ORIGINAL ARTICLE

Infrastructure equity issues of airports and universities across regional states in Ethiopia: A preliminary overview

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ABSTRACT

The purpose of this article is to determine the equitability of airport and university allocations throughout Ethiopian regional states based on the number of airports and institutions per 1 million people. According to the sample, the majority of respondents believed that university allocation in Ethiopia is equitable. In contrast, the majority of respondents who were asked about airports stated that there is an uneven distribution of airports across Ethiopia's regional states. Hence, both interviewees and focus group discussants stated that there is a lack of equitable distribution of universities and airports across Ethiopia's regional states. This paper contributes a lesson on how to create a comprehensive set of determining factors for equitable infrastructure allocation. It also provides a methodological improvement for assessing infrastructure equity and other broader implications across Ethiopian regional states.

Keywords: airport; university; principal component analysis; normalization; formula; Ethiopian regional states; Ethiopia

1. Introduction

Ethiopia is a multicultural and multilingual country found in the Horn of Africa with about 112.1 million people. The country is divided into nine regions (Oromia, Amhara, SNNP, Tigray, Somali, Benshangul-Gumuz, Afar, Gambela and Harari) and two administrative cities (Addis Ababa and Dire Dawa). The purpose of this paper is to investigate the equitable allocation of airports and universities in Ethiopia and to give the readers new information about the issue. The emphasis is basically on the range of equity policies devised and the level of alignment among the several tools chosen to implement these policies.

This study contains theoretical and methodological advances that have far-reaching implications. This paper's contribution begins with the development of comprehensive determining criteria for infrastructure equity. Furthermore, the paper's importance lies in providing a methodological improvement to the previously problematic subject of how to analyze infrastructure equity and other broader implications across Ethiopia's regional states.

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Section 2, which presents the literature review, overviews the airport and university infrastructure equity in Ethiopia. Section 3 describes the data and methodology. Section 4 presents the results and discussions. Section 5 indicates policy implications. Finally, section 6 states the conclusion and future prospects, where the paper indicates policy implications and the scope for further studies.

2.   Literature review

Equity theory (also called justice or fairness) denotes the distribution of effects (benefits and costs) and whether that distribution is considered fair and right (Adams, 1963; Ferreira and Walton, 2005; Litman, 2021). However, it is an abstract concept; for example, a specific decision may seem equitable when evaluated one way but inequitable when evaluated another way (Son, 2013). However, equity analysis is significant and inevitable (Litman, 2021). This is because policies for spatially balanced growth are often justified by equity (Scott, 2009). An improved equity analysis in planning can reduce conflicts and delays and can better reflect a community's needs and values (Litman, 2021). Actually, leading scholars and practitioners now recommend increased spending on infrastructure to stimulate balanced growth and reduce income gaps, especially between the upper and lower deciles; this should occur not only during declines but also when economies are increasing (Peters and Pintus, 2018). In other ways, in terms of implications for policy-makers in governments and national organizations, Anderson and O'Neil (2006) have identified the need to be committed to the values of equality (equal privileges and prospects) and cohesion (equity and social impartiality). Based on this theoretical framework, it is necessary to assess the equitability of airport and university infrastructure allocations in Ethiopia, as it is becoming one of the issues for the nation-building process (Anderson and O'Neil, 2006). Hence, an overview of airport equity and university equity are reviewed as follows.

2.1.   An overview of airport infrastructure equity in Ethiopia

In the context of increasing globalization of trade, rising international flows of goods and people and the resulting global rise in air traffic, international airports have become strategic assets for the development and attractiveness of nations (Weber, 2021). What is true at the national level is also true at the more local scale of the areas surrounding an international airport, where their own urban, demographic, social, economic and environmental developments are closely linked to the presence of such major equipment (Weber, 2021). In simple terms, air connectivity is about making travel as easy and affordable as possible, given the geographical separation involved. However, defining and measuring air connectivity is challenging (Egeland and Smale, 2017). Thus, collaborative decision-making is crucial to this. This is because the current synergy between airports and urban development, which includes infrastructure development, is governed by stand-alone policies, which makes joint oversight activities difficult at the local and national levels (Weber, 2021). Generally, airport capital development requirements are driven by current and forecasted traffic, use and age of facilities, as well as altering aircraft technology, due to which airports need to substitute equipment and infrastructure (Atkinson, 2020; Zhang et al., 2018).

According to Zhang et al. (2018), to encounter the demand for air transportation in the United States of America, airports and the national airport system should be, for example, wide to provide as many people as possible with appropriate access to air transportation, usually by having most of the population within 20 miles of a National System Planning (NPIAS) airport. Moreover, the

central government of India, for example, informs on the policy for Greenfield airports from time to time. Thus, airports shall be kept in view by the delegated body while granting a license; for example, no Greenfield airports would be allowed within an aerial distance of 150 km of an existing civilian airport (Ministry of Civil Aviation of India, 2008, unpublished). Furthermore, airport planning is a systematic process used to create guidelines for the efficient development of airports that is related to national, state and local goals (Atkinson, 2020; Zhang et al., 2018).

Generally, Africa's air transport sector is the least developed but one of the fastest-growing in the world, as it currently only represents 4.5% of the world's aviation (Shelly, 2016). A key factor determining the level and the future growth of continental air traffic in Africa is the extent of airline market liberalization (Shelly, 2016). Although under the Yamoussoukro Decision, 44 African signatory states are required to allow free market access in terms of airline seat capacity, service frequency and tariffs to all registered African airlines, restrictions still apply in too many circumstances (Shelly, 2016). As a result, route networks are often undeveloped and there is a lack of market competition, leading to high fares. Moreover, it is not possible to find a clear policy for airport allocation in African countries, unlike in India and the USA. However, population demography can be one of the criteria for the establishment of a new airport in a region within the country (Atkinson, 2020; Zhang et al., 2018).

By citing Africa Infrastructure Country Diagnostic, Deloitte and Touche (2014) explained that, in recent years, Ethiopia has made important developments in infrastructure, and its infrastructure indicators relate relatively well with low-income country peers (Deloitte and Touche, 2014). The country has established Ethiopia Airlines (now one of the three foremost African airlines) and allied with regional air transport hubs. However, if somebody were to ask what the principles and guidelines are to establish an airport in a region in Ethiopia, there are no written guidelines on how to establish new airports and to ensure the equitability of airport allocation across the regions in Ethiopia (Ethiopian Airport Enterprise, 2018, unpublished). Following this, an overview of university infrastructure equity is discussed.

2.2.   An overview of university infrastructure equity in Ethiopia

Education has long been recognized as a basic human right. It is a critically important requisite for the productivity and well-being of individuals, the social and economic growth of entire societies, and the nation-building process (Chotia and Rao, 2015). Thus, citizens can only become capable, both knowledge-wise and skill-wise, through education, and thus education gives to the development of the economy (Chotia and Rao, 2015). Because of this, the importance of equal access to education has been emphasized repeatedly in international conventions. With the agreement on Sustainable Development Goals (SDGs) and the Education 2030 Framework for Action in 2015, equity has been engaged at the heart of the global development agenda for the first time (Alcott et al., 2018). In the field of education, the fourth Sustainable Development Goal calls on all UN Member States to ensure equitable and inclusive quality education and endorse lifelong learning opportunities for all (Alcott et al., 2018). However, it is increasingly recognized that learning levels in many countries are highly unequal (Alcott et al., 2018). Available data have also shown that participation in higher education continues to be unequal from the social background perspective (Salmi, 2019).

According to Salmi (2019), research produced by United Nations Educational, Scientific and

Cultural Organization (UNESCO) in 2016, looking across 76 mostly low-income countries, indicated that only 1 percent of the poorest 25–29-year-olds had accomplished at least four years of higher education, compared with 20 percent of the richest. Therefore, addressing these inequalities will require a sustained policy commitment at the national, regional and global levels. However, there is limited information available in the present state of policy focus on these equity aspects (Salmi, 2019). Moreover, policy commitment varies considerably across countries. Salmi (2019) also stated that:

> *A number of countries are still paying only lip service to the equity agenda, in the sense that they do not spell out clear equity promotion strategies, define concrete targets to enroll and support students in vulnerable conditions, mobilize sufficient resources targeted to underrepresented groups, and put in place actions to help students complete their degrees. (p. 4)*

It was also stated that it would be hard to find a Ministry of Higher Education anywhere on the planet that said that it did not care about equity (Salmi, 2019). Practically, allocation decisions for building new universities, though not documented, seem to be transparent and are determined by four main criteria, which are accessibility of the campus, local needs, research potential and spill-over effects in Ethiopia. Although equity is not included as one of the four criteria, there have been efforts to build universities in regions where none existed before (Harris et al., 2019, unpublished). On the other hand, the most important problem faced by the system of higher education in India is the persistence of inequalities for access to higher education (Tilak, 2015). In other ways, a crucial indicator giving information about the frequency and number of educational institutes in a particular state was used in India (Chotia and Rao, 2015). Thus, a study on access to education worldwide showed that expansion means greater inclusiveness—essentially, more young people and those from less advantaged backgrounds attend higher education (Buckner, 2013).

Furthermore, the establishment of higher educational institutions is in pursuit of meeting the global requirements of producing manpower that will serve in different capacities and contribute positively to a nation's socio-economic and political development, for example, in Nigeria (Iruonagbe et al., 2015). However, there are enormous problems facing the education system in Nigeria. In other cases, at a countrywide level, for example in South Africa, the new institutions must advance the national goals for higher education, particularly enrolment growth and augmented contribution in absolute numbers and in proportion to the population demographic of the country, as well as the growth in teaching and academic capability, in order to support a sustained national development (Pouris and Inglesi-Lotz, 2014). In addition, the status and feasibility of the new institution would be improved by a town that is host to significant government institutions, research institutes and other public entities (Pouris and Inglesi-Lotz, 2014).

Generally, education is the mechanism that energizes the growth and development of a nation. Some developing countries, especially in Asia, have been able to transform their economies and their people. Nations such as Japan, Korea, India and China did not necessarily wait for the transfer of technology—as detected in most African countries, such as Nigeria and Ethiopia—but were dedicated to a system where they fabricated copied and adapted foreign technology through an inward-looking strategy to meet their own cultures, environments and needs (Iruonagbe et al., 2015). This is where countries failed to understand that education must be pragmatic in nature if

it is to create any meaningful effect on the lives and living conditions of the people (Iruonagbe et al., 2015). Indeed, expansion without equity benefited the initial years of massification in Egypt. In observing Egypt's higher education policies since independence, Buckner (2013) and Cupito and Langsten (2011) found that Egypt's long-standing policies to enlarge and democratize access to universities have not balanced the opportunity for Egyptians from lower-class backgrounds. These all could show that the Ethiopian government could learn from the above international and African experiences (Buckner, 2013; Cupito and Langsten, 2011).

Historically, the introduction of higher education in Ethiopia began in the mid-1960s. However, it is only in the previous two decades, due to the government's and development partners' commitment to prioritizing the sub-sector, that access to higher education has been unlocked to the broader population (Ministry of Education (MoE), 2015, unpublished; Bishaw and Melesse, 2017). Moreover, the contemporary higher education in Ethiopia has a short history of slightly over six decades. Over the past two decades, there have been incredible reforms that aimed at increasing and updating the higher education sub-sector so that it would make significant contributions to the country's development (Bishaw and Melesse, 2017; Semela, 2011; Woldegiyorgis, 2015). The constitution of Ethiopia (1995) Article 90's Sub-Articles 1 and 2 on social objectives read that "to the extent the country's resources permit, policies shall aim to provide all Ethiopians access to public health and education, clean water, housing, food and social security, and education shall be provided in a manner that is free from any religious influence, political partisanship or cultural prejudices." More specifically, the Ethiopian constitution strongly supports the idea of equity to ensure fairness and bring social justice and harmony (MoE, 2018, unpublished). Henceforth, social inclusion and guaranteeing a reasonable distribution of educational opportunities across regional states, ethnic groups and other emerging regions of the Ethiopian society are the basic political priorities (Semela, 2011). At the center of the political discourse, social inclusion takes a fundamental place with respect to assuring the constitutional rights of nations and nationalities (Semela, 2011). In addition, the Higher Education Proclamation 351/2003 indicates that one of the objectives of higher education is to deliver an equitable distribution of higher education institutions (Bishaw and Melesse, 2017).

However, there are no documents that explain the equitable distribution of higher education institutions (HEIs). But, women and those from emerging regions are given special emphasis through affirmative action (Bishaw and Melesse, 2017). This is a good attempt in Ethiopian history of delivering equity in the Ethiopian higher education system. One of the other strategies to expand higher education and to provide regional equity in the distribution of resources for educational expansion is cost-sharing through graduate tax (Bishaw and Melesse, 2017). From the access and equity points of view, in the previous 10 years, the Ethiopian government has demonstrated continued commitment to expanding equitable access to quality and relevant higher education (Seid et al., 2016). Private higher education institutions have also extended, realizing 98 institutions in total, accommodating around 15 percent of all student enrolment by the end of the Ethiopian Education Sector Development Program IV (ESDP IV) period (MoE, 2015, unpublished).

Moreover, a large scale of expansion is possibly one of the typical features of education in Ethiopia at all levels in the previous two decades. In higher education, an extraordinary scale of expansion was started in the late 1990s and early 2000s (Bishaw and Melesse, 2017; Woldegiyorgis, 2015). Access and equity are the driving justifications for the ongoing expansion, which is also

considered as a strategic dimension in the Education Sector Development Program (ESDP) (Woldegiyorgis, 2015). Therefore, compared with two universities at the time of the transition period in May 1991, at present there are more than 50 public universities and around 170 private-owned institutions, including institutions deemed to be universities and university-level institutions (Ministry of Science and Higher Education (MoSHE), 2019, unpublished). As stated in the Proclamation 650/2009, the proclamation has become essential in establishing a legal system to allow institutions to impact institutional transformation (MoE, 2009, unpublished). Proclamation 650/2009 calls for a minimum enrollment capacity of 2,000 students in regular undergraduate and graduate programs in at least three academic units larger than departments, etc., and a new public institution may be established as a university or a university college on the basis of the decision by the Council of Ministers of Ethiopia, etc. (MoE, 2018, unpublished).

Furthermore, Woldegiyorgis (2015) identified that the Ethiopian higher education matches well with the views of those in early-stage developmental states, but with limitations of its own. This is mainly because the expansion seems to be led by the condition of ethnic politics, where the fair distribution of public HEIs and expanding access in all regions have influenced the pattern of the establishment of institutions. Thus, the numbers have been highly maintained and some HEIs have been established in remote areas where there are fewer facilities and it is very difficult to invite and retain qualified academic staff, which meaningfully compromise quality (Woldegiyorgis, 2015). Moreover, along with the national agency, institutional capacity building should be given priority to put in place equitable and effective institutional-quality-enhancement systems (Semela, 2011). Finally, international and regional experiences showed that new institutions must advance the national goals for higher education, particularly in proportion to the population demographic of the country. Therefore, what are the policies, standards and guidelines to establish universities in a region in Ethiopia? Population demography can mainly be one of the criteria for the establishment of new HEIs in a region within the country.

3. Data and methodology

3.1. Methodology

According to an empirical analysis, Yılmaz and Çetin (2018) claimed that infrastructure has positive and significant effects on growth. Therefore, many types of research with different approaches have been performed by many scholars to test the effects of infrastructure on income inequality (Yılmaz and Çetin, 2017). The first group of researchers used a single indicator as the infrastructure proxy. For example, Zhang and Fan (2002) used the indicator of road density to measure the impacts of infrastructure on inequality in India, whereas the second group of researchers used several indicators to proxy for infrastructure. For instance, Bajar and Rajeev (2015) used several sectors, such as roads, electricity, and telecommunication, as the proxies of infrastructure to investigate the inter-relationship between infrastructure and inequality in India. There is also the third group that used several indicators and construct indices to proxy for infrastructure to overcome the high correlation often found among various infrastructure indicators. Thus, this present study followed the approach used by Bajar and Rajeev (2015), Patra and Acharya (2011) and Calderón and Servén (2004, 2010, 2014) by constructing quantitative indices to measure the multi-dimensional concept of infrastructure as a methodology (Bajar and Rajeev, 2015; Calderón

and Servén, 2004, 2010, 2014; Patra and Acharya, 2011). Thus, using the theoretical framework that showed the relation between economic growth and infrastructure development provided in the literature to build infrastructure indices, Calderón and Servén (2004) followed Alesina and Perotti (1996) and Sanchez-Robles (1998) and applied the principal component analysis (PCA) to disaggregate infrastructure indicators; their synthetic indices were given by the first principal component of the underlying variables (Alesina and Perotti, 1996; Calderón and Servén, 2004; Sanchez-Robles, 1998).

Principal component analysis (PCA) works best when asset variables are interrelated, but also when the distribution of variable indicators varies across cases. It is the assets that are more inequitably distributed between regions that are given more weight in PCA. Therefore, as a first step, the study carried out descriptive analyses for all the indicator variables by looking at means, frequencies and standard deviations. Furthermore, descriptive analysis can inform decisions on which indicator variables to include in the analysis and highlight data management issues, such as coding of indicator variables and missing variables (Akanbi, 2013; Chakamera and Alagidede, 2018; Chotia and Rao, 2015; Vyas and Kumaranayake, 2006). In SPSS/STATA, when specifying PCA, the user is given the choice of deriving eigenvectors (weights) from either the correlation matrix or the covariance matrix of the data. Thus, PCA can be used for comparison across regions or settings, or over time, provided that the separate indices are calculated with the same variables (Akanbi, 2013; Chakamera and Alagidede, 2018; Vyas and Kumaranayake, 2006).

The debate about the use of PCA reflects the fact that principal components are artificially constructed indices. However, it is up to the user to bear in mind that PCA is best considered as a summary empirical method. Therefore, PCA has been used to aggregate infrastructure components, such as airport and university infrastructures (Chakamera and Alagidede, 2018; Chotia and Rao, 2015; Patra and Acharya, 2011). Hence, based on the above descriptions, to comprehend and gauge the trend and pattern of regional disparities between Ethiopian regional states in terms of infrastructure, the selected indicators (for the latest time period available) are listed below, which constitute the infrastructures of Ethiopian states. Indicators from the sub-sectors of university and airport infrastructures have been selected so as to give a comprehensive view of the infrastructures. The two infrastructures quantities enter the first principal component with almost similar weights (Makmuri, 2017). Actually, this study used physical stocks as measurements.

The survey took place between January and July 2019 in four Ethiopian regional states. Questionnaires were submitted directly to Oromia, Amhara, Tigray and Benshangul-Gumuz federal and regional agencies. Other data were obtained from the Ethiopian personnel of Addis Ababa-based foreign institutions, such as the World Bank and the United Nation Development Program (UNDP), in order to triangulate the findings. Multi-stage stratified random selection procedures were used to choose 1,037 samples from a total population of 2,688 infrastructure sector institutions in Ethiopia (Kothari, 2004). In total, 1,037 questionnaires were issued to the concerned respondents, with 947 of them being returned. There were 6 unengaged responses and 37 wrongly filled questionnaires among the returned responses. As a result, a total of 904 respondents completed the survey correctly.

Therefore, the study was able to reach its aim of higher officials (110, or 12.2%), middle-level management (246, or 27.2%) and experts (548, or 60.6%) in each of the seven institutions for a total of 904 (100%). A response rate of 80% had been set as the benchmark for evaluation (Fincham,

2008). Saldivar (2012) claimed that if a survey is conducted in person, an 80%–85% response rate is acceptable (Saldivar, 2012). Therefore, the sample size was sufficient for statistical analysis (Hair et al., 2016). According to these researchers' surveys, an acceptable response rate for the study was 87 percent.

Defining the sample size for the interviews was challenging. Creswell (1998) recommended a sample size of 5 to 25 people. Malterud et al. (2016) suggested that a purposive sample of 6 to 10 people with various experiences might give sufficient information power, as referenced from researchers' experiences. However, there are no precise guidelines to follow when conducting qualitative research. Because in-depth interviews in this study largely involved presenting the current issues of fairness in infrastructure development in Ethiopia and responses based on respondents' experiences, the sample size that was closest to the maximum sample size that the research intended was 23. A total of 10 federal institutions and 10 individuals were chosen for in-depth interviews.

There were also in-depth interviews with 13 individuals (from Oromia, Amhara, Tigray, and Benshangul-Gumuz) from four regional governments in four institutions (regional president office, road, electric, and telecommunication) for a total of 23 individuals (from Oromia, Amhara, Tigray, and Benshangul-Gumuz). Eighteen people (8 from federal and 10 from regional institutions) were interviewed out of the 23. Furthermore, the interviews were conducted in Amharic and transcribed in that language (the transcript writing included every idea enunciated but omitted unrelated content, unnecessary repetitions and mistakes). The interviews were taped and evaluated using content analysis tools in a methodical manner. The study's findings were based on an examination of the following data sources: in-depth interviews and a review of relevant documents. As a result, the transcription was converted into English. This study's qualitative questions are shown in the annex.

3.2. Data

In order to construct the aggregate index of infrastructure access, the study used data from two sub-sectors: airport and university.

A) Airport

Based on the population in each region and each administrative city and the number of airports per 1 million of population, the following results have been identified. The airport allocation or quota in the Oromia region is below the national average. Amhara and SNNP regions' allocations are equal to the national average, whereas the allocations in the Gambela, Dire Dawa, Benshangul-Gumuz, Tigray, Afar and Somali regions are above the national average.

The other point that needed to be considered was the distances in km between airports within a region, which were compared. Actually, in terms of distance in km between two airports within a region, there is a lack of clear standards in the new establishment of airports in Ethiopia across regions (Ethiopian Airport Enterprise, 2018, unpublished). Besides, the distance between airports in km also does not have similar patterns. Airport officials mentioned that airports should not be established within a 100 km radius. But, there are airports within 100 km in some regions, for example, between Axum and Shire (63 km). Airports are allocated arbitrarily across the regions in Ethiopia. From this, one can understand that long-term and short-term plans, clear principles, and policies, standards and guidelines with relation to national and regional development plans are

needed for the equitable allocation of airports among regions in Ethiopia.

In addition to the above overview of airport development, the paper also assessed the perceptions of infrastructure sector staff about airport distribution in Ethiopia. The question they were asked was whether there is no fair distribution of infrastructure development (e.g., airports) in Ethiopia. Thus, out of 904 respondents, 172 (19.03%) disagreed and 349 (38.60%) agreed. Out of 110 higher officials, 21 (19%) disagreed and 41 (37%) agreed. This shows that the majority of the respondents believed that there is no fair allocation of airports in Ethiopia (see **Table 1**).

Table 1. Job positions and responses of respondents

Response	Job position of respondents			Total
	Higher officials	**Middle-level management**	**Experts**	
Strongly disagree	7	12	22	41
Disagree	21	54	97	172
Undecided	12	37	77	126
Agree	41	88	220	349
Strongly agreed	29	55	132	216
Total	110	246	548	904

The same question of whether there is no fair distribution of infrastructure development (e.g., airports) in Ethiopia was asked to six staff members of Ethiopian Airport Enterprise. Out of the 6 respondents, 2 (33.33%) disagreed and 3 (50%) agreed. This shows that the majority of the respondents believed that there is no fair allocation of airports in Ethiopia (see **Table 2**).

Table 2. Responses of Ethiopian Airport Enterprise staff

Institution	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Ethiopian Airport Enterprise	0	2	0	3	1

In addition to the above, 89% of interviewees (16 out of 18 at federal and regional institutions) and all 4 focus group discussants (at 4 regional state capitals) believed that there is no equitable allocation of airports across the regions in Ethiopia.

B) University

Based on the population in each region and each administrative city and the number of universities per 1 million of population, the following results have been identified. The university distributions or quotas in the Oromia and Somali regions are below the national average. The Amhara and SNNP regions' university distributions are equal to the national average, whereas the distribution in the Gambela, Dire Dawa, Benshangul-Gumuz, Tigray and Afar regions are above the national average. But, candidates from all regions have equal entrance access to higher education, as university assignments are done at the national level. However, inequities in primary and secondary

education outcomes across regions might affect tertiary-level access. There is a lack of data on tertiary-level access by region of origin. But, differential entry requirements for emerging regions aimed to correct for this. In other ways, the larger regions have more universities, but the number of universities per 100,000 people is higher in smaller areas (Harris et al., 2019, unpublished). With respect to the allocation of universities, some regions indicate that Harari should have at least one university. However, Harari is served by universities in Oromia and Dire Dawa. No formal written guidelines are used by the Federal Democratic Republic of Ethiopia's (FDRE) Ministry of Science and Higher Education (MoSHE) in its allocation decisions, though the institution is able to verbally describe its processes. This shows that there are no clear standards and guidelines. Moreover, the guidelines used for allocating expenditure by the MoSHE ought to be documented and extensively distributed across the government, parliament and civil society to enhance transparency in higher education spending (Harris et al., 2019, unpublished).

Moreover, the distance in km between universities in a region has been considered in Ethiopia. Although one official from the Ministry of Science and Higher Education had mentioned that there has been a decision that there should be a 100 km distance between two universities as a criterion, there are universities within 100 km of a region, for example, between Adama and Arsi (75 km) in the Oromia region and between Hawassa and Dela (86 km) and between Wachemo and Woraba (54 km) in the SNNP region. As there might be political purposes, such as identity recognition or other economic and social purposes, having universities within 100 km is good, as the country needs more universities. However, the question is whether these universities are doing differently, for example, in course allocation, or duplicating the same issue. It has been assessed that there are no clear specialized courses given by these universities. They are not doing it differently; rather, they do have duplication of efforts. Thus, the state of institutional quality assurance is confirmed to be in a much weaker position to implement the provisions of Proclamation 650/2009 (Semela, 2011). Therefore, there are no clear principles, policies, standards and criteria for establishing new universities in a region in Ethiopia. From this, one can understand that Ethiopia needs long-term and short-term plans and clear principles, policies, standards and guidelines with relation to national and regional development plans in the distribution of universities among regions.

In addition to the above overview of higher education, the perceptions of infrastructure sector staff about university distribution in Ethiopia were also assessed. The question they were asked was whether there is no equitable distribution of educational infrastructure (e.g., universities) in Ethiopia. Out of 904 respondents, 300 (33.19%) disagreed and 255 (28.20%) agreed. Out of 110 respondents comprising higher officials, 43 (39.09%) disagreed and 26 (23.64%) agreed. This shows that the majority of the respondents believed that there is a fair distribution of universities in Ethiopia (see **Table 3**).

The same question of whether there is no equitable distribution of educational infrastructure (e.g., universities) in Ethiopia was asked to 13 staff members of the FDRE's Ministry of Science and Higher Education. Out of 13 respondents, 4 (30.77%) were undecided and 5 (38.46%) agreed. This shows that the majority of respondents believed that there is no fair distribution of universities in Ethiopia (see **Table 4**), as opposed to the results in **Table 3**.

Table 3. Job positions and responses of respondents

Response	Job position of respondents			Total	% age
	Higher officials	Middle-level management	Experts		
Strongly disagreed	12	28	53	93	10.29
Disagreed	43	94	163	300	33.19
Undecided	16	41	93	150	16.59
Agreed	26	55	174	255	28.20
Strongly agreed	13	28	65	106	11.73
Total	110	246	548	904	

Source: Survey

Table 4. Responses of FDRE's Ministry of Science and Higher Education staff

Institution	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
MoSHE	1	1	4	5	2

In addition to the above, 22% of interviewees (4 out of 18) and all 4 focus group discussants believed that there is no equitable distribution of universities across the regions in Ethiopia.

4. Results and discussion

This study analyzed nine regional states and one administrative city across Ethiopia in order to evaluate their levels. The study excluded Addis Ababa administrative city, as it has extreme values in infrastructure stocks. Hence, the study attempted to consider the number of airports per 1 million of population and the number of universities per 1 million of population. **Table 5** indicates the number of airports and universities per 1 million of population with normal values. In order to analyze Ethiopian regional states' disparities in terms of infrastructure, the nine regional states and one administrative city were classified based on the normalized distribution by adopting the following formula and PCA (Chotia and Rao, 2015).[1] To normalize the distribution, this study used the following formula, with a sample calculation:

$$NV_{ij} = 1 - \frac{\left(BestX_i - ObservedX_{ij}\right)}{\left(BestX_i - WorstX_i\right)}$$

where,

NV_{ij} = Normalized value corresponding to the Xth indicator, where i = corresponding state and j = corresponding indicator.

[1.] "In India, wide inter-state and intra-state disparities in economic and human development are posing questions about the authenticity of the growth process" (Chotia and Rao, 2015, p. 54). "Throughout this paper we have used principal component analysis to compute a composite infrastructure index (CII) for the 21 Indian states by combining individual indicators pertaining to the major sectors..." (Chotia and Rao, 2015, p. 67).

Best X$_i$ = Best/maximum value of Xth indicator, where i = number corresponding to the state (in this case, values of nine regions and one administrative city under the Xth indicator will become the i series).

Observed X$_{ij}$ = Observed/current value of Xth indicator, where i = corresponding state, j = corresponding indicator and *Worst X*$_i$ = worst/lowest value of Xth indicator. For instance:

$$NV_{ij} = 1 - \frac{(BestX_i - ObservedX_{ij})}{(BestX_i - WorstX_i)} \quad NV_{11} = 1 - \frac{(2.3 - 0.6)}{(2.3 - 0.0)} = 1 - \frac{1.7}{2.3} = 0.2609$$

Table 5. University and airport infrastructures' distribution by region

No.	Region	Number of airports per 1 million of population	Normality	Rank	Number of universities per 1 million of population	Normality	Rank
1	Afar	0.6	0.2609	4	0.6	0.2609	5
2	Amhara	0.2	0.0869	7	0.5	0.2174	6
3	Benishangul-Gumuz	0.9	0.3913	3	0.9	0.3913	3
4	Dire Dawa	2.1	0.9130	2	2.1	0.9130	2
5	Gambela	2.3	1.0000	1	2.3	1.0000	1
6	Harari	0.0	0.0000	10	0.0	0.0000	8
7	Oromia	0.1	0.0435	9	0.3	0.1304	7
8	SNNP	0.2	0.0840	8	0.5	0.2174	6
9	Somali	0.5	0.0870	6	0.3	0.1304	6
10	Tigray	0.8	0.2174	5	0.8	0.3478	4
	Country level	0.2	0.3478			0.3609	

Source: Based on Ethiopian Airport Enterprise and the Ministry of Science and Higher Education data and researcher's calculations

The variance-covariance matrix, eigenvalues and factor loadings of the normalized university and airport infrastructures' variables were calculated and illustrated below.

```
. factor Noofairport1000000pop NoofUnivetsity1000000pop ,pcf
(obs=10)

Factor analysis/correlation                    Number of obs    =         10
     Method: principal-component factors       Retained factors =          1
     Rotation: (unrotated)                      Number of params =          1
```

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.98762	1.97524	0.9938	0.9938
Factor2	0.01238	.	0.0062	1.0000

```
LR test: independent vs. saturated:  chi2(1)  =    31.49 Prob>chi2 = 0.0000
```

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Uniqueness
Noofairpor~p	0.9969	0.0062
NoofUnivet~p	0.9969	0.0062

As shown in the above procedure, the distribution was normalized. This helped to avoid the variation that can occur due to non-considered effects. Then, PCA was done. This is a systematic way of reducing a large set of factors in a narrowed manner without losing the generality. In the calculations, eigenvalue and eigenvector composition results were obtained. The eigenvalues show the total variance accounted for by all factors. The sum of all eigenvalues is equivalent to the total number of variables. When negative, the sum of all eigenvalues is equal to the total number of factors (variables) with positive eigenvalues.

In the distribution of airports, the regions were divided into sound and lagging regions according to their values in the normalized data. The sound regions, which are Gambela, Dire Dawa and Benishangul, have values higher than the average value (0.3478) of the normalized data, while the lagging regions which are Afar, Tigray, Somali, Amhara, SNNP, Oromia and Harari, have lower-than-average values. Similarly, in the distribution of universities, the regions were divided into sound and lagging regions according to their values in the normalized data. The sound regions, which are Gambela, Dire Dawa and Benishangul, have values higher than the average value (0.3609) of the normalized data, while the lagging regions, which are Tigray, Afar, SNNP, Amhara, Somali, Oromia and Harari, have lower-than-average values.

Analyzing the regions by the normalized data of airports from the result, anyone can observe the variations among them. Gambela has the distinction of being at the top of the list with an overall index score of 1.0000. Its score is 100 times the value of the region with the lowest value of the overall development index, which is Harari with an index score of 0.0000. The difference between these two extreme overall index scores is 1.0000. The mean normalized value for all regions is 0.3478 and the standard deviation is 0.3440. This is clear evidence of dispersions or disparities between regions with respect to the normalized data.

Analyzing the regions by the normalized data of universities from the result, anyone can observe the variations among them. Gambela has the distinction of being at the top of the list with an overall index score of 1.0000. Its score is 100 times the value of the region with the lowest value of the overall development index, which is Harari with an index score of 0.0000. The difference between these two extreme overall index scores is 1.0000. The mean normalized value for all regions is 0.3609

and the standard deviation is 0.3165. This is clear evidence of dispersions or disparities between regions with respect to the normalized data.

5.   Policy implications

The survey of national equity policies in airports and universities barely argued the surface of the problems and the challenges involved in seeking to increase opportunities for access to and achievement of these infrastructures. It only focused on reviewing government strategies, policies and plans but it did not touch upon the degree of effectiveness of the various policies formulated and implemented, nor did it attempt to measure their actual impact on the concerned equity target groups. Thus, equity should not be arbitrarily treated in the future. Otherwise, gradually it will create many complaints in the society, which may affect the nation-building process in Ethiopia.

6.   Conclusion and future prospects

Both the survey and the interview, including the normalized data analysis, show that there is a lack of equity in these two infrastructures, except the survey results about university equity. Hence, both airport and university establishments do not have clear criteria for ensuring equitable infrastructure distribution across regions, which negatively affects the nation-building processes in Ethiopia. As a researcher, I understand that there is a trade-off between efficiency and equity. Currently, Ethiopians are becoming more sensitive regarding equity than the efficiency of infrastructure distribution, which needs a great effort for attitudinal changes.

However, major airport investments are essential to meeting the growing passenger and cargo demand, but they are often contentious and controversial. The risks and uncertainties, particularly in relation to future aviation demand, make the decision-making process difficult. And even if such developments are agreed upon, it takes a very long time to build a new airport infrastructure. Therefore, governments and the aviation sector in general should examine how to improve the utilization of available airport capacity. However, in the case of Ethiopia, there is a need to have clear principles, policies, standards and criteria for establishing new airports in a region in Ethiopia.

Moreover, the expansion or the establishment of universities seems to be led by the condition of ethnic politics, where the fair distribution of public HEIs and expanding access in all regions have influenced the pattern of the establishment of institutions. Thus, numbers have been highly stressed and some HEIs have been established in remote areas where there are fewer facilities and it is very difficult to invite and retain qualified academic staff. Therefore, Ethiopia needs to prepare clear principles, policies, standards and criteria for establishing new universities in a region.

Regarding the limitations of the study, the findings are based on evaluations of what would limit the equitable allocation of overall airport and university investments in the infrastructure sector. However, each infrastructure fosters economic growth in a unique way. As a result, different sectors will have different priorities, necessitating distinct strategic approaches. Furthermore, the factors determining the equitable allocation of public infrastructure investments addressed in this study are limited to Ethiopian domestic factors. External variables, on the other hand, are becoming increasingly important, as countries become more connected to the global economy.

In terms of future prospects, airports are gateways to other countries and regions because they promote the continuous circulation of goods and services to service supply and distribution chains. Therefore, it would be good to revise the airport infrastructure equity policies across the regional states in Ethiopia. There is also a huge higher education expansion in Ethiopia. Basically, the emphasis is on the range of equity policies that need to be revised and the level of alignment among several instruments that should be chosen to implement these policies equitably in university allocation. In addition, only universities and airports were included in the paper. Other sectors could be included, depending on their practicality and importance in terms of the study's goal. Besides that, the focus of this is solely on *ex post* evaluation. It is also critical to investigate the *ex ante* evaluation process and make recommendations for Ethiopia's future infrastructure allocation.

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Appendix

Interview questions

Do you have an idea about the institutional capacity in the infrastructure sector, infrastructure governance and infrastructure equity regarding the nation-building process in current federal Ethiopia? If yes, what is (are) the role(s) of each in state-and-nation-building processes? How/why?

What is your observation and understanding of infrastructure (in) equity among regional states in contemporary Ethiopia? Do you have an idea who is the decision-maker and how public infrastructure allocation is done among regional states? What are the criteria for infrastructure allocation in our country?

What is (are) the challenge(s) of the above issues (institutional capacity, governance and equity in the infrastructure, etc.) in the future in our country? What best strategy (ies) could be used for each issue in current Ethiopia? What kind of standards can be applied to allocate public infrastructure equity among regional states? How/why?