On the Earliest Income Inequality and Economic Growth

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Abstract: Analysis of the earliest income inequality and economic growth reveal new insight on interrelation between the variable. This is why our study focuses on analyzing causes of the earliest inequality and growth. We find that external power exercised by slave owners is force which has given occasion to inequality and growth and their positive correlation. This finding provides fundamentally different understanding of the issue.

Key Words: Division of Labor, Economic Growth, Freedom, Game Theory, Income Inequality, Slavery.

1. Introduction

With the current study, we attempt to contribute to understanding interrelation between income inequality and economic growth. We analyze the earliest income inequality and economic growth in human history since we believe that contradictions in current economic literature on the topic occur because thorough study of the earliest inequality and growth has not been conducted. To efficiently conduct our analysis, it is imperative to analyze individual behavior at times when the market relations among individuals have started taking place. The analysis serves mostly as a development of Tolstoy's study (1886), a study which has been ignored by economists. Unlike the author's examinations, our analysis is based on simple, yet strong, model of game theory. Yet we are constrained to scrutinize the issue from economic point only, whereas Tolstoy studies philosophical aspect of the issue as well.

We have organized the paper as follows. We will elucidate our models in the next section. Later, we will state results deducted from the models. In sections 4 and 5, we will deliver explanation of the results and compare our results with those of the earlier studies. We will provide concluding remarks in the final section.

2. The Model

Time span between primeval and slavery ages is commonly known as a period when the earliest market relations started taking place. To construct a model, we will make assumptions on individuals' freedom, exchange/trade, and division of labor to make our model to fit to reality of the above time period. We apply most of the assumptions for simplification purposes, and later we will relax them.

One of the assumptions of the model relates to individual freedom. We assume that a person is free to do anything he wants, and no one restrains his freedom. Nevertheless, in order to maintain the sense of freedom, a person is absolutely free to do anything, except that which restricts the freedom of another. This idea eliminates the existence of monopoly, oligopoly, government, and any other institutions and/or powers which can exercise power to compel a person to act against his will. Each person makes his individual decisions, and each one acts on the basis of the decisions he made.

Next, we assume that, in a society in which freedom exists, all people in workforce are homogenous in their needs and abilities.[1] Each person produces those types of goods and services which maximizes his utility. Since everyone has approximately the same needs,

[1] The assumptions of the homogeneity of people and freedom are reasonable to describe the state of societies in ancient times before slavery and after primeval periods, times when no institutions to control people's actions had been established. That time span has taken place in different dates depending on the place. According to Boatwright et al. (2004), 4,000 BC corresponds to the time when degree of specialization and that of income inequality as well as technological improvement were insignificant in the territory of modern Italy. In Cantor's (2003) study, a social order before 6,000 BC in Egypt is close to that we describe in our study. For other authors (MacKendrick et al, 1969), time before 200,000 BC in England represents a period in our model. The dates, however, are of little importance for us. What is important is properties of the society in those time period. During those times, people were close to absolute homogeneity in their needs and abilities. It is commonly known that each man was busy hunting and/or producing agricultural goods. Each woman was busy in the agricultural sector too, but she also was busy doing jobs which naturally tend to be done by women—such as taking care of children—instead of hunting. Men's and women's duties differed to some extent; still specialization did not reach that degree which caused great improvement of labor. Also no human established institutions which had restrained people's freedom. A tribe might have certain rules, but those rules were designated mostly to support the above principle of freedom—to not do actions which limit others' freedom. Hence, it is not wrong to assume that in the earliest periods of human history people were homogenous in needs and abilities.

each person produces that same set of goods and services which every other person does. That each person produces the same set of goods and services eliminates existence of division of labor. Since there is no specialization of labor, the production of a person is barely high enough to satisfy his needs. In other words, a person produces just enough to meet his own needs because there is no division of labor which causes improvement in production. In light of these points, it logically follows that there is no need for exchange.

Also, in such society, there is no need to specialize. Given that there is no power that forces a person to exchange, let us assume that a person chooses to specialize in production of a good *X*. He produces that good in such quantity that he possesses surplus. In case, if the other persons in the society exchange their goods and services to the good *X*, the person can improve his utility by exchanging his surplus product with the other goods and services. However, the others do not want to exchange anything with him since each of them produces a set of commodities in such quantities which are only high enough to satisfy each of the others own needs. That is, no one, but the person who specializes, will have a surplus production for the exchange. This means that, if a person specializes in production of a certain good, then the person ends up with consuming only that good only, i.e., the person will not be able to meet his needs. Thus, in this type of society, people do not possess the will to specialize.

2.2.Society with Two Persons and Two Goods

Figure 1 demonstrates the above state of society in a simplified form. We assume that there are two individuals and two different goods. Each faces two choices: to specialize in production one of the goods or not to specialize, which is to produce both goods. In the case they choose to specialize, it would be logical they will specialize in production of different commodities—specializing in the production of the same good does not make sense. Since we suppose the persons are similar in their needs and abilities, the level of each one's utility in identical cases are equal. Although the model is a simplified one, it is relevant to apply it for an analysis of the type of society described above.

In the figure, the numbers in the brackets show the level of utility of each person. In the brackets, the numbers on the left represent *Person 1*, and the numbers on the right represent *Person 2*. The numbers are chosen arbitrarily, but that does not affect the overall outcome.

If no one specializes, then the level of utility of each person is equal to *5*, which is less than the outcome *(7;7)*, which occurs when both choose to specialize and exchange their goods. In the latter case, each consumes more than each does in the former case. In each of the other two cases, a person who specializes consumes only that good, in production of which he specializes; and the other person who produces a set of both goods consumes that set because that set of goods is utility maximizing and also is barely high enough to meet his needs. Although the one who specializes consumes more of the good in production of which he specializes, more consumption of that good only decreases his initial level of utility (from *5* to *2*) since only consumption of a combination of the two goods can satisfy his needs.

Person 2 / Person 1	Specialize	Not Specialize
Specialize	(7;7)	(2;5)
Not Specialize	(5:2)	(5;5)

Figure 1. A two person game with two commodities.

There are two equilibriums in the system. They are *(Specialize; Specialize)* and *(Not Specialize; Not Specialize).*

In the model, it is not necessary that, in equilibrium point in which both persons choose *Specialize* strategy*,* the utility levels of the persons are equal. That point will still be an equilibrium point even if the utilities are different; but each utility level should not be less than utility level in the other equilibrium *(5;5).*

Furthermore, in the model, we have assumed that a person can produce only one good under *Specialize* strategy and a fixed set of both goods under the other strategy. Now, we will loosen that presumption, and will suppose that a person may choose to partially specialize in production of a certain good under *Specialize* scheme. That is, a person can produce both goods, but a production of one of them is now higher than it has been under *Not Specialize* strategy.

Relaxing the assumption generalizes the above model. If degrees of partial specialization are closer to each other, then there are two equilibrium points as above. If degrees of partial specialization are significantly different from each other, there is only one equilibrium point, which is autarky.

2.3. Society with n Persons and m Goods and Services

To better fit our model to the reality, we say that there is *n* number of persons in a society. In autarky, each person produces *m* number of different goods and services.[2] Each faces mainly three choices: to specialize in production of one good or service only and exchange the surplus; to partially specialize in production of one or more goods or services and exchange the surpluses; or not to specialize at all, that is, to produce a set of goods and services which meets his needs and, correspondingly, not to exchange, since he does not have any surplus. Also more than one person can specialize in production of the same good or service. And finally, each one has fixed number of pure strategies.

The above system has multiple equilibriums. Given that two persons specialize in different production, *(Specialize; Specialize; …)* with different combinations instead of multiple full stops, *(Specialize; Partially Specialize; …)* with different combinations instead of multiple full stops, *(Partially Specialize; Partially Specialize; …)* with different combinations instead of multiple full stops, and autarky are the equilibriums.

We should note that it is not reasonable to apply mixed strategy game to We analysis. In fact, we do not have enough data and information to support this point. Nevertheless, on the basis of logical judgments, we are inclined to believe that our point is a right one. The reason is that it is so difficult for an individual to repeat the process of specializing and then

[2] If $n>m$*, or* $n<m$*, or* $n=m$ do not affect our analysis.

going back to autarky several times that it is most probable that he does not choose mixed strategy. Usually it takes several years to specialize in production, for instance, of wheat. Once a person starts earning his living by producing wheat only, it is hard for him to switch to autarky. Although hard, but that is possible. Yet it is extremely hard to repeat such switches several times. Still this is a product of our logical thinking only, which is why a thorough analysis of test our point is needed.

Finally, we will loosen the presumption that the production is barely high enough to satisfy a person's needs. We suppose that, in autarky, each person produces surplus of some goods and the persons do not produce surplus of the same single good. In fact this notion of surplus production releases constraint imposed by assumption of homogeneity of individuals. Now the individuals are different in their abilities and wants (but not necessarily needs)—a person produces surplus of those goods and services which he wish to consume more, and this leads to improvement of his skills in those surplus productions. Following Nash's model (1949), we have a typical model in which specialization and trade is the only equilibrium.

3. Results

Summing up our above analysis, we have reached the following results. In a society with two persons and two goods, in which a person can do anything but that which hinders the freedom of the other, in which specialization has not taken place, and in which production without specialization is barely high enough to satisfy the persons' needs, the economic system is in a state of equilibrium. Each individual in that society does not possess the will to specialize or to trade. Only cooperation or an external force can disturb the equilibrium and move the system to another equilibrium—each person specializes and trades.

Supposing that the persons can partially specialize generalizes our conclusions. Again, an autarkic society is in a state of equilibrium. Also there is another equilibrium point, which holds only if the degrees of the persons' partial specialization are not significantly different from each other. The society can move to that equilibrium only if the persons agree to specialize and exchange their surpluses or if an external force compels them to do so.

In a model with n individuals and m types of goods and services, the analysis triggers the following outcomes. A free autarkic society in which each individual, similar in his needs and abilities to the other individuals, produces a set of commodities and services which is barely high enough to satisfy his needs is in a state of equilibrium. The society can move to another of many possible equilibriums only if the individuals agree to specialize and exchange their surplus products with each other or only if an external power forces them to do so.

In a similar model, but in which the individuals in the society have initial surplus (which also implies that the persons are not homogenous in their skills and wants), the individuals tend to specialize and trade.

4. Explanation and Discussion of the Results

The last two models with n individuals and m types of goods and services—the one with no initial surplus production and the other one with initial surplus production—are of our interest since they provide better picture of the reality. What we need to pay attention is that, in the equilibrium points, in which the persons choose to specialize, each utility level is not less than the utility level in autarky. This implies that, in the equilibrium point in which the persons choose to specialize, the income inequality is not so high that some live in extreme poverty whereas the others reside in luxury. By extreme poverty, we mean a condition in which a person's utility level is less than that under autarky. If a person's utility level under the equilibrium in which the persons choose to specialize is less than that under autarky, the person leaves the market and chooses to live in autarky.

However, history demonstrates that opposite happened during the slavery period. History informs that the slaves suffered extreme poverty while the slave owners enjoyed luxurious lives. Although the slaves were supposed to choose autarky according to the model, we observe high degree of specialization.

The main reason of the contradiction is that the slaves did not possess freedom—it would have been a quite amazing picture of slaves leaving their owners to live in autarky. There is no doubt that the slaves wanted to escape their owners and to live in autarky; alas, we know that the owners would have punished (usually kill) the slaves if the slaves tried to escape. In other words, the slave owners controlled the slaves' freedom.

That control of freedom is the root cause of the earliest income inequality and possible reason of the earliest economic growth and division of labor. If we assume that there was no surplus in autarky, then the slave owners have compelled specialization among the slaves against the latters' wills. Most probably, the slave owners have not had in mind to divide labor among slaves in order to increase output. Rather, the slave owners have taken such actions because that was the most convenient way of ruling for them. Having forced division of labor, the slave owners have also prevented trade among the slaves by taking away substantial part of the slaves' productions. In other words, the slave owners, on the one hand, have forced division of labor among slaves and caused economic growth, and, on the other, they have triggered income inequality. The latter action has pushed the slaves to leave for autarky, but, because their freedom was controlled by the slave owners, the slaves have kept on doing their routine and tiresome jobs. If we suppose there was no initial surplus in autarky, then the root cause of the earliest specialization of labor, growth, inequality, and their positive correlation has been slavery.

If we assume there was surplus production in autarky, then the slave owners forcefully have, first, taken away the goods and used the services produced by the slaves and, later, forced specialization. In this case, initially the slave owners have not had to force the slaves to specialize since the "slaves" (the word appears in brackets because free people become slaves only after slave owners control the people's freedom) individually tended to do so. The only purpose that the slave owners had to achieve in this stage has been to forcefully take away production of slaves, thus decreasing degree of trade among the slaves. Such action has caused the slaves to leave the market; yet their right to leave the market has been restricted by the slave owners. Having taken away most part of the slaves' production, the slave owners now have compelled specialization. In this case, we have similar picture as in the above one with some differences: that the fundamental cause of the earliest specialization of labor and thus economic growth has been people's propensity to trade; that the reason of the subsequent specialization, growth, and the earliest income inequality, and the variables' interrelations has been slavery.

Our findings hold that individuals tend to specialize and trade only if their utility levels under *Specialize* strategy are higher than under autarky. Otherwise the individuals prefer to live in autarky. History shows that, during slavery period, slaves have specialized even though their utility levels under specialization were lower than under autarky. The reason is that slaves, who have lived in free autarkic society, have been forced to specialize and to dispose production of their labor to slave owners. In essence, the reason of such occurrence is that slave owners compelled the salves to specialize and consumed significant proportion of the slaves' productions which decreased slaves' utility level below the autarky level.

4. Comparison of the Findings with Other Studies

Some may argue that our study does not consider the slave owners as persons who specialize in controlling freedom. Although the argument seems sound, it is flawed. The paper analyzes specialization of persons in different branches of productions. All the produced commodities and services in those different branches add up to the total production. Control of someone's freedom cannot increase total production; it rather transfers someone's production to another. In essence, the slave owners redistribute income rather than they generate it. This is why control of freedom cannot be considered as specialization in a certain production.

To that some may accuse us in excluding slave owners from our model. It is true that we do not include slave owners to the model and consider them as external agents. This is one of the weaknesses of our analysis. We need to develop this aspect of our model; nevertheless, it is out of scope of our work.

Some other may claim that redistribution of income by slave owners is a service that requires certain effort and has increased entire income in the society by causing specialization. The former part of the argument is flawed whereas the latter part may hold true only under certain conditions. In fact, income redistribution by slaves is a type of service that restricts freedom of certain individuals whereas usual service does not. Income has been redistributed mainly from slaves to slave owners against the slaves' wills. However, any type of other services not only does not hinder individual freedom but also is desirable. That the income redistribution by slaves has stirred economic growth may be true only under the following conditions: in autarkic society there is no initial surplus; and individuals in the society either are not aware that specialization and trade can lead to economic growth, or they know about it but, in order to avoid risk, do not wish to specialize and trade by mutual agreement. Nevertheless, it is questionable whether that has been a case in autarky. Therefore, we need to avoid such constraints in order to provide general elucidation of our main issue.

Also our findings are in line with those of the earlier authors who have conducted similar studies. Results of our analysis are consistent with those of Tolstoy's (1886) study, except for that the author gains the conclusions on the basis of philosophical judgments whereas we do the same on the basis of game theory. Similarly, our results are in line with Marx's (1867) findings with few differences. Marx states that the main reason of income inequality in capitalistic society is that capitalists control laborers and arbitrarily assign them wage rates. Our findings claim that inequality in slavery is a consequence of restriction of slaves' by slave owners. Next, our study supports the Sraffa's (1963) idea by implying that the prices are affected by those who restrict freedom of others. Though it may look our results deny Smith's (1776) theories of division of labor and income inequality, the only difference between the author's study and ours is that we provide more general picture on the issues than Smith does. The author states that division of labor is a consequence of people's propensity to trade. We do not eliminate such possibility. According to our analysis, Smith is right only if there is absolute freedom and people possess initial surplus production. On income inequality, the author distinguishes inequalities within three production factors—land, capital, and labor. He claims that there are two types of forces which cause income inequality within the factors of production. One of the groups includes natural forces, i.e. market forces; and the other group consists of external powers which are exercised by government and/or corporations. Such elucidation of the causes of income inequality is reasonable only if specialization is a consequence to people's propensity to exchange and only if factors of production can be grouped to three as they are done by Smith. Our study does not deny such explanation, but it only implies that Smith's conclusions hold only under precise suppositions.

In addition, we need to note that our study does not contradict to Kuznets' (1955) and his followers' studies (Alba Ramirez and Collado, 1999; Banerjee and Duflo, 2003; Barro, 2000; Fishman and Simhon, 2002; García-Peňalosa and Turnovsky, 2006; Kuştepeli, 2006; Lee and Roemer, 1998; Milanovic, 2006; OECD, 2011; Panizza 2002; and Willen et al., 2008). This group of authors analyzes the effects of different variables on income inequality and/or economic growth. Taking under consideration Tolstoy's (1886) elucidation of evolution of freedom control from slavery to capitalistic system, we may be imply that the above authors find forces, which are consequences of freedom control and which affect inequality and/or growth.

In addition, our findings may elucidate one of the possible causes why Kuznets and his followers reach ambiguous conclusions. The reason of the uncertainty may be the following. On one hand, governments of some countries adopt policies purposed to increase freedom in the market, and those of some other states introduce laws which contribute to equal income distribution. Some of the policies are successful and decrease income inequality. On the other hand, richer income brackets still can influence market prices.[3] Depending on which of the forces higher than the other, income inequality widens/shrinks. However, deeper research on the relation between our study and the study of these authors needs to be conducted.

5. Conclusion

On the basis of the above discussion, we have found that *the reason of the earliest income inequality is the restriction of freedom of some persons by the others*—which is slavery. The cause of the earliest division of labor and economic growth is ambiguous. Yet the cause of specialization and economic growth which have been accompanied with income inequality is the limitation of freedom of some individuals by the others too. *Such limitation of freedom (i.e. slavery) has caused positive correlation of division of labor, growth, and inequality*.

Although our model serves as a general picture of how inequality and growth have appeared, it is restricted to analyze the beginnings of market relations only. It needs to be developed further and the results obtained need to be supported by appropriate data to elucidate the modern economic system.

In addition, we do not consider mixed strategy game. The reason is that is we think that using mixed strategy is so difficult for a person that he does not tend to apply it. Yet this question needs to be thoroughly studied.

Still our analysis helps to view the relation between division of labor, economic growth, and income inequality from a different angle. Our findings are more general and analyses are simpler than those of the earlier authors. By applying game theory, we have found that the earliest inequality, and possibly the earliest specialization and growth, is based on restriction of freedom of some people by other ones. This control of freedom is a root

[3] According to Naqvi (2008), richer income groups of the United States, decided to move their capital from the US to countries with lower wages, such as China and India. This increased unemployment in the US from 4.6% in 2007 up to 9.3% in 2009. And top 1% income group in the country, who possessed 8% of income, earned 24% of income in 2006.

cause which has triggered positive correlation between economic growth and income inequality.

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