogeneity of households there are two capital accumulation dynamics:

$$\dot{k}^R = \alpha k^\beta h^{1-\beta} + W^R + k(1 + \delta - \gamma) - c^R, \quad (14)$$

$$\dot{k}^P = \begin{cases} \alpha k^\beta h^{1-\beta} + W^P - k(1 + \delta + \gamma) - c^P, & k^P = k \\ W^P - kh - c^P, & k^P < k_t \end{cases} \quad (15)$$

Equation (15) shows poor households to be able to take productions decisions if they access to credit market, in addition to work and increase human capital; or the contrary when no credit is available. This allows the model to analyze income inequality. Households' objective is to maximize (1) subject to (14)-(15). Hence, macroeconomic equilibrium depends on both types of households as follows:

Scenario A: Macroeconomic equilibrium with credit market

$$\lim_{t \rightarrow \infty} \lambda k e^{-\rho t} = 0, \quad (16)$$

$$\frac{c^i}{l^i} = \theta [\alpha k^\beta (1 - \beta)(1 - l)^{-\beta} + w^i], \quad (17)$$

$$\frac{k^i}{h^i} = \frac{\beta w^i}{(1 - \beta)r}, \quad (18)$$

$$\alpha - \delta - \gamma = \rho - \frac{\lambda}{\lambda}, \quad (19)$$

$$\psi^R = \alpha + 1 + \delta - h - \rho, \quad (20)$$

$$\psi^P = \alpha - 1 - \delta - h - \rho, \quad (21)$$

$$\Psi = \frac{\psi^R + \psi^P}{2} = \alpha - h - \rho, \quad (22)$$

where equation (17) is the intertemporal marginal substitution rate of households if all of them produce, (18) shows the physical and human capital ratio, while (19) stands for the Keynes-Ramsey consumption rule, equations (20) – (22) are the economic growth rates of both sectors and the total economy.

Scenario B: Macroeconomic equilibrium without credit market

$$\lim_{t \rightarrow \infty} \lambda k e^{-\rho t} = 0, \quad (23)$$

$$\frac{c^R}{l^R} = \theta [\alpha k^\beta (1 - \beta)(1 - l)^{-\beta} + w^R], \quad (24)$$

$$\frac{c^P}{l^P} = \theta w^P, \quad (25)$$

$$\frac{k^R}{h^R} = \frac{\beta w^R}{(1 - \beta)r}, \quad (26)$$

$$\alpha - \frac{\delta - \gamma}{2} = \rho - \frac{\dot{\lambda}}{\lambda} \quad (27)$$

$$\psi^R = \alpha - h - \rho, \quad (28)$$

$$\psi^P = -h - \rho, \quad (29)$$

$$\Psi = \frac{\psi^R + \psi^P}{2} = \frac{\alpha}{2} - h - \rho. \quad (30)$$

In the absence of a financial system, poor households will allocate less time to leisure if they want to consume more or increase human capital or both, as equation (25) shows. In fact, their intertemporal marginal substitution rate depends only on salary; while the corresponding to rich households on total income: benefits plus salary as equation (25) displays. The physical and human capital ratio of the economy relies only upon one sector. The economic growth rate in this case is lower since only one sector performs production activities.

1.7 Distributional dynamics

In order to analyze the dynamics of this economy is necessary to subtract the stationary growth path, under scenarios A and B, for output, physical capital and human capital. When combining (1), (6), (19) and (22) as well as (1), (6) (27) and (30) we get the following conditions for scenarios A and B respectively:

$$\frac{\dot{y}}{y} = \frac{\dot{k}}{k} = \frac{\dot{c}}{c} = \phi, \quad (31)$$

$$\phi = \frac{y}{k} - \frac{c}{k} + \alpha - h - \rho, \quad (32)$$

$$\phi = \frac{y}{k} - \frac{c}{k} + \frac{\alpha}{2} - h - \rho. \quad (33)$$

Therefore, at the steady-state the gap between output-capital and consumption-capital ratios in both scenarios is:

$$\frac{y}{k} - \frac{c}{k} = h + \rho - \alpha, \quad (32)$$

$$\frac{y}{k} - \frac{c}{k} = h + \rho - \frac{\alpha}{2}. \quad (33)$$

To complete the steady-state is necessary to withdraw the long-run net return to private capital that equals the rate of time preference, so by combining (11) with (19) and (11) with (27) respectively, while considering (7), we get:

$$\frac{1}{\beta} \left(\frac{k}{h} \right)^{1-\beta} = \rho + \delta + \gamma, \quad (34)$$

$$\frac{1}{\beta} \left(\frac{k}{h} \right)^{1-\beta} = \rho + \frac{\delta + \gamma}{2}. \quad (35)$$

In this economy, income is define as:

$$y^i = rk + w(1 - l). \quad (36)$$

Consequently, by combining (7), (32) and (33) into (36), income dynamics under both scenarios A and B respectively is:

$$\frac{\dot{y}}{y} = r(h + \rho - \alpha) + w\gamma, \quad (37)$$

$$\frac{\dot{y}}{y} = r \left(h + \rho - \frac{\alpha}{2} \right) + w\gamma. \quad (38)$$

Finally, following Turnovsky (2002), the share of output earned by physical capital, ε^k , and the share of output earned by human capital, ε^h , are:

$$\varepsilon^k = \frac{F_k K}{Y} = \frac{\beta}{k} \left(\frac{y h^{\beta-1}}{\alpha} \right)^{\frac{1}{\beta}}, \quad (39)$$

$$\varepsilon^h = \frac{F_h H}{Y} = \frac{1 - \beta}{h} \left(\frac{y k^{-\beta}}{\alpha} \right)^{\frac{1}{1-\beta}}. \quad (40)$$

According to income dynamics, it can grow mainly due to an increase in the time preference and the rate of growth of human capital; see equations (37) and (38). Due to the constant returns to scale, is easy to understand that an increase in one share of output will be compensated by a decrease in the other share. Furthermore, to set the equality on shares leads to a no gap that generates inequality within the model. This idea will be tested in section 3, because of two main conditions: shares of output are never equal across countries according to data and inequality is created despite constant returns to scale.

1.8 Long-run shocks

To demonstrate the long-run dynamics in this economy shocks on the intertemporal marginal substitution rate of households, physical and human capital ratio, the growth rate of output, returns of investment and the share of output earned by both physical and human capital are defined. First, long-run adjustments in the intertemporal marginal substitution rate of households are:

$$\frac{\partial c/l}{\partial \beta} = \beta \theta \alpha k^{\beta-1} - \theta \alpha k^{\beta} + \beta \theta \alpha k^{\beta}, \quad (41)$$

$$\frac{\partial c/l}{\partial \alpha} = \theta k^{\beta} (1 - \beta)(1 - l)^{\beta}, \quad (42)$$

$$\frac{\partial c^P/l^P}{\partial w} = \theta. \quad (43)$$

The rate of substitution between consumption and leisure for households could increase if there is a positive adjustment on the total factor marginal productivity, technological innovation and salary. Therefore, individuals are more likely to consume more under these conditions and to do so they need to devote less time to leisure. Consequently, either they find a job or increase their human capital. Regarding physical-human capital ratio shocks are:

$$\frac{\partial k/h}{\partial \beta} = \frac{w - r}{[(1 - \beta)r]^2}, \quad (44)$$

$$\frac{\partial k/h}{\partial w} = \frac{\beta}{(1 - \beta)r}, \quad (45)$$

$$\frac{\partial k/h}{\partial r} = \frac{w\beta}{(\beta - 1)r^2}. \quad (46)$$

The physical-human capital ratio would increase if the returns of investment or innovation also increase, thus leading to leaps in the total factor productivity and the growth rate of human capital. When considering shocks on the growth rate of output, results show that there is a positive effect on it due to increases in returns of investment or in the growth rate of human capital, as equations (47)-(50) show.

$$\frac{\partial \dot{y}/y}{\partial r} = h + \rho - \alpha, \quad (47)$$

$$\frac{\partial \dot{y}/y}{\partial w} = \gamma, \quad (48)$$

$$\frac{\partial \dot{y}/y}{\partial \dot{h}/h} = w, \quad (49)$$

$$\frac{\partial \dot{y}^P/y^P}{\partial r} = h + \rho - \frac{\alpha}{2}. \quad (50)$$

If output increases, consumption will also increase. Therefore, households allocate less time to leisure and if they want to consume more, work will rise. Shocks on the returns of investment due to adjustments in total factor productivity are also positive.

$$\frac{\partial r}{\partial \alpha} = \beta k^{\beta-1} h^{1-\beta}, \quad (51)$$

$$\frac{\partial w}{\partial \alpha} = (1 - \beta) k^{\beta} h^{-\beta}. \quad (52)$$

Subsequently, market-clearing conditions in the long-run remain. Finally, shocks on the share of output earned by both types of capital are as follow:

$$\frac{\partial \varepsilon^k}{\partial y} = \frac{y^{1-\beta/\beta} h^{\beta-1/\beta}}{k\alpha^{1/\beta}}, \quad (53)$$

$$\frac{\partial \varepsilon^h}{\partial y} = \frac{y^{\beta/1-\beta} k^{\beta/\beta-1}}{h\alpha^{1/1-\beta}}. \quad (54)$$

Equations (53) and (54) show that when output is rising the share earned by companies and educated workers also increases. The more human capital exists within the economy the highest the share will be earned by it. Along with all the shocks that were analyzed in this section, results proved that inequality could be reduced if households increase their level of human capital.

2. EMPIRICAL EVIDENCE

To analyze if the theoretical model described above is consistent with reality, a panel data was estimated by using information from the Penn World Table, see Feenstra et al (2015), for 81 countries, during the time interval 1970 – 2019. The objective is to test impacts on Inequality (INEQ) due to Real Gross Domestic Output (RGDO), Human Capital (HC), Stock of Capital (K), Capital Services (KS) and Total Factor Productivity (TFP). Variables Employment (EMP), Total Population (POP), Interest Rate (IR), Real National Consumption (RNC) and National Income (NI) control all the estimations, and they were selected as possible enhancers on the causal relation between main indicators and inequality. The following table resume all variables:

Table 1. Variable description

Name	Description	Units
RGDO	Output-side real GDP, using prices for final goods exports and imports that are constant across countries and over time.	Constant 2017 national prices in US\$
HC	Human capital per worker based on the average years of schooling, linearly interpolated and an assumed rate of return for primary, secondary, and tertiary education.	Index
K	Capital stock at constant national prices, based on investment and prices of structures and equipment	At current PPPs in 2017 US\$
KS	Capital stock using prices for structures and equipment that are constant across countries	Capital services levels at current PPPs (USA=1)
TFP	TFP level, computed with RGDO, CK, labor input data, and LABSH.	At current PPPs (USA=1)
EMP	Persons engaged in economic activities	Number in millions
POP	Total population	Number in millions
IR	Real internal rate of return	Percentage
RNC	Real household and government consumption at constant national prices	Constant 2017 national prices in US\$
NI	Real Gross Domestic Product using prices for goods and services that are constant across countries and over time	Constant 2017 national prices in US\$

LABSH	The share of labor income of employees and self-employed workers in GDP	Compensation in GDP at current national prices
KSH	The share of capital income of owners in GDP	Compensation in GDP at current national prices

Source: Own elaboration based on Penn World Table

The Penn World Table (Groningen Growth and Development Centre, 2023) is a consolidated dataset that provides with the same variables being measure exactly the same way for every country. In consequence, heterogeneity across countries comes from their own domestic market conditions and not because different measurements in data. It also offers variability among periods and economic units, which is very suitable for LS techniques on a panel data, since estimating random and fixed effects on the relationships between variables, permits the understanding of macro dynamics at a country and/or time specific level. On the other hand, this technique allows to control unobserved time-series and cross-country data. In particular, creates a feasible analysis on inequality due to the nature of the proposed variable and the way is measure by the Penn World Table. All this conditions represents advantages for estimating relations between finance, real economic variables and inequality, according to Beck et al, (2007) and Hann and Sturm (2017).

Regarding the dataset, it is important to highlight that Real Gross Domestic Output is a variable that measures the amount of goods and services being produced within time intervals and economic units, therefore sets not only the value but also the gap between shares of output. Even when RGDO considers exports and imports, as if the economy was open, what matters is the effect on inequality measure by the gap and not by external sector dynamics. For running the empirical test, the econometric equation is:

$$INEQ_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \mu_{it}, \quad (55)$$

where X_{it} stands for the main variables set, Z_{it} the control variables set and μ_{it} the error term. It is proposed Inequality variable be created by using equations (39) and (40) as follows:

$$INEQ = \varepsilon^k - \varepsilon^h, \quad (56)$$

which measures the distance between the capital and labor shares of output. When the distance is positive capital share is greater than labor share and is negative if vice versa. A positive distance means capital appropriates greater amounts of output than labor, in other words earnings a bigger for owners of production means than for workers. Estimations were performed with fixed and random effects on both cross-section and time analysis as well, and were based on the equation:

$$INEQ_{it} = \beta_0 + \beta_i + \beta_t + \beta_1 X_{it} + \beta_2 Z_{it} + \mu_{it}, \quad (57)$$

where β_i measures the country fixed/random effects and β_t the time fixed/random effects. Results are presented regarding significant estimations only. The use of fixed/random effects incorporates robust estimations for dynamic panels, which also controls for potential endogeneity, reverse causality, or omission of pertinent variables. It is common to introduce a lagged variable of inequality since previous values could affect the current one. This is particularly true when inequality is measured by income across households, because they can get better or worse in terms of income in a relative easy way. Nevertheless, companies do not change easily from a high level in the capital share of output to a lower one. Theoretical speaking, equations (39) and (40) show that shares tend to be constant over time; statistical speaking the same property can be seeing across time and countries, so lags on inequality are not relevant for this research.

When analyzing individual impacts of main variables, see Table 2, it is found that increases in output, lead to increases in inequality as Estimation I shows, since for every additional dollar in output there is a bigger inequality. Regarding human capital, estimation II shows that an increase in 1% on human capital index generates a decrease in inequality in about -54310.98 units. This result is consistent with the theoretical model, when more human capital exists in the production activities, the higher the marginal productivity is, then salary increases (Firpo, 2018). When salary goes up, the labor share of the product also goes up leading to a decrease in inequality (Panico, 2018). Estimation III displays that on extra dollar invested leads to an increase in 0.01 units on inequality; this result is also consistent since the more physical capital

is available, the greater the product will be; and as previous results stands for, more output leads to higher inequality. Therefore, it is clear evidence that idle resources exist in fact across countries along time. If physical capital is not being used at full capacity, then there is no way to generate positive impacts on production and so on inequality.

On the same estimation, an increase in 1% on capital services (also known as financial capital) causes a direct impact on inequality due to a rise in 912572.4 units; which means that investing in nonproductive sectors makes inequality grow. This result is consistent with the theoretical model as well. Another variable that decreases inequality besides human capital, is total multifactorial productivity for every additional 1% in that index creates a fall in 70989.43 units on inequality; see Estimation IV. Productivity leaps, often associated with increases in human capital, are well known to decrease inequality across specialized literature. Estimation V, verifies that all control variables have a significant effect on inequality by themselves; which replicates across all previous estimations. Estimation VI shows the same previous individual effects in a joint estimation; one additional dollar in RGDO increases inequality in 0.042 units, a 1% growth on human capital leads to a fall in inequality of 48349.93 units. Every new dollar created by the financial services increases inequality in 883687.6 units; the bigger increase so far. An important result is relying on the positive effect of interest rates on inequality in every single estimation.

Table 2. Panel estimations of main variables versus inequality

INEQ	I	II	III	IV	V	VI
RGDO	0.1077 (0.009)***					0.0424 (0.0154)***
HC		-54310.98 (2864.71)***				-48349.93 (2958.36)***
K			0.01 (0.001)***			0.009 (0.002)***
KS			912572.4 (46281.22)***			883687.6 (45514.7)***
TFP				-70989.43 (7957.07)***		-25252.55 (7951.13)***
EMP	-5522.821 (194.69)***	-4161.04 (130.89)***	-4217.17 (143.75)***	-3923.36 (134.94)***	-3906.525 (135.85)***	-4751.33 (202.32)***
POP	2510.273 (83.94)***	2085.48 (64.26)***	2006.22 (68.42)***	1952.1 (66.09)***	1907.54 (66.32)***	2279.73 (83.48)***
IR	461798.3 (21583.79)** *	388636.2 (21467.9)***	464106.5 (21462.9)***	385471.2 (25276.3)***	474144.8 (21898.9)***	336998.4 (23380.7)***
RNC	-0.3717 (0.011)***	-0.2505 (0.001)***	-0.2382 (0.006)***	-0.2432 (0.001)***	-0.2402 (0.001)***	-0.2711 (0.013)***
LABSH	-83918.13 (6392.22)***	-303536.9 (12885)***	-78512.7 (6298.4)***	-169510.0 (10764.08)***	-89455.55 (6475.01)***	-293201.5 (13177.9)***
R ²	0.8735	0.8803	0.8835	0.8725	0.8696	0.8937
Obs	4050	4050	4014	4014	4050	4014

Source: Own elaboration. *** significance <0.01; ** significance <0.05; *significance <0.10

n.s. = not significant.

It is important to highlight that control variable Employment impacts on inequality with an inverse relation while total population with a positive one, both across all estimations, proving that proposed Inequality measure is consistent. When fixed/random effects are incorporated into the analyses, results regarding human capital, capital services, output, national income, employment, and total population remain, as Table 3 displays. For instance, an increase in one dollar on output generates a rise in inequality, when fixed or random effects are applied to cross sections and period. An increase in 1% in human capital index creates a decrease in inequality among all fixed and random effects specifications. Physical capital and capital services creates an increase in inequality, in particular, an additional dollar created by the financial system, increases inequality in every effect specification but fixed effects on cross-sections.

Table 3. Fixed/Random Effects on full panel estimations

<i>INEQ</i>	<i>Cross-section Fixed Effects</i>	<i>Period Fixed Effects</i>	<i>Cross-section Random Effects</i>	<i>Period Random Effects</i>
RGDO	0.093 (0.01)***	0.036 (0.014)***	0.0869 (0.011)***	0.0431 (0.014)***
HC	-54392.55 (4270.99)***	-16882.21 (3635.4)***	-57117.64 (3890.50)***	-24480 (3059)***
K	0.005 (0.001)***	0.007 (0.001)***	n.s.	0.008 (0.001)***
KS	1130712. (100909)***	783306.8 (45644.45)***	705779.1 (59152.15)***	835178.1 (43458.2)***
TFP	-29997.59 (8526.74)***	n.s.	-32428.46 (8146.55)***	n.s.
EMP	-5328.59 (194.05)***	-4343.40 (195.72)***	-5205.82 (187.50)***	-4504.13 (193.27)***
POP	3939.39 (99.58)***	2064.44 (80.84)***	3142.85 (89.30)***	2128.50 (79.94)***
IR	138998.3 (28523.3)***	n.s.	154633.3 (27804)***	n.s.
RNC	-0.359 (0.015)***	-0.255 (0.012)***	-0.3168 (0.011)***	-0.26 (0.01)***
LABSH	-316963.8 (0.015)***	-546163.8 (19284.36)***	-469243.1 (27554.44)***	-563469.3 (18396.5)***
R^2	0.9619	0.9046	0.7687	0.9035
Haussman			0.0000	0.0000
Obs	4014	4014	4014	4014

Source: Own elaboration. *** significance <0.01; ** significance <0.05; *significance <0.10
n.s. = not significant.

As summary, when analyzing the cross-section fixed effects, human capital, consumption, and income have a strong positive relationship with the income inequality while total factor productivity and employment a strong negative relationship. Regarding the period fixed effects, human capital, employment, and consumption have a strong negative impact on inequality, meanwhile financial capital and interest rates a strong positive effect. Therefore, financial development increases income inequality.

3. DISCUSSION

The endogenous growth model with human, physical and financial capitals, diminishing returns, constant scale effects and heterogeneous agents that has been defined allows analyzing the dynamics between income inequality, economic growth and a financial system. First, the setting of an economy without a financial system shows that if idle resources are not reallocated, then economic activities are carried out only by one sector, thus generating lower economic growth rates. Since there is a portion of the economy not participating in economic activities, inequality is rising as a natural result. However, when a financial system appears, and credit cost is accessible for the borrower sector, the economic activities increase. Under a standard analysis, growth will tend to increase inequality if, and only if, the share of output earned by labor and capital remains constant. This research shows that both shares are affected also by the financial system, so inequality depends on the credit cost as well. In both scenarios, marginal productivity influences in a positive way on economic growth at the same time that human capital has a negative effect on growth. The latter effect is present in the short-run since in order to increase human capital investment is require in education, therefore fewer resources are allocated to consumption and investment.

Regardless of human capital and economic growth interactions, macroeconomic equilibrium is better with financial system than without it. Balanced growth is in place and the economy in steady-state, and growth will be positive if $\alpha > h + \rho$. All sectors, households divided in lenders and borrowers, companies and credit markets evolve at the same rhythm and consequently the entire economy. Bank loans have an important role in financing a country's economy. The availability of loans enables households companies to consume better and make investments that cannot be done with their own funds (Ratnawati, 2020). In the long-run the steady state guarantees the net return to private capital to be equal to the rate of time preference. Return to private capital relies on the cost for credit and the human capital growth rate. Income dynamics is defined by human capital, marginal productivity, salary and the subjective discount rate, and will grow as long as $\alpha > h + \rho$ and also fulfills $r(h + \rho - \alpha) + w\gamma$.

Long-run dynamics analyzed through shocks on the intertemporal marginal substitution rate of households, physical and human capital ratio, the growth rate of output, returns of investment and on the share of output earned by both physical and human capital, show that the rate of substitution between consumption and leisure for households could increase, if there is a positive adjustment on the total factor marginal productivity, technological innovation and salary. On the other hand, that physical-human capital ratio would increase if the returns of investment or innovation also increase, thus leading to leaps in the total factor productivity and the growth rate of human capital.

When considering shocks on the growth rate of output, results indicate that there is a positive effect on it due to increases in returns of investment or in the growth rate of human capital. Shocks on the returns of investment due to adjustments in total factor productivity are also positive. Finally, when output is rising the share earned by companies and educated workers also increase. The more human capital exists within the economy the highest the share will be earned by it, thus reducing inequality.

Empirical evidence proves that inequality increases if output increases but decreases when human capital goes up. In addition, that the stock of physical capital generates small and positive changes in inequality. Capital services cause positive impacts on inequality, which means that investing in nonproductive sectors makes inequality grow. When total factor productivity goes up, then inequality goes down. These results are consistent with Sorger (2000), Ehrlich and Kim (2007), and Turnovsky (2015) findings.

Theoretical and empirical results highlight several features of the economy under the established conditions. First, if human capital and marginal productivity remain constant then inequality will tend to grow as output grows since the earnings share of capital will persist the same. Earnings share of labor will only grow if human capital increases and therefore productivity. Marginal productivity could increase due to other factors, as allocating less time to leisure, but it will be a one-time positive shock and only in the short-run. Second, an increase in human capital generates two types of effects: in the short-run a little decrease in economic activities because idle resources are being allocated as an investment in education, but in the long-run will increase productivity leading to a higher level of economic growth rates. Consequently, the earnings share of labor increases while capital's decreases reducing the gap of inequality.

Third, capital services constitute an obstacle when the financial system is inefficient or is less developed. A less-developed financial system generates credit constraints, higher costs on financing projects and diminishes the speed at which firms can start a new project (Kivanc and Yildirim, 2019). When there is credit constraints or higher costs on financing, inefficiency appears since allocations of resources in time and space are not happening, see Merton and Bodie (1995). If this is the case, economic activities decrease since only productive projects are less founded, until the limit in which only the lender sector carries out the production process. This scenario will also tend to increase inequality. That is how the positive relation between capital services and inequality is explained. The financial system would have the main object to reallocate resources and only that. In this sense, the present research follows the idea that a well-developed financial system facilitates economic activities, provides liquidity, allocates capital to highest-return projects and stimulates specialization (Kivanc and Yildirim, 2019), at the same time that corrects information problems and tends to diminish transaction costs (Levine 1997). Nevertheless, in any case, a financial system generates inequality since affects negatively the shares of output earnings.

Regarding interest rates, results stand for having positive effects on inequality because idle resources could be allocated into the financial system as portfolio investment leading to a decrease of economic activities, and if earnings share on both production factors is constant, then inequality grows. There is one additional feature that could be missed, consumption impacts in a negative way to inequality. At first sight, it may not be evident how this works but imagine that a household wants to increase consumption and if leisure remains the same, then it could only be financed by more salary. In order to earn more salary, labor will have to increase human capital and therefore inequality decreases.

When considering the entire set of macroeconomics dynamics, inequality is produced by high distances between labor and capital shares. The shares are affected by how production processes are financed; usually it is through a credit provided by the financial system. The cost for a credit modifies capital accumulations in economic agents, which are compensated by changes in labor and capital shares, and so far, so on. This negative cycle depends on two main phenomena: first, the way earning shares are initially set in the economy and second the way they are adjusted by the development of the financial system. If the financial system would offer low-cost instruments to economic agents, shares distances will be reduced and therefore inequality. This is the only way financial systems can positively affect inequality. Low-cost instruments are the main characteristic of a well-developed financial system, this type of system is usually found in developed economies, which curiously have higher levels of earning labor share and therefore low levels of earning capital share, hence low inequality.

Policy implications are: first, if reducing inequality is an objective, then regulations to financial systems are needed; questions is what type? Reducing bank fees will be a good beginning for instance, otherwise, high-cost of financial instruments will foster inequality. High interest rates is also a cause for high bank fees and costs of instruments, monetary policy could be considered as an instrument for reducing inequality. Second, human capital theory has usually proved that higher education leads to better salary, which can be paid if the owner of a company diminishes the capital share of output, therefore increasing labor share, thus reducing the gap, that is inequality. A very natural implication will be rising employment, but this research has also found (because human capital effects) that a better salary is more effective for reducing inequality than a simple rise on employment.

FINDINGS

The macro dynamics between inequality, growth and financial system were analyzed by exercising an endogenous growth model with human, physical and financial capitals, diminishing returns, constant scale effects and heterogenic agents. Heterogeneity was introduced into capital endowments in agents, particularly households, hence creating the financial system into the economy at the same time. When the economy does not possess a financial system, macro dynamics are in a lower position than if it does. In each scenario, macroeconomic equilibrium, distributional dynamics and long-run shocks during the interaction between economic growth, inequality and financial system were characterized.

Main theoretical results show that in the absence of a financial system, poor households will allocate less time to leisure if they want to consume more or increase human capital or both; the physical and

human capital ratio of the economy relies only upon one sector when there is none financial system; the economic growth rate is lower when only lender sector is doing production activities (Dhrifi, 2014); increases in output lead to increases in inequality especially because earnings share of production factors remain constant. But when a financial system is introduced, capital accumulations change since production is financed by credit instruments, capital and labor shares of output will adjust depending on the cost of credit instruments. Consequently, income inequality relies on the financial system development as well. This is the main contribution of the research.

Inequality decreases when human capital goes up in the long-run; physical capital generates small and positive changes in inequality; financial capital causes negative impacts as increases inequality and inequality decreases if total multifactorial productivity increases. Empirical evidence verifies theoretical findings. Thru the use of information of the Penn World Table for 81 countries during the time interval 1970 – 2019, LS Panel Data techniques with fixed and random effects estimations were performed.

Based on the interpretation previously made, the economic policy recommendations should be directed towards promoting human capital accumulation, fostering consumption, encouraging salary increases and diminishing financial capital accumulation. The last two recommendation will directly affect the gap between labor and capital share, which naturally will reduce inequality. In this sense, investment in education is needed at the same time as salary rises, which will lead to a higher income so consumption will increase. If rises in income comes from salary, capital accumulation will also increase creating superior economic conditions for the use of financial services. However, to expect financial services to directly decrease income inequality is an outcome that is very unlikely to occur. The main limitations of the research are: a simple outlined for the financial system activities, assuming there is no government, to consider a closed economy, avoiding technological and financial innovation. For sure, the pending agenda would have to consider analyzing these macro dynamics under the conditions already described.

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