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A Boolean Analysis of Structural and Organizational Determinants of Equality and Efficiency Balance in Higher Education

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Abstract

Efficiency and equality are both important goals and values in higher education, and their concurrency (balance) has been one of the main concerns of higher education scholars and policy makers over the past decades. The aim of the present study is to discover the causal mechanism and contextual factors that are likely to result in concurrency of equality and efficiency in higher education. To this end, the combination of two explanatory theories of equality and efficiency were used. The theory of equality focused on three dimensions of equal opportunities, modernization, and cultural differences. Likewise, to explain efficiency, Chalabi's three-level causal model of sustainable production of science was used. Methodologically, a multiple case study method was adopted, and the cases under study (nine countries) were selected based on purposive sampling. The findings showed that for the concurrency of equality and efficiency in higher education, a set of conditions must be present in the configurational and combinational causality. The preconditions for this concurrency is the presence of some social conditions such as productive economy, the rule of law, inter-societies competitiveness, social cohesion, democracy, universalism, egalitarianism (at macro level), meritocracy, academic autonomy, and organizational competitiveness (at the meso level) and the absence of some other conditions including fatalism (at the macro level).

Keywords

higher education – equality – efficiency – analytic generalization – Boolean analysis – three-level conceptual model of sustainable production of science

1 Introduction

During the last decades of the twentieth century, higher education has undergone a process that is sometimes interpreted as massification, popularization, and democratization. Due to this evolution, a significant shift took place in the process of admitting students at universities around the world. Accordingly, in 1900, roughly 500,000 students were enrolled in higher education institutions around the world, about one percent of college-age people. However, the number of higher education students increased by two hundred times and reached 100 million in 2000, nearly 20 percent of college-age people (Schofer and Meyer 2005). According to UNESCO (2017), there are 207 million students in higher education around the world.

However, some evidence indicated that the massive expansion of higher education in all countries has not led to equal academic efficacy. Based on science, technology and development indicators, some countries are still underdeveloped in spite of higher education expansion and its dramatic progress regarding science production and export of high-tech products in the last few years (World Bank 2008). Moreover, the indicators of science production and the number of students per hundred thousand people showed that in some countries these two indicators had been faced with an unbalanced growth. In other words, while the number of graduates and students had increased rapidly, there had been little increase in scientific output so far.

Equality and efficiency in education are topics that have always been of interest to philosophers and thinkers. In general, there exist two competing approaches that each of them insists on either equality or efficiency. In relation to equality, some thinkers claim that equality as an educational ideal is worthless and should be abandoned (White 1994 and Cooper 1980). Some speak of trade-offs between equity and equality (Haas 2009) and some other scholars suggest that what is needed is equity in education, not equality (Anderson 2007, Giesinger 2011, Gutmann 1987, Satz 2007, Schouten 2012). In the contrast between equality and efficiency, in an approach focusing on efficiency, the role of commitment to equal opportunity in education has been neglected and the value of equality as an educational ideal has been underestimated (Jencks 1988, Howe 1993, Cooper 1980, Meyer 2013). By contrast, there is an egalitarian

approach that in its radical form merely gives priority to equality, but its moderate form with the influence of Rawls' votes and led by individuals such as Brighthouse (2000), Wilson (1991), and Satz (2007) seeks to reconcile these goals. An attempt to balance between equality and efficiency is made in a situation where some scholars like Hayek and Nozick, implicitly emphasize the unconditional negative relationship between them. In this regard, they claim that the improvement of equality would lead to a disruption of efficiency, and the balance and reconciliation between these values are impossible (Nash 2004 and Meyer 2013). Welch (1998) believed that the efficiency-based approach often included an economic and technical view of education. He also highlighted that focusing on the efficiency might impede achieving various educational goals including equality and democracy (Menashy 2007: 174-75). The relationship between efficiency and equality can take on different forms and even be strengthened by complementary ways (Wobmann 2008). In this regard, empirical evidence suggests that equality policies in higher education have not necessarily been ineffective in all parts of the world. For example, countries such as Poland, Russia, and Argentina have not been able to achieve the desired efficiency, despite equality in higher education. In contrast, countries such as the United States, Japan, and the United Kingdom have been able to realize two goals concurrently.

According to the above explanations, the aim of the present study was to discover the causal mechanism and contextual factors that are likely to result in concurrency of equality and efficiency in higher education. The point is that how would it be possible to reflect both equality and efficiency in the transition from elite to mass education through considering not only efficiency but also equality and more opportunities for access to education. For the sake of that, in this study, the combination of the causal conditions and introduction of evidence as empirical supporters have been taken into consideration. This study explicitly sought to answer the question: The presence or absence of what conditions at a macro level (inter-societies) promotes the concurrency of both equality and efficiency, the absence of both them or merely the presence of equality without considering the efficiency of higher education.

2 Theoretical Framework

2.1 *Determinants of Educational Equality*

Several factors at different levels can lead to the realization of equality. In general, three types of explanations can be given in this regard. The first explanation focuses on equality of opportunity (Shavit and Blossfeld 1993; Breen and

Johnson 2005). The second type of explanations focuses on modernization, and the third one can be attributed to the individual cultural characteristics of countries and focuses on cultural and contextual factors.

In connection with the first explanation, it can be said that educational equality is influenced by the government's degree of welfare systems, and equality of opportunity in education enables low social classes to equal participation in educational life and access to academic achievements based on their abilities (Viotti 2008; Peter, Edgerton and Roberts 2010; Schlicht, Stadelmann-Steffenand and Freitag 2010). Crutchfield and Pettinicchio (2009) argue countries with a greater taste for inequality, (or "tolerance for inequality") experience more educational inequality. Where there is inequality culture, people exhibit attitudes that indicate inequality is allowed. In this approach, the prevailing view is that the government is not responsible for creating equality in education, and inequality in education is due to people's lack of ability and failure, and government intervention to help disadvantaged groups and any other effort in this area is only a waste of tax revenue. Therefore, the nature of the welfare state regimes affects the ability and capability of individuals to participate and provides appropriate structural conditions for participation and overcoming institutional and individual barriers (Rubenson and Desjardins 2009).

According to the second explanation, modernization plays a fundamental role in educational equality and the rule of law and the spread of democratic thoughts are among the most important factors affecting the distribution of scarce resources, including cultural capital in society. According to the theory of modernization in developed societies, which are open and free societies, social achievements are less dependent on social context and other ascribed features (Marks 2005). In these societies, social equality prevails over the inherited inequality of positions. Halsey et al. (1990 cited in Husén 1987; 48-49) point out that there are two types of movement in industrial societies, one called the equality of opportunities, regardless of class, and the other in the name of distribution by merit. Modern societies have left the aristocracy's structures, and are floating between meritocracy and egalitarianism. Therefore, the formal distinction based on ascribed features decreases largely in modern societies by moving towards universal and legal equality. In these societies, clear mechanisms of discrimination based on ascribed features such as race, gender, class, and social origin are less major, and there is rarely legal and formal social closure (Adkins and Vaisey 2009).

In industrialized societies, people are demanding the equal distribution of the products of society, and in democracies, compared with authoritarian regimes, because the adopted policies are not far from the will of the masses,

equality is greater, and democracy can impact on inequality through competitive pressures. Covaleskie (2007) writes: "Democracy is a balancing act: On the one hand, democratic societies value liberty and individual freedom to pursue each individual's own good as he or she sees it. On the other hand, and no less importantly or validly, they recognize that democracy requires a high degree of equality (a) in the opportunity to succeed, (b) before the law, and (c) in the political arena." In this regard, Chalabi (1996) states the equality of members of society is accepted as a fundamental political principle with political development. It is based on such a principle that equality against the law, equality in opportunities and equality in participation is first raised and then gradually flows at the society level. Therefore, through political development, it is expected that external inequality will gradually decrease. Also, he believes that the process of economic development and adhere to the performance norm, which is the same as technical efficiency, requires that the criteria for the allocation of people to social positions gradually change from ascribed criteria to achieved criteria. Failure to realize it, for whatever reason, is an obstacle to economic development and the increase of technical efficiency in society. Therefore, economic development requires people to be distributed primarily by their efforts, talents, and motivations in different social positions. In Chalabi's view, with increasing economic development, we can see the relative decline of inequality in the distribution of cultural capital. Another variable he believes explains the percentage of inequality changes is the level of egalitarianism in the society that has a decreasing effect on inequality. That is, a greater tendency toward egalitarianism in society will lead to a fairer cultural capital (Chalabi 1996: 183-193).

According to the third explanation, societies can be distinguished regarding the two features of universalism and particularism. In societies in which particularism dominates, ascribed features are possible to unevenly distributed. It is also assumed that educational opportunity is strictly limited to the special group, and the substitution for the ascribed features is unacceptable. On the contrary, it is assumed that in universalistic-oriented societies there is no ascribed status system based on diffused skills and ascribed features that cause unequal distribution; therefore the maximum educational opportunity is accessible (Hopper 1977).

In general, it can be concluded that the culture of egalitarianism, the existence of a productive and industrialized economy, democracy, the rule of law, and universalism can be taken into account as important conditions for educational equality. Considering these causal conditions, we now focus on the causal conditions of academic efficiency, which is largely based on Chalabi's theory.

2.2 *Determinants of Educational Efficiency*

According to the theory of Chalabi (2014), the social ontological foundation (society as social becoming) of the three-level model of the academic efficiency is based on Figure 1. Here, each structure of the society with their own enabling and constraint potentials to provide equipment and limitation for individual and collective actors. In contrast, individual actors through converting potential capacities to the actual ones are involved in producing and reproducing of products (in this study science) and systems (e.g., groups, organizations, and institutions), either directly or in connection with each other, simply or embedded, horizontally or vertically. Providing structural equipment and constraints is equivalent to structural causality and the actions of individual and collective actors equal to agentive causality. In this model, the agency is the supplier of individual and collective actors' capacities (e.g., groups, both formal and informal organizations). The notion of the structure refers to both a relatively stable arrangement between the individual and collective actors at the meso or macro levels and a normative arrangement and structures of valuable resources distribution in society (Chalabi 2014: 56-57).

2.2.1 Micro Level

At the micro level, causes of research capability are generated from intellectual creativity, curiosity motivation, and cognitive skills in a specific field. All the major properties that are considered for research capabilities are potential. For the sake of that, at least two sets of external conditions are needed. It must be noted that both material and nonmaterial incentives, mainly social and cultural, are prerequisites to realize the research capabilities in science production and productive research. The second set of external conditions is the minimum necessary opportunities to use this capacity that are divided into two categories. The first is related to material opportunity, but more importantly, it is job security and freedom of speech for researchers and scientists. The combination of research capabilities with environmental incentives and opportunities, as configurational causation leads to the production of science at the micro level (Chalabi 2014: 57-56).

2.2.2 Meso Level

At the meso level, although the organization and structure of each university is to some extent dependent on facilities, inputs and, its far and near environment, it seems that access to the generic goals, namely the production and education of science, follows four basic principles that include: (1) the principle of distribution of resources in line with scientific and research capabilities; (2) the principle of academic meritocracy coupled with the relative autonomy of professors

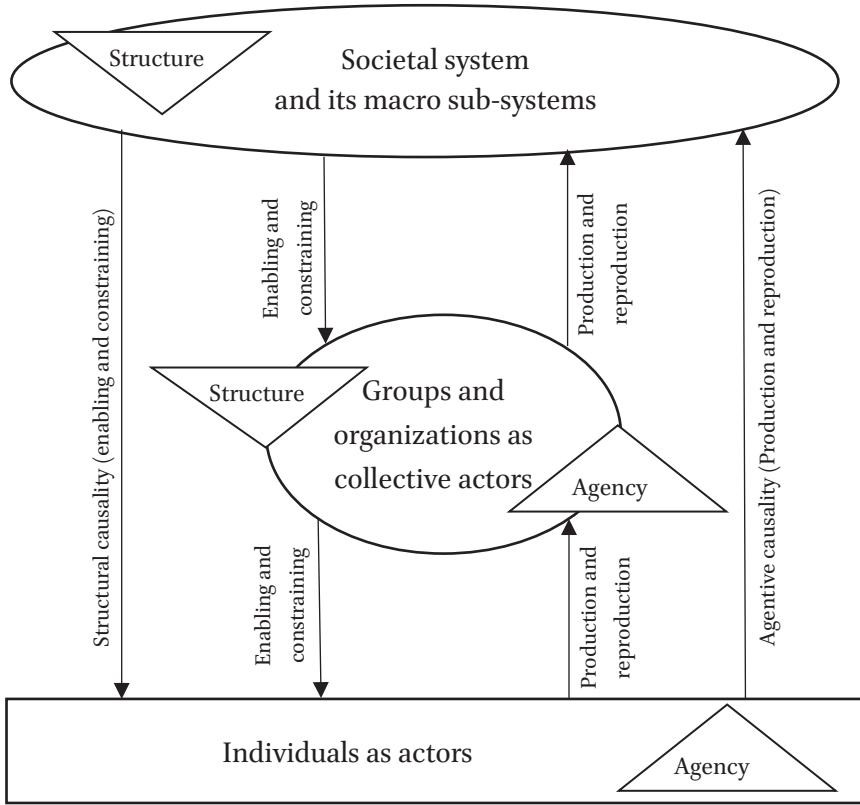


FIGURE 1 A general conceptual model of society
CHALABI 2014, 64

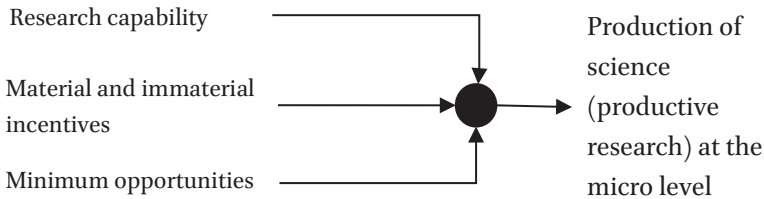


FIGURE 2 External conditions of realization of research capabilities
CHALABI 2014, 58

and elite circulation in the key roles of management and research; (3) The principle of the formation of an organizational community based on the network of the main actors' relationships, especially the professors and students, based on mutual respect, fairness and conviction (the formation of academic norms and academic identity of students), and (4) the principle of cultural

modelling based on the ethics of the responsibility, the value of science, rationalism, experience and observation and emphasis on flexible, problem-oriented, thought-provoking and up-to-date educational curricula, and as much as possible with interdisciplinary orientations (Chalabi 2014: 61-60).

It should be noted that at this level, academic autonomy is essential to the fulfilment of the missions of the higher educational institutions through quality, proportionality, efficiency, transparency, and accountability. Transferring power from government to educational institutions had meant moving from a centralized state-based model to manage the educational institutions based on institutional autonomy, and intense competition and quality improvement are one of its consequences (Kogan et al. 2006: 80). In the shadow of academic autonomy, there is no political-ideological hegemony under any name from outside. Also, their management, educational and research planning is done by the full participation of faculty members, and their managers are selected according to the scientific criteria and meritocracy (and not by external appointments with official political criteria) (Toufighi and Farasatkah 2002).

Another main dimension of the meso level, which has a positive effect on the quality of the educational system, is the competition between educational institutions. Competition in the higher education sector can be initiated to achieve the desired criteria and the inadequacy of market performance weakening the acquisition of business information and resulting to the survival of weak and exploitative institutions and even ultimately causing them to succeed (World Bank 2008: 45).

Decentralization in higher education also increases the academic efficiency of universities and increasing quality of education is affected by decentralization (Osorio 2003). In centralized academic system, where the government determines all higher education issues of policy making, planning, management and implementation, practically the realm of the emergence of new talents and creativity in university management is limited, and on the other hand, in an all dimensions, university managed centrally and hierarchically, with the government's patronizing approach, the context of accountability is gradually being eliminated. In this connection, Scott and Meyer (1988) have shown that governmental institutions demonstrate more complex higher level administrative structures, less relevant goals and less autonomy for academic staff in decision-making (Quoted in Hofman et al. 2005: 11). In the structures of the regimes that there is interventional and maximalist government's attitude in higher education planning, governments are the main policy-makers of higher education with regard to the broad interventionist role that they assume for themselves and use higher education as part of their ideological devices, they use it in the way of persuasive goals. In these systems, the government is the

owner, financier, and host of higher education institutions. Politicians often select the heads of universities and the ministers to impose the conditions for obtaining degrees and curricula, and this governmental control undermines the principles and causes to the politicization of higher education (World Bank 2008: 71).

2.2.3 Macro Level

The potential of the internal structure that is fed from development to the general notion plays a constructive role in the efficiency of an educational sub-system in mutual and sectional *interaction* with other level factors and affects the efficiency and quality of the scientific sub-system. In this regard, Cornali (2012) states that the capacity of accountability of the sub-system of science depends on increasing the efficiency of the set of social, economic sub-systems, and government relations in these societies. Chalabi (2014) argues that this level pays attention to the role of macro social systems, namely, economy, politics, society and culture in the production of science and its mechanisms. Each of the four systems, in particular, provides certain opportunities for the production of science. The economic system delivers material opportunities, and the political system provides security and through its organizational opportunity. Society (nation) provides and supports relational opportunities at different levels and dimensions, and finally, the cultural system provides symbols, concepts, and values for the production of thought.

While an economy is productive (like an advanced industrial economy), it requires empirical, applied and technological sciences, thus spreading science within the society. Therefore, it has the possibility of providing financial and organizational opportunities and is a willingness to do so; it allocates various material resources for the research and development of science. In contrast to an unproductive economy, such as a commercial economy, it not only does not pay much attention to the comprehensive and balanced development of science; in some cases, its material and non-material interests, are in a conflict with the advancement of science, and it is possible that such a system either willingly or unwillingly limits financial resources for the comprehensive development of science (Chalabi 2014: 61).

Freedom in the shadow of the rule of law is also among appropriate conditions, playing a key role in the production of thought and scientific innovation. Relative security and comfort for thinking, exchanging of thoughts and disseminating thoughts and thinking competition, and it is the responsibility of the political system to provide such a safe and favorable environment for science-oriented people. Every science is often flawed in its production and its products often suffer from the error and defect. Obviously, the discovery,

compensation, and correction of an error are possible only from within the same system and scientific disciplines through the mechanism of healthy competition and quality control by the peer reviewers, and not by external factors. If the control of science is done externally, it will be gradually infertile, lose its growth and prosperity opportunity. In authoritarian systems with maximalist ideology, the power ideology usually encounters a relationship of love and hatred with scientific knowledge, which can compromise the intellectual and job security of practitioners of science. Additionally, it causes an ideological and organizational impediment to the comprehensive development of science. In such systems, the development of science, like social development, is usually one-dimensional, not comprehensive and balanced (Chalabi 2014: 61-62).

If a social system benefits from the societal cohesion, then such a system creates the basis for the accumulation of characteristics that each one can cause to increase the individual and organizational energy (synergy) for each type of production, including science. Also, each of these characteristics can contribute to the social stimulation for science production. Instead, if the society does not have such a system and suffers from social disruption or based on a type of tribal cohesion, then it can be cautious to say that all the characteristics derived from such an arrangement are detrimental to production, including the production of science. Tribal cohesion can spoil individual energy and organizational capabilities and through the overshadowing of organizational health, cause administrative corruption. At the same time, it prohibits meritocracy and produces moral wrath in society. These all contribute to the failures in production, including the production of science, both quantitatively and qualitatively (Chalabi 2014: 63).

The essence of the cultural system is the symbol and thought. A culture that pays attention to reason, thought, and invites everybody to think in all matters, such a culture can be one of the main means of scientific development. In addition, universalism indirectly contributes to national cohesion and helps to promote the level of science production. Universalism can also provide grounds for the rule of law and meritocracy, which both of them become the ground makers of the prosperity of science and research. Fatalism is an inverted mechanism of rationalism that suppresses superstition, fantasy and intellectual passivity in society, which in turn contributes to distributing the growth and prosperity of science and research. Chalabi (2014) believes that scientific under-development has been influenced by intra-system barriers (such as the weakness of performance of scientific actors and the weakness of academic institutions) and macrostructure barriers, and these barriers are effective in scientific under-development and its intensification. The mentioned

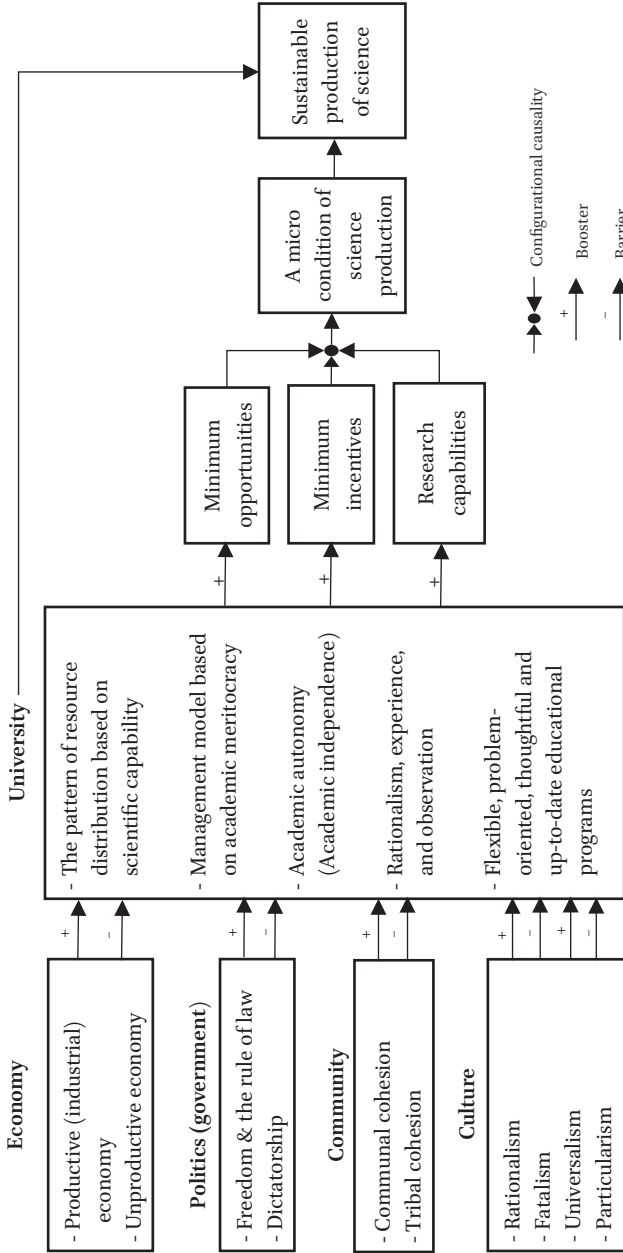


FIGURE 3 The reduced version of the three-level model of the boosters and barriers to the sustainable production of science
 CHALABI 2014, 64

barriers to interaction with each other make the process of production, dissemination, and application of scientific findings in various domains subject to disparity, confusion, and disorientation. In general, the variables with different levels in the form of a three-level causal pattern are presented in Figure 3.

To create a balance between equality and efficiency and realize these two goals and vital values of higher education, the underlying assumption of this study that the combination of causal conditions of equality and efficiency will lead to the reconciliation of these two values. For the sake of that, the selected theoretical model was evaluated through referring to several empirical evidence including some cases with a high level of efficiency as well as a high level of equality, moderate level of efficiency and high level of equality, then low efficiency and low level of equality.

3 Method

The main purpose of this study, which was carried out by adopting a case-oriented comparative approach, to compare the empirical results of different cases, confirm the theory and consequently make an analytic generalization based on them. In the case of empirical confirmation of the theory, it can be concluded that empirical results have a higher potential or capacity. Therefore, in this study, by extending the set of results within the theory, the results have been generalized to the theory, and thus the possibility to obtain reliability based on external factors have been increased. In this study, a multiple case study method was implemented based on replication logic. On the one hand, this kind of research design is similar to an analytical comparison that includes uses the joint method of agreement that is the method of agreement and the method of difference. In other words, it refers to the comparison between two sets of positive and negative cases (Neuman 1991: 421). On the other hand, according to the mentioned design, in this study, the results have been predicted through not only the inductive reasoning but also several contradictory states based on the theoretical model of research. Therefore, the replication of the cases is almost equal to those cases used in multiple experiments (Yin 2003). Furthermore, bearing in mind that the sample only was consisted of nine countries, the design of the study can be considered as a qualitative comparative method (Ragin 1987).

3.1 *Sample*

As mentioned before, the sample of the research was composed of a set of countries including a set of positive cases and the other set with negative

cases. A set of positive cases included three countries, all of which have a high level of equality and efficiency in their higher education system. In contrast, the set of negative cases included six countries that all suffered from inequality and inefficiency or absence of one of them in their higher education system. However, in order to have a theory with appropriate analytic generalization possibility (in contrast with the statistical generalization), the selection of the cases under study was based on purposive sampling. Bearing this in mind, if a theoretical prediction was consistent with the results of a set of positive cases (i.e., true replication) and the results of the set of negative cases (i.e., theoretical replication) in this case, the empirical findings confirm the theoretical model of the research and the results of the research can be generalized to similar cases.

Also, each of the equality and efficiency conditions were associated with the result independently through Boolean algebra. After clarifying the effective factors on each of the equality and efficiency separately, the configurational causation leading to equality and efficiency was evaluated in the final analysis. This algebra, which is the Boolean development of the logic of John Stuart Mill's nominal comparison (namely, a method of agreement and disagreement) provided the opportunity to identify a set of related and logical causes.

In the present study, we used the average data of the years between 1995 and 2010 for the independent variables and the average data of 2010 and 2014 for the dependent variable. The rationale behind using data from the different period is that the effect of features as well as macro and meso structural variables on the dependent variable is not instantaneous. Therefore, the aspect of time and its impact must be taken into consideration. To select the samples, we tried to select cases that were a typical sample of the whole population. Thus, the selected cases to a large extent, could represent a variety of cases.

In addition, the criterion for selecting nine countries was according to their score on two levels of educational equality and academic efficiency of the higher education system. It is attempted to make sure that the countries with a small population were excluded from the sample. Based on the calibration result, the positive cases (United States, Japan, and the United Kingdom) included cases with an upper bound of equality and efficiency. It is obvious that among these countries, some cases including France and Italy due to their lower bound of equality and efficiency than selected cases were not selected. Moreover, the negative cases (Nigeria, Bangladesh, and Ethiopia) were in the lower bound of equality and efficiency. In the same vein, the countries that were in moderate level, as well as countries whose data were not available in some of the variables, were excluded from the analysis. For instance, Poland, Russia, and Argentina were considered as countries with an upper bound of

equality but a low bound of efficiency. Among the selected cases, there were no countries with a high level of efficiency but low level of equality. Therefore, a selected sample included 52 countries each has a population of over 20 million people. The reason for determining the minimum population was that some developed countries (for example, the Scandinavian countries) despite having the efficient higher education system, they were ranked as inefficient countries due to their small population and consequently less science production. As such, in the combination of configurational causation, the related condition in those cases did not lead to the desired and preferred result. Therefore, to avoid this bias, only countries that had more than 20 million population were studied.

By using external criteria, especially expertise knowledge and experiences, nine studied countries calibrated in the two dimensions. The calibration based on the fuzzy approach normalized the degrees (intervals) of the measurement instrument. The result of this calibration is as follows:

Academic efficiency:

Less than 1.75 = inefficient

7 = neither efficient nor inefficient (in the sense of 'moderate')

More than 15 = highly efficient

Educational equality:

Less than 16.5 = completely unequal

35 = neither unequal nor equal (in the sense of 'moderate')

More than 55 = highly equal

The following table shows empirical evidence of degrees of equality and efficiency.

TABLE 1 Empirical cases of varying degrees of equality and efficiency

		Efficiency	
		High	Moderate /Low
Equality	High	UK, USA, Japan	Russia, Poland, Argentina (moderate and lower than moderate)
	Low	–	Pakistan, Nigeria, Bangladesh (Low)

By combining the values of the above table, the position of the cases can be indicated as follows.

TABLE 2 The position of the selected cases regarding result (equality, efficiency, and balance)

Position	Cases	Result		
		Equality	Efficiency	Balance
High equality and moderate and lower than moderate efficiency	Poland, Russia, Argentina	+	-	-
Lack of both equality and efficiency	Ethiopia, Nigeria, Bangladesh	-	-	-
The presence of both equality and efficiency	Japan, USA, UK	+	+	+

The criterion for determining variables' cut points was content knowledge and consultation with experts. The data related to the composite indexes of the new variable was obtained through factor analysis (Kerlinger 1986: 423). In addition, Cronbach's alpha coefficient was calculated for composite indexes to evaluate their measurement power.

3.2 Variables

In this study, *Equality* was considered equivalent to access to higher education. To measure educational equality the average of the expected academic years in higher education, the enrolment in the higher education per 100,000 inhabitants, and the gross enrolment ratio in higher education were used.¹ These variables had a correlation coefficient of 0.93 to 0.99. Also, the factor analysis showed that all components by placing in one factor, an Eigenvalue of 2.91 and an explanation of variance of 97.12 have a high measurement power.

Efficiency refers to the production of sustainable, continuous and balanced science (Chalabi 2014, 56). This index was made of six indicators of the amount

¹ <http://data.uis.unesco.org>.

of paper production, citations, and references rate,² the number of scientists and researchers per million people,³ Nobel prize winners,⁴ the ranking of universities at the international level and the diversity of scientific production.⁵ The findings of the factor analysis showed that all components have a high measurement power by placing in a high load factor, an Eigenvalue of 4.13 and an explanation of variance of 82.70.

The *productive economy* (vs. unproductive economy) means that all the collective activities that shape society's use or demand for goods and services. To measure the productive economy, the combination of three indicators of GDP per capita, per capita consumption of energy and value added of the industry sector were used.⁶ These indicators by placing in one factor, an Eigenvalue of 2.10 and an explanation of variance of 70.15 had a high measurement power.

Competition is an individual or collective effort to acquire four valuable resources of wealth, power, knowledge and prestige. To measure *Inter-Society Competitiveness*, data from the Global Competitiveness Index was used. This index includes the indicators of the institution's ability, infrastructures, the economic environment, basic education and health, the commodity market, financial market development, market size, in touch technology, innovative factors and sophistication factors (business expertness and innovation).⁷

The *rule of law* reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, the quality of contract enforcement, property rights, the authority of the court and the police, as well as the likelihood of crime and violence occurrence. Data from the 'Worldwide Governance Indicators report'⁸ was used to measure this variable.

In a primary definition *democracy* "includes an emphasis on the freedom and liberty as its essential goals, with the institutions of democracy a way to achieve these goals" (Dalton, Shin, Jou 2007: 3). Two indicators of political rights and civil liberties⁹ were used to measure *democracy*.

Organizational competitiveness refers to an organization's ability to gain and maintain market share in its industry and meet the needs of important stakeholders (Noe et al. 2008: 4). Data from the Global Competitiveness Index¹⁰ was used to measure this variable.

2 <http://www.shanghairanking.com>.

3 <http://www.worldbank.org>.

4 <http://www.nobelprize.org>.

5 <http://www.scimagojr.com>.

6 <http://www.worldbank.org>.

7 <https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018>.

8 <http://info.worldbank.org/governance/wgi/#home>.

9 <http://www.freedomhouse.org>.

10 <https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018>.

Social cohesion is “the capacity of a society to ensure the well-being of all its members, minimizing disparities and avoiding marginalization.” (Council of Europe 2008). For measuring this index, social capital data, ethnic tensions and internal conflicts of countries were used.¹¹ Factor analysis showed that all components have a high measurement power by placing in a high load factor, an Eigenvalue of 1.87 and an explanation of variance of 62.53.

Universalism means the application of generalized norms, values or concepts to all people and cultures, without regard to the contexts in which they are located (Kohfeldt and Grabe 2014). Universalism was measured by the level of tolerance for racial, ethnic, and language diversity.¹² The findings of the factor analysis showed that all components have a high measurement power by placing in a high load factor, an Eigenvalue of 2.88 and an explanation of variance of 96.04. Cronbach’s alpha coefficient of universalism was 0.98.

Generally, *equality of opportunity* refers to people having equal access to opportunities such as education and work. Data from Human Development Reports¹³ in three dimensions of health, education and living standards were used to measure the equality of opportunity.

Fatalism is “the degree to which an individual perceives a lack of ability to control his or her future” (Rogers 2003; 273). A degree of freedom choice and attitude towards predestined fate were used to measure fatalism.¹⁴ These two variables correlated above 0.80.

Bureaucratic quality reflects “the strength, expertise, autonomy and recruitment and training mechanism of the civil service” (Kyriacou and Sagalés 2008: 11). The quality of organizational bureaucracy¹⁵ was used to measuring bureaucratic quality. The range of the data was from 1 to 4. The larger number represents the quality of the bureaucracy, and the smaller number represents the absence of bureaucracy quality.

Academic autonomy is defined as the “ability of the institution to develop its own rules, regulations, and values without the interference of the state, and thus to be unencumbered by external political and economic pressures that could impede academic progress.” (Osakwe et al. 2015). Data from the Encyclopedia of higher education (Ghorchian, Arasteh, and Jafary 2004) was used to measure academic autonomy.

Table 3 and 4 show the descriptive statistics, membership, non-membership, and cut points of the condition and outcome variables.

11 <http://www.prsgroup.com>.

12 <http://www.worldvaluessurvey.org/WVSContents.jsp>.

13 <http://hdr.undp.org/en>.

14 <http://www.worldvaluessurvey.org/WVSContents.jsp>.

15 <http://www.prsgroup.com>.

TABLE 3 Descriptive statistics of variables

Variables	Minimum	Maximum	Mean	Standard deviation
Scientific Efficiency	0	100	39.91	30.03
Educational Equality	0	100	7.52	15.88
Productive economy	0	100	19.79	23.47
Inter-society competitiveness	3.06	5.43	4.27	0.634
Rule of law	-1.83	1.95	-0.193	0.957
Democracy	14.29	100	39.51	26.88
Organizational competitiveness	2.47	5.66	4.06	0.905
Social cohesion	0	100	58.88	23.37
Universalism	1	83.45	9.08	13.62
Equality of opportunity	1	2.86	1.56	0.496
Fatalism	0	100	28.49	23.98
Bureaucratic quality	0	4	2.10	10.2
Academic autonomy	0	1	0.67	0.49

TABLE 4 Membership, non-membership and cut points of the condition and outcome variables

Variables	Full membership	Cut point	Not full membership
Scientific Efficiency	90	50	2
Educational Equality	90	20	1
Productive Economy	80	30	2
Inter-Society Competitiveness	5.4	4.5	3.5
Rule of Law	1.8	0.3	-1.50
Democracy	95	50	15
Organizational Competitiveness	5.6	4	2.6
Social cohesion	95	60	20
Universalism	40	8	2
Equality of Opportunity	2.8	2	1.1
Fatalism	100	32	5
Bureaucratic quality	4	3	1
Academic autonomy	1	-	0

4 Results

Table 5 reflects the data related to causal conditions and the results of the study separately for each country. As shown in Table 5, among the selected cases, six countries had equality in access to higher education, but from this number of countries, three countries had equality and efficiency concurrently. These cases include the United Kingdom, the United States, and Japan. Meanwhile, the three countries that had only equality in access to higher education and lacked efficiency were Poland, Russia, and Argentina. Apart from these six cases, in the other three countries, namely, Bangladesh, Nigeria, and Ethiopia, none of the two values (equality and efficiency) were present.

TABLE 5 Values of countries regarding data related to conditional and outcome variables

Cases	Causal conditions											Results	Balance	
	Productive economy (E)	Universalism (U)	Fatalism (T)	Democracy (P)	Social cohesion (S)	Rule of law (L)	Inter-society competitiveness (M)	Academic autonomy (A)	Bureaucratic quality (B)	Organizational competitiveness (H)	Equality of opportunity (O)	Efficiency (F)	Equality (Q)	Combination of equality and efficiency (EQ)
UK	1	1	0	1	1	1	1	1	1	1	1	1	1	1
U.S.A.	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Japan	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Argentina	0	1	0	1	0	0	0	1	0	0	1	0	1	0
Poland	0	1	1	1	1	0	0	1	0	1	1	0	1	0
Russia	0	1	1	0	0	0	0	0	0	0	1	0	1	0
Ethiopia	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Nigeria	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Bangladesh	0	0	1	0	0	0	0	0	0	0	0	0	0	0

As indicated in Table 5, in the United States, the United Kingdom, and Japan, all conditions were present except for the fatalism. Therefore, these countries were benefited from both equality and efficiency concurrently. Conversely, in Ethiopia, Nigeria and Bangladesh none of the mentioned causal conditions was present, except the fatalism that is a negative condition. As a consequence, there was neither equality nor efficiency in these countries. In Russia, except for fatalism that is a negative condition for the realization of academic efficiency, only the conditions of universalism and egalitarianism were present. Hence, these conditions provided the only setting for the realization of equality in this country. Moreover, in Argentina, only the conditions of universalism, democracy, academic autonomy, and egalitarianism were present, and these conditions alone could not provide the necessary setting for the concurrency of equality and efficiency. Poland has most of the mentioned conditions in all positive cases (the United States, Japan, and the United Kingdom), but it lacked some of the basic conditions, such as the productive economy, the rule of law, inter-societies competitiveness and organizational competitiveness. Therefore, Poland also benefited from equality even though it had a low level of efficiency. As mentioned, all the positive conditions were present only in positive cases without any negative condition (fatalism). That is why both equality and efficiency have taken place in these countries concurrently.

In order to simplify the explanation and avoid complexity, we started with simple models. At first, we mentioned to the conditions causing equality in higher education and the conditions in equal countries (the United States, England, Japan, Argentina, Russia, and Poland) that unequal countries lacked it. Then, among the equal countries delineated in Table 1, it was indicated that what was the difference between equal and efficient countries (United States, England, and Japan) in equal conditions with equal countries (including Argentina, Russia, and Poland) with a moderate level of efficiency? Consequently, the causal conditions and the possible combination of these conditions of equality that might lead to different results were identified based on the empirical evidence, then the explanation of efficiency and the combinational causal conditions were discussed. The following table illustrates the combinational causal conditions of equality in access to higher education.

As can be seen in Table 6, in three observations (England, the United States, and Japan), all variables of a productive economy, the rule of law, egalitarianism, democracy, and universalism were present in the causal conditions, and they were countries that could have both values concurrently. In the other two countries, Poland and Argentina (countries with high equality and moderate efficiency), there were three conditions of universalism, democracy, and

TABLE 6 Combinational causal conditions of equality of higher education

Output code of equality	The number of cases of equality	The number of observed cases	Causal combinations*	Causal conditions				
				Universalism (U)	Democracy (P)	Equality of opportunity (O)	Rule of law (L)	Productive economy (E)
1	3	3	UPOLE	1	1	1	1	1
1	2	2	UPOle	1	1	1	0	0
1	1	1	UpOle	1	0	1	0	0
-	0	3	upole	0	0	0	0	0

* In the Boolean analysis, the presence of a causal condition is indicated by a capital letter (e.g., B) and its absence with a small letter (e.g., b).

egalitarianism, and in another case (Russia) there were only two conditions of universalism and egalitarianism. Among the unequal and inefficient countries, none of the mentioned causal conditions was present in all three cases (Bangladesh, Ethiopia, and Nigeria). Comparing the efficient and equal countries to the countries with moderate efficiency, the presence of the conditions of the productive economy and the rule of law was a way of distinguishing them from one another, and perhaps these conditions led to the concurrency of equality and efficiency of higher education in positive cases. This distinction was more significant in comparing equal and efficient countries with unequal and inefficient countries, where none of the conditions were present, and its result expressed in the absence of equality and efficiency. Hence, based on the presence of at least one empirical evidence in the equality result, the Boolean equation of analyzed societies can be written as follows:

$$Q = UPOLE + UPOle + UpOle$$

By using the minimization rule, these combinations can be reduced to smaller combinations as follows:

$$\text{Combination of UPOLE with UPOle} = UPO$$

$$\text{Combination of UPOLE with UpOle} = UO$$

From the combination of these minimizations, the equation of equality of higher education will be as follows:

$$Q = UO + UPO \rightarrow Q = UO (P)$$

In the interpretation of the Boolean equation, it can be said that the equality causal conditions in access to higher education were the combination of universalism (U) with egalitarianism (O) or the combination of these variables with democracy (P). Therefore, it can be assumed that in each of the nine countries, that universalism combined with egalitarianism or these variables combined with democracy led to equality of education in each country. Nevertheless, this kind of equality had not necessarily been accompanied with efficiency, because among equal and efficient countries (England, Japan and the United States) all the equal conditions of equality, egalitarianism, democracy, the rule of law and productive economy had been present and the mentioned equation was a condition of equality, not an equality accompanied by efficiency. The empirical evidence of this equation was Argentina, Russia, and Poland. Due to the absence of these conditions in Ethiopia, Bangladesh, and Nigeria, there was no equality in their higher education. After the causal conditions of educational equality were determined, the combination of these conditions should be taken into account as well that were related to the absence of the consequence (educational inequality). To this end, the De Morgan's laws (the inverse equation) was used and based on that the above equation obtained. According to De Morgan's Law, the above equation will come up as follows:

$$q = (u + o) \times (u + p + o) = u + up + uo + op + o$$

Based on this equation, educational inequality might be high in societies that are lacking these conditions: egalitarianism; universalism and political development concurrently; universalism and egalitarianism; political development and egalitarianism; and egalitarianism. The empirical evidence of this equation is Bangladesh, Ethiopia, and Nigeria.

In the equation of Q, the main purpose was to explain the causal conditions related to the presence of equality. As stated, our main aim was to explain how equality and efficiency are concurrently present in higher education. The result of the study obtained from only three cases out of six cases that were empirical evidence of equality. In the equation of equality without efficiency that represented Russia, Poland, and Argentina, the combination of universalism with egalitarianism, or the combination of these two variables with

democracy, were the causal conditions of equality. But, the result has shown that the combination of these conditions merely cannot bring about equality with efficiency, and the causal conditions of the productive economy and the rule of law must be present in the equation. Therefore, a kind of equality is likely to cause efficiency if all of these five variables are present in the causal and configurational condition because, in the empirical evidence of the efficient countries, all of these variables were present as the causal conditions of equality. According to the De Morgan's laws, it can also be stated that the absence of the rule of law and the productive economy in the combination of the causal conditions of equality leads to equality but not the efficiency. Moreover, the absence of egalitarianism, universalism, and democracy may lead to inequality.

It is evident that the mere presence of the causal conditions of egalitarianism with universalism, or the combination of these conditions with democracy in Russia, Poland, and Argentina, has not led to the concurrency of equality and efficiency. Also, the causal combination of POLUE represents in causal conditions of equality in the United States, England, and Japan. Besides, the result of the equality originated from this causal combination has been prerequisite for efficiency and has been able to create a balance between these two values and the important goal of higher education.

To calculate the Boolean equation for efficiency, due to the complexity of compound combinations, it was attempted to analyze the conditions of efficiency independently on both macro and institutional levels and merge them eventually. At the institutional level, all the conditions of meritocracy, academic autonomy, and organizational competitiveness were present in efficient and equal countries and one or all of them were absent in the other inefficient countries. Poland has met the required conditions of organizational competitiveness and academic autonomy, and Argentina was benefited from the only condition of academic autonomy, while in Russia and other countries (Ethiopia, Bangladesh, and Nigeria) none of the above conditions were present.

Based on the data in Table 7, the Boolean equation of academic efficiency in the institutional level is as follows:

$$F = HBA$$

Based on the results at the institutional level, academic efficiency is achieved in the presence of specific conditions such as academic autonomy (A), meritocracy (B), and organizational competitiveness (H). Because all of the efficient cases have benefited from mentioned conditions. Consequently, as the

TABLE 7 Causal conditions of efficiency and combination of variables based on empirical cases

Output code of equality	The number of cases of equality	The number of observed cases	Causal combinations	Causal conditions									
				Organizational competitiveness (H)	Bureaucratic quality (B)	Academic autonomy (A)	Inter-society competitiveness (M)	Rule of law (L)	Social cohesion (S)	Democracy (P)	Fatalism (T)	Universalism (U)	Productive economy (E)
1	3	3	HBAMLSPtUE	1	1	1	1	1	1	1	0	1	1
-	0	1	hbamlsPtUe	0	0	0	0	0	0	1	0	1	0
-	0	1	hbAmlsPtUe	0	0	1	0	0	0	1	0	1	0
-	0	1	HbAmlSPTUe	1	0	1	0	0	1	1	1	1	0
-	0	3	hbamlsptue	0	0	0	0	0	0	0	1	0	0

Boolean equation and De Morgan’s laws indicated that at the institutional level, in the absence of these variables, a high level of academic efficiency is not predictable.

$$f = h + b + a$$

Therefore, to interpret the above equation, it can be argued that if there is no one of the conditions of organizational competitiveness or meritocracy or academic autonomy at the institutional level, the academic efficiency of higher education is not expectable.

At the macro level, it can be concluded that the following combination was present in all the equal and efficient countries (England, the United States, and Japan), while it was absent in the equal countries with the moderate level of efficiency and the countries without equality and efficiency:

$$F = MLSPtUE$$

De Morgan's laws:

$$f = (m + l + s + p + T + u + e)$$

In other words, the efficient countries have been benefited from the productive economy (E), a favorable status regarding the rule of law (L), inter-societies competitiveness (M), social cohesion (S), democracy (P), and universalism (U). In contrast, these countries have a low degree of fatalism (t), and this combination has been present in all three countries. Based on the result, the combination of the causal conditions at meso and structural levels, the equation of academic efficiency will be as follows:

$$F = \text{MLSptUE} + \text{HBA}$$

With the aim to interpret these equations, it can be claimed that the prerequisite of the academic efficiency is the combination of causal conditions including the productive economy, the rule of law, inter-societies competitiveness, social cohesion, democracy, universalism, and the absence of fatalism at the macro level, whereas the presence of meritocracy, academic autonomy, and competitiveness at the meso level. Among the selected cases, wherever the aforementioned conditions were present in the configurational causation, also the efficiency was present. As specified in the equation of De Morgan's laws, the absence of any of these conditions may lead to the academic and scientific underdevelopment.

According to the results, it can be suggested that the prerequisite of equality and academic efficiency in higher education is the combination of causal conditions including the productive economy, the rule of law, inter-societies competitiveness, social cohesion, democracy, universalism and the absence of fatalism at the macro level. As such, at the meso level, the presence of meritocracy, academic autonomy and competitiveness may lead to quality and academic efficiency in higher education. Among the selected cases, wherever the aforementioned condition was present in the configurational causation, equality and efficiency were present as well. Table 8 indicates that the UO (P) equation is a single causal condition of equality, the $\text{MLSptUE} + \text{HBA}$ equation is causal conditions of efficiency, and $\text{PLUEMOS}t + \text{HBA}$ equation is the causal conditions for concurrency of equality and efficiency in higher education. Therefore, the UO (P) equation may not realize the concurrent presence of academic equality and efficiency.

TABLE 8 The causal combinations of equality and efficiency in a single and a balanced way

Efficiency and its empirical cases	Equality conditions	Efficiency conditions	
		Macro	Meso
Single (Poland, Russia, Argentina)	UO(P)		
Balanced (USA, UK, Japan)	POLUE	MLSPtUE ↓ PLUEMOST	HBA ↓ +HBA

5 Conclusion

Generally, to realize both values of equality and efficiency in higher education, a set of conditions must be present in the causal and configurational causality. The equality and academic efficiency in higher education will have concurrent only through the combination of causal conditions including the productive economy, the rule of law, inter-societies competitiveness, social cohesion, democracy, universalism and the absence of fatalism at the macro level. As such, at the meso level, the conditions of meritocracy, academic autonomy, and organizational competitiveness may provide the setting for the concurrent presence of equality and academic efficiency in higher education. The set of positive cases (US, UK, and Japan) are empirical evidence of this interpretation. All of these conditions were present in these countries. Hence both values of equality and efficiency were present (Appendix 1).

All in all, the findings indicated that the prediction of the theory (Three-level conceptual model of sustainable production of science) is correct in three positive cases that are the countries with the presence of all causal conditions and therefore the findings are consistent with prediction. Therefore, the findings were in line with a theoretical prediction (i.e., actual replication) and the predicted causal conditions were not present in the negative cases (Nigeria, Bangladesh, and Ethiopia) (i.e., theoretical replication). All variables related to the predicted assumptions were present or absent and through a predictable combination paved the way for academic equality and efficiency. Among the nine selected countries, there were no cases found in which the causal and

configurational conditions were absent, but the conditions for equality and efficiency were present.

The final equation related to the realization of both values includes all the above conditions in the theory of research. However, the important finding of the study is that in the absence of four conditions including productive economy, the rule of law, inter-societies competitiveness and meritocracy in higher education and the presence of fatalism, there will be no concurrent between equality and academic efficiency. The evident example of this claim is Poland in which academic efficiency was not as achievable as expected and was below the average despite having all the conditions other than the mentioned conditions and having access to equality in higher education (See Appendix 1). Therefore, the presence of universalism, democracy, social cohesion, academic autonomy, organizational competitiveness, and egalitarianism in this country could not be brought about equality accompanied by academic efficiency. In Argentina, the presence of the conditions related to universalism, democracy, academic autonomy, egalitarianism, and the absence of fatalism could not make a balance between the two values, because important variables such as the productive economy, social cohesion, the rule of law, inter-societies competitiveness, meritocracy, and organizational competitiveness were absent. On the other hand, in Russia, only two conditions of universalism and egalitarianism, as well as fatalism, were present, and most of the main positive conditions were absent.

Therefore, in order to confirm the reliability of the findings, it is worth noting that Russia, Poland, and Argentina have achieved high equality and relative efficiency due to the presence of certain theoretical conditions. Whereas, in positive cases, the maximum level of equality and efficacy have been associated with the severity of the presence of causal conditions. Thus, all of the conditions were present in cases with a maximum level of equality and efficiency. In the negative cases, all the causal conditions were absent and in some cases with a high degree of equality, and a moderate and low efficiency (e.g., Poland, Russia, and Argentina) some conditions were present and some were not.

The most important theoretical achievement of this research is that confirming the theory in a limited number of cases provides the opportunity to generalize the findings analytically and cautiously to the same cases. Furthermore, it can be argued that the theory of research in relation to empirical evidence has higher potential. Hence, by expanding the findings of this research in line with the theory of research, this theory will bring about high reliability due to the consistency with external examples. Consequently, the findings may approve the theoretical reliability of the research and its analytic generalizability at least for the same cases.

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Appendix

TABLE A1 Results data (scientific efficiency and equality)

Countries	Efficiency	Equality	Countries	Efficiency	Equality
France	19.42	57.07	Australia	15.7	15.7
England	31.49	57.72	Turkey	3.98	3.98
Italy	13.89	57.08	Ukraine	2.59	2.59
Spain	12.2	74.73	Russia	9.38	9.38
America	100	92.4	Peru	0.86	0.86
Canada	19.61	69.35	Venezuela	0.49	0.49
Japan	22.18	55.81	Ghana	0.11	0.11
Mexico	2.11	32.01	Philippines	0.21	0.21
South Africa	3.72	21.57	Tanzania	0.11	0.11
Argentina	2.75	87.93	Iran	3.68	3.68
South Korea	15.05	100	Iraq	0.7	0.7
Poland	6	71.8	Malaysia	4.36	4.36
Brazil	5.36	-	Ethiopia	0.14	0.14
Nigeria	0.31	9.17	Germany	26.6	26.6
India	7.24	25.77	Kenya	0.49	0.49
Romania	2.59	53.67	Uzbekistan	0.77	0.77
Pakistan	0.89	9.03	Cameron	0.06	0.06
China	33.37	27.98	Sudan	0.06	0.06
Thailand	1.17	51.26	Syria	0.05	0.05
Bangladesh	0.65	12.79	Yemen	0.05	0.05
Indonesia	0.43	31.84	Afghanistan	0	0
Vietnam	0.35	26.61	Madagascar	0.06	0.06
Columbia	0.66	54.39	Mozambique	0.04	0.04
Uganda	0.08	1.88	North Korea	-	-
Sri Lanka	0.21	17.16	Saudi Arabia	-	-
Egypt	2.04	35.41	Morocco	1.77	1.77