

**Measuring Diversity in Higher Education Institutions:
A Review of Literature and Empirical Approaches**

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Abstract

This paper reviews studies on diversity in higher education institutions and suggests empirical approaches to measure diversity. “Diversity” in this paper refers to the internal and external differences among academic programs and institutions. As the empirical literature is relatively salient about how to measure diversity in higher education, the study suggests and compares the use of the Herfindhal index, Gini coefficient, Theil entropy index and the Birnbaum (1983) measure. Applying the indices to data on Dutch higher education, the results indicate limited diversity between institutions, disciplines, and bachelor’s programs. The diversity at the master’s program and first year bachelor’s program levels increased between 2008 and 2013.

Keywords: diversity; institutions; indices.

Introduction

The end of the 1960s marked the start of the democratization of higher education in most Western countries and a number of institutions were faced with the challenge of how to accommodate a growing student intake (Beerkens-Soo & Vossensteyn, 2009, p. 3). In many parts of the world that have experienced an expansion of higher education, diversity has been emphasized as a tool to accommodate growing student numbers. In view of these changes, the student population of universities funded by the Dutch government has grown tremendously in the last five-years. Over the period 2009 to 2014, student enrollment grew by 13% to reach approximately 250,000 students (Law, 2016, p. 101).

Diversity in higher education refers to the variety in institutions or systems of higher education. It concerns the differences among the programs or services provided by institutions and the differences among the types of institutions themselves (Meek, Goedegebuure, Kivinen & Rinne, 1996). Diversity can be measured between institutions and programs. Diversity between institutions includes diversity “in size, in type or mission, in program profiles, in type of control and in location” while diversity between programs includes diversity “in field, in academic degree level, in orientation, in quality and in program delivery” (Dill & Teixeira, 2000, p. 100). Meek, Goedegebuure and Huisman (2000) explained that diversity is a system that “affects every aspect of higher education including access and equity, teaching methods and student learning, research priorities, quality, management, social relevance, finance” (p. 1). The Trow (1995) study defines diversity as characterized by the existence of institutions “within a state or nation that differ from missions, lifestyles, laws and relationships to government” (as cited in Meek et al., 2000, p. 3). Lang (2003) argues that “diversity is a policy objective” from a “planning, regulation, and funding” perspective (pp. 29 and 40). Van Vught (2007) claims that diversity is the “variety of entities in the system within time” (p. 2).

Diversity has long been recognized as uniquely associated with the higher education systems of many colleges and universities around the world and higher education institutions have used diversity as a measure to appraise their systems. Studies of diversity have been ongoing since the 1980s (Birnbaum, 1983). Although dozens of studies have focused on diversity in higher education institutions, there has been little review of the empirical findings of these studies. Moreover, the few existing reviews rarely take into account the strength of the evidence. The first best-evidence research in favor of diversity was from Birnbaum (1983). He measured the effect of external diversity in American higher education between 1960 and 1980. Morpew (2009) repeated Birnbaum’s study and found a decline in diversity in the American higher education system. The literature on diversity in higher education has given limited attention to empirical approaches to measuring diversity (Huisman & Morpew, 1998). This paper contributes to the literature on diversity in higher education by suggesting and applying approaches to measuring diversity among higher education institutions.

Several recent reviews have described the findings of empirical studies that focus on measuring diversity. Horta, Huisman and Hector (2008) studied the use of research funding mechanisms between institutions and applied the Gini coefficient in order to evaluate the result. Rossi (2009) explained “the relationship between market competition and diversity in higher education” (p. 390) using the Herfindhal index to measure diversity and diversification. Bonaccorsi (2010) used the Entropy measure to measure diversity among universities in several European countries. In order to expand this literature, this paper explores four innovative approaches for measuring diversity in the Netherlands, which is an Organization for Economic Co-operation and Development (OECD) country. This focus addresses the Dutch

government's policies to increase and maintain diversity in its higher education system. The 1985 Higher Education Autonomy and Quality (HOAK) claimed that program diversity is achieved "by granting institutions autonomy" (as cited in Huisman & Morphew, 1998, p. 7). According to the 1985 HOAK policy document, "the government tried to direct the higher education system with these stringent regulations and extensive control mechanisms" and "strengthen the autonomy of higher education institutions" (as cited in Maassen & Vught, 1988, p. 66). Furthermore, the government expected to raise the level of quality and stimulate diversity within the system (Maassen & Vught, 1988, p. 66). The focus of our review lies on diversity between programs and higher education institutions. It builds on investigations of external diversity in higher education, i.e. the differences between higher education institutions (Birnbbaum, 1983). As such, the goal of this study is to assess whether diversity and its mechanisms provide changes in the higher education systems by applying the Gini coefficient, Herfindhal index, Theil entropy index and Birnbbaum index. These indices were used to measure concentration within the context of diversity and to compare institutions and academic programs.

The next section presents an overview of the earlier literature on diversity using empirical approaches in higher education systems and diversity indicators that have been used in these studies. This is followed by a description of the methods and search strategies. After that, the paper presents an empirical study and the results. The final section presents the findings and conclusion of the study.

Literature on Measuring Diversity

In this section, we provide a review of the previous literature on diversity in higher education. The review starts by over viewing the conflicting views on the definition of diversity. It then highlights how earlier literature has conducted empirical analysis.

In his seminal study, Birnbbaum (1983) studied forms of diversity. He focused on external diversity and presented "an overview of the various arguments found in the literature" (as cited in Vught, 2007, p. 5). Birnbbaum identified seven forms of external diversity: "systemic diversity, structural diversity, programmatic diversity, procedural diversity, reputational diversity, constitutional diversity, and values and climate diversity" (as cited in Vught, 2007, pp. 2-3). Birnbbaum (1983) used six variables: institutional control, size, minority enrollment, proportion of female students, program types and degree levels (as cited in Huisman & Morphew, 1998, p. 5). Birnbbaum found that during the study period, external diversity in the American higher education system did not increase.

Four empirical studies have explored diversity at the discipline level. Rossi (2009) defined diversity as a variety of institution types, with the institutions categorized "according to one or more specific institutional characteristics, at a certain point in time" (p. 395). Rossi (2009) argued that the increase in diversity is one of the strategic arrangements in the higher education system. He measured diversity between universities at a discipline level. He also explored the effects of competition on diversity using Italian data for the period 1999-2006 in specific disciplines (Rossi, 2009, p. 391). Rossi used the Herfindhal index to derive a diversity index, as well as a regression analysis. The study concluded that there was a positive relation between competition and diversity. However, the relation was not robust. He recommended further study using other indicators. For example, the quality of the research in institutions or access to institutions would enrich knowledge of diversity in higher education.

There has been some research focusing on institutional diversity (Horta, Huisman & Heitor, 2008; Bonaccorsi, 2010). Horta et al. (2008), for example, focused on the relationship between funding for research in higher education and institutional diversity. They argue that funding might contribute to increased levels of institutional diversity in higher education systems. Their application uses the Gini coefficient. They describe the two main models which have dominated in higher education systems. The first model is “the state control model in which the government regulates through direct control” and the second is “the market based model, the autonomy by institutions of higher education” (Horta et al., 2008, pp. 148-149). Horta et al. (2008) observed that competitive funding rather than direct funding promotes institutional diversity. As such, institutional diversity can be fostered by “funding mechanisms for academic research” (Horta et al., 2008, p. 156). In a more recent study, Bonaccorsi (2010) measured diversity by using an empirical approach. Diversity in doctoral education was measured between universities in several European countries. The underlying census data originated from the project Aquameth, which collected data on all universities in 11 European countries during the period 1994–2004. Bonaccorsi applied entropy and distance measures and concluded that diversity at universities in several European countries had mixed effects on dynamic diversity. There were both positive and negative effects on diversity between universities.

The four studies reviewed above show a similar point of view regarding diversity. Some authors (Birnbaum, 1983; Rossi, 2009; Bonaccorsi, 2010) describe empirical approaches to measure diversity, while others (Horta et al., 2008) do not use empirical analysis. The studies clearly measure diversity and describe which variables have been used. The theoretical framework related to diversity and its effects are clear. The four studies specify which aspects of the systems in higher education the study refers to. Birnbaum’s (1983) conclusions on whether government interference could increase diversity are different from those of other researchers. Rossi (2009), Bonaccorsi (2010) and Horta et al. (2008) do not explicitly explain government interference. Finally these four studies provide recommendations or advice for government policies in higher education.

Method

This study relied on published papers and working papers from the years 2000 to 2014. The following electronic databases were used: Higher Education and Economic Reviews, ERIC, JSTOR, Taylor and Francis, Wiley Online Library, Springer, and Google Scholar. The literature review used the following keywords: institutional diversity, program diversity, diversity and differentiation, diversity higher education, diversity and inequality, and external diversity. Our search identified thirty articles. Despite our inclusion criteria, we included the older literature by Huisman and Morpheu (1998) and Birnbaum (1983) since these studies provided the seminal work on this topic. Eight studies attracted our attention in particular (Lepori, Huisman & Seeber, 2014; Bonaccorsi, 2010; Rossi, 2009; Horta, Huisman & Heitor, 2008; Ayalon, Grodsky, Gamoran & Yogef, 2008; Huisman, Meek & Wood, 2007; Kelchtermans & Verboven, 2010; Huisman, Kaiser & Vossensteyn, 2000). The difference between the latter eight studies and the other articles is that they specifically focus on diversity between higher education institutions while the other studies emphasize only general diversity unrelated to higher education. In the next step, all papers that did not meet our inclusion criteria were excluded. The decision to include studies was based on a combination of reading summary abstracts, theoretical framework, methods and results. Included studies also had to present definitions and measure diversity empirically. After applying these inclusion criteria, we had four studies left. The four studies are considered in this review.

Table 1 provides the relevant information and a systematic summary of the literature on diversity as well as the applied empirical procedures. The following information was relevant: author(s), country, type of study, type of diversity, methodology, and outcome.

Table 1: Literature review on the type of diversity and the applied empirical approaches and outcomes (after the year 2000)

Authors/Scholars/ Researchers	Country and year	Type of study	Topic on type of diversity	Methods/ Tools	Outcomes
Rossi	Italia (2009)	Empirical approach	Institutional	Herfindahl index	↓ Diversity
Horta, Huisman & Heitor	USA and UK (2008)	Empirical approach	Institutional	Gini coefficient	↑ Diversity
Bonaccorsi	European (2010)	Empirical approach	Institutional	Theil entropy	Dynamic mixed diversity
Lepori, Huisman & Seeber	Swiss and various European (2014)	Empirical approach	Institutional	Herfindhal index	↑ Diversity
Ayalon, Grodsky, Gamoran & Yogev	Israel and USA (2008)	Empirical approach	Institutional	Gini coefficient and across national and longitudinal analysis	Diversification affects to inequality
Huisman, Meek & Wood	OECD (2007)	Empirical approach	Institutional	A cross national and longitudinal analysis	↑ Diversity
Kelchtermans & Verboven	Belgium (2010)	Empirical approach	Program	Concentration index	↓ diversity
Huisman, Kaiser & Vossensteyn	OECD (2000)	Empirical approach	Institutional, Program	Relative score	↑ diversity

The Higher Education Institutions in the Netherlands

Higher education in the Netherlands is organized as a binary system (de Boer, Enders and Leisyte, 2007, p. 28). There are three types of Dutch higher education institutions, consisting of government-funded (*bekostigde*), approved (*aangewezen*) and private (*particuliere*) institutions (Law, 2016, p. 100). The Dutch higher education system is comprised of 13 research universities (*wetenschappelijk onderwijs, WO*) that are accredited and funded by the Dutch government and fifty universities of applied sciences (*hoger beroepsonderwijs, HBO*).

Approved institutions are different; they do not receive funding from the government. Private institutions also play an important role in the higher education system. They can apply for accreditation by the *Nederlands-Vlaamse Accreditatieorganisatie (NVAO)*. Table 2 provides an overview of the institutions of higher education in the Netherlands.

Table 2: Number of institutions in the Netherlands in 2016

Institutions	Total
Research universities	13
Universities of applied sciences	50
Total	63

How to Measure Diversity

The Herfindahl index can be used to measure concentration in a variety of contexts. One way is to analyze horizontal diversity between institutions. The Herfindahl supports multiple variables and allows multiple groups (year, discipline and program level). To use this statistical measure, the study considered the number of degree programs in each institution, for example the number of disciplines offered by each institution. The Herfindahl index (HH_i) can be constructed and computed for each institution as follows (Rossi, 2009):

$$HH_i = \sum_i \left(\frac{x_{ci}}{x_c} \right)^2$$

Where x_{ci} is the number of students in a degree program in discipline i offered by an institution in the year c . x_c is the total number of students in a degree program offered by an institution in the year c . Since not all institutions offer each discipline, this index determines the range of disciplines offered by each institution. The index varies from 0 to 1: the minimum diversity is indicated by zero and the maximum diversity is indicated by 1 referring to the total number of disciplines. A low value of HH_i indicates that the institution is “more specialized” (low diversity), and a high value indicates that the institution is “more diversified” (high diversity) (Rossi, 2009, p. 396). The advantage of using the Herfindahl index is that it can be determined by the range of each discipline in the program offered.

The second method is the Gini coefficient. The Gini coefficient is a measure of inequality. The techniques for calculating the Gini coefficient have been designed for ungrouped data and are popular “because of their simplicity and accuracy” (Abounoori & McCloughan, 2003, p. 505). The Gini coefficient has the disadvantage that the cumulative percentage cannot be calculated if one variable, for example the number of programs or the number of students, is not leveled from the minimum to the maximum value. The data required to calculate the Gini coefficient are the total number of programs in each institution and the number of students in each institution. The Gini coefficient is calculated by comparing the area between the diagonal and the Lorenz curve (area A) divided by the area of the triangle below the diagonal (area B).

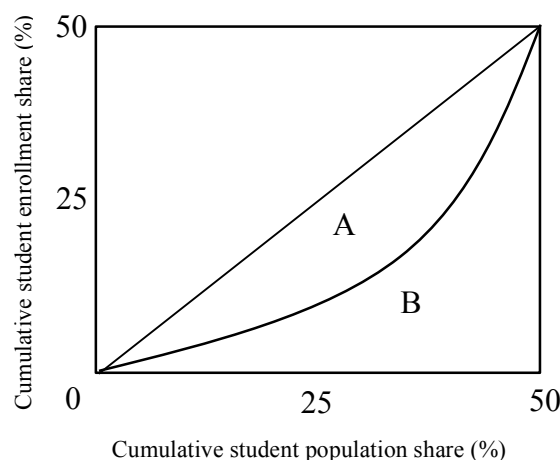


Figure 1: Representation of the Gini – measured as the area A / area B

Alternatively, the Gini coefficient is defined as follows:

$$G_i = \frac{A}{(A+B)} = 1 - 2B \quad (1)$$

$$G_i = 1 - 2 \int_0^1 L(x) dx \quad (2)$$

The function $L = L(x)$ is the cumulative proportion of the number of disciplines in each institution; L denotes the cumulative proportion of the number of students. In practice, function $L(x)$ is unknown. In this formula, $G_i = 1$ indicates perfect (maximum diversity) and $G_i = 0$ indicates absolute equality (minimum diversity).

As a third methodology, the Theil entropy index (E_i) can be defined as a “measure of the uncertainty” in a random variable (Mhaskar, 2013, p. 1). If E_i approximates to 0, this indicates a minimum diversity, and E_i approximating to 1 indicates a maximum diversity. The Theil entropy can be written as follows:

$$E_i = \sum_i \left(\frac{y_i}{Y} \right) \log \frac{\frac{y_i}{Y}}{\frac{x_i}{X}}$$

Where y_i is the number of disciplines in institution i . Y denotes the total number of disciplines. x_i is the number of students in institution i . X stands for the total number of students and i is number of institutions (1,2,3 ... n).

Finally, this study also replicates the diversity measure by Birnbaum (1983). The Birnbaum index is applied by measuring institutional diversity based on the largest number of observations. Birnbaum (1983) explains that diversity increases as the largest number of observations increases. The Birbaum index can be calculated as follows:

$$D_i = \sum_i \left(\frac{Y_i}{X_i} \right)$$

Where Y_i is the most populated number of students in disciplines in institution i , and X_i is the total number of students in a discipline in institution i .

Data

The data was obtained from the Dutch Ministry of Education (*'Dienst Uitvoering Onderwijs', DUO*). The data includes for each institution the number of students in the academic years 2008 to 2013 for each institution. In addition, it provides program-level information on the number of students in specific disciplines and program types (bachelor's, master's and first-year bachelor's programs). First, we considered the number of students at the institution level. The study has information on all fifty institutions in higher education in the Netherlands. Second, we examined the number of students at program type and sector levels. The data consisted of program type, namely bachelor, master, or first-year bachelor. Third, we applied the methodology to the number of students based at the discipline level (1356 disciplines in total).

Results

Applying the four methodologies described above to data for higher education in the Netherlands yielded some interesting insights. Table 2 provides a summary of the outcomes for each of the four indices for the years 2008, 2009, 2010, 2011, 2012 and 2013.

Table 3: Diversity at institution level

	Year	2008	2009	2010	2011	2012	2013
Indices							
Herfindahl		0.0375	0.0374	0.0374	0.0372	0.0370	0.0374
Gini coefficient		0.4765	0.4755	0.4749	0.4773	0.4799	0.4778
Theil entropy		0.5276	0.5233	0.5208	0.5232	0.5274	0.5259
Birnbaum		0.9341	0.9373	0.9385	0.9345	0.9339	0.9301

Source: Authors' own calculations, based on the dataset from the Dutch Ministry of Education

The Herfindhal index is close to 0. It can be seen from Table 2 that the index value is 0.0375 in 2008 and 0.0374 in 2013. A lower number of students in each institution generated a low value on the Herfindhal index. The Gini coefficient and the Theil entropy are both close to 1. The results also indicate that the Birnbaum index is close to 1. This is because a large number of students in each institution generated a higher value on the Birnbaum index.

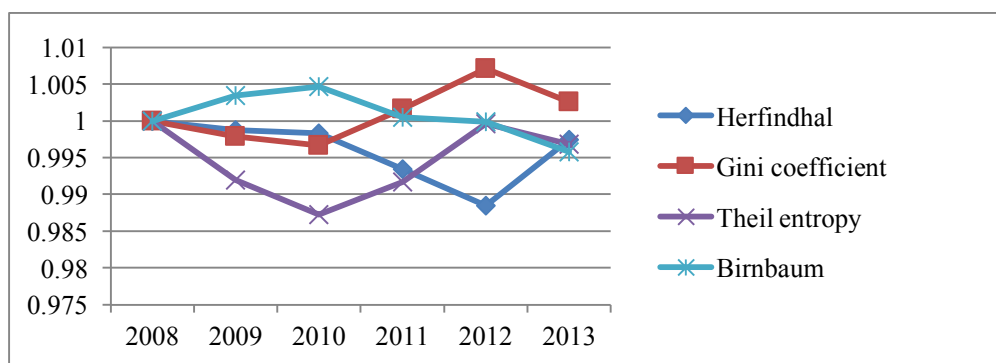


Figure 2: Comparison between four indices at institution level (2008–2013)

Using the four indices, the trend shows that diversity at the institution level decreased over time. The decrease means that institutions became more specialized during the period of study. Similar to the result of the Gini coefficient for 2008 to 2010, the figure decreased slowly from 0.4765 to 0.4749. However the trends significantly increased to 0.4773 and 0.4799 in the years 2011 and 2012, respectively. This increase is probably caused by an increase in the number of students in higher education. In the year 2013, the Gini coefficient decreased to 0.4778. The decrease of the Gini coefficient shows that diversity in institutions reached a minimum (institutions became more specialized in the period of study), and the Theil entropy index shows a similar movement. Both indices decreased between 2008 and 2010, then increased in 2011 and 2012, but in 2013 they decreased again. The decrease in diversity over time can also be seen from the Birnbaum index. The overall conclusion is that there is little diversity at the institution level. In other words, the institutions are relatively homogenous.

Table 4: Diversity at discipline level

	Year	2008	2009	2010	2011	2012	2013
Indices							
Herfindahl		0.0089	0.0101	0.0098	0.0097	0.0094	0.0095
Gini coefficient		0.1715	0.1397	0.1441	0.1483	0.1502	0.1481
Theil entropy		0.6445	0.8400	0.8087	0.7868	0.7686	0.7785
Birnbaum		0.0476	0.0434	0.0316	0.0316	0.0313	0.0320

Source: Authors' own calculations, based on the dataset from the Dutch Ministry of Education

The results are based upon a total of 1356 disciplines at fifty institutions. The Herfindahl index, the Gini coefficient and the Birnbaum index at the level of discipline are low and close to 0. These low index values may be caused by a small number of students in each discipline. While the results from the Theil entropy index are above 0.5 in 2008 (0.6445) and in 2013 (0.7785), they are still below 1.

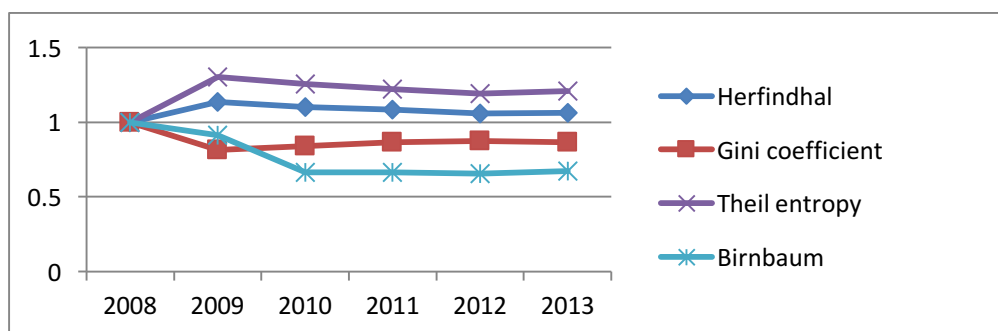


Figure 3: Comparison between indices based on disciplines (2008–2013)

The values vary between 0.0089 (2008) and 0.0095 (2013). However, the overall diversity at discipline level has decreased. Similar changes are also shown by the Theil entropy index. Both results indicate a decrease in diversity (disciplines became more specialized over time). The overall trends in the Gini coefficient increased from 2009 (0.1397) to 2012 (0.1502) and then decreased in 2012 and 2013. In 2013, the Gini coefficient decreased somewhat, and overall it can be concluded that diversity at the discipline level increased (disciplines became more diversified over time). The Theil entropy index increased from 2008 to 2009 and then decreased significantly until 2012. The Theil entropy index slightly increased in 2013. The overall comparison between the four indices indicates that diversity at the discipline level decreased (specialization increased).

Table 5: Diversity at bachelor level

Indices	Year	2008	2009	2010	2011	2012	2013
Herfindahl		0.8329	0.8319	0.8316	0.8300	0.8298	0.8282
Gini coefficient		0.5549	0.5648	0.5625	0.5589	0.5598	0.5587
Theil entropy		0.6635	0.6821	0.6811	0.6777	0.6807	0.6798
Birnbaum		0.7146	0.7030	0.7043	0.7012	0.6993	0.6945

Source: Authors' own calculations, based on the dataset from the Dutch Ministry of Education

The results show that the four indices are not close to 1, indicating that the bachelor's level programs are relatively homogenous. However the Herfindhal index is high at the bachelor's program level. The Gini coefficient is the lowest of the four indices.

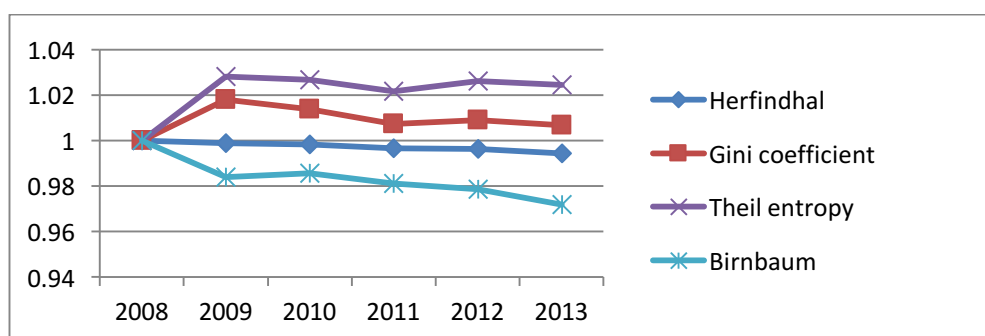


Figure 4: Comparison between indices based on bachelor's programs (2008–2013)

The Herfindhal index decreased from 2008 to 2013. It can be concluded that bachelor's programs during that period had minimum diversity (more specialization). The Gini coefficient and the Theil entropy index decreased from 2009 to 2011. From 2011 up to 2013 there was an unstable movement. In general, these indices were rather similar concerning the direction of the movement. The decrease in diversity was also found in the Birnbaum index. The overall result of these indices supports the conclusion that diversity at the bachelor's program level was low. Bachelor programs were relatively homogenous.

Table 6: Diversity at master level

	Year	2008	2009	2010	2011	2012	2013
Indices							
Herfindahl		0.8604	0.8727	0.8734	0.8752	0.8757	0.8784
Gini coefficient		0.6482	0.7082	0.7145	0.7284	0.7264	0.7440
Theil entropy		0.7659	0.8139	0.8178	0.8277	0.8333	0.8472
Birnbaum		0.7734	0.8191	0.8252	0.8271	0.8281	0.8398

Source: Authors' own calculations, based on the dataset from the Dutch Ministry of Education

The results in Table 5 show that the Herfindhal index approached 1. The Gini coefficient had a low value compared with other indices. However, most indices were relatively high. The high values of the indices imply that diversity at the master's program level was large.

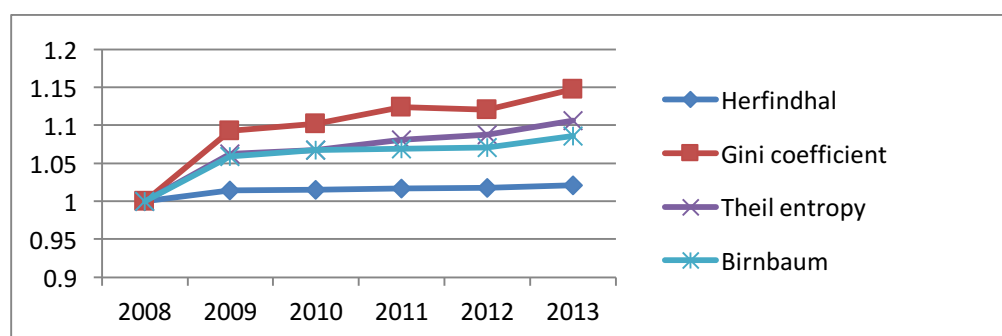


Figure 5: Comparison between indices based on master's programs (2008–2013)

The Herfindhal index, the Gini coefficient, the Theil entropy index and the Birnbaum index were similar in their trend from 2008 to 2013. All indices increased during this period. Diversity in master's programs at sector level increased significantly. This increase was probably due to the growth in the number of bachelor's students who continued in a master's program, thus affecting the number of students in master's programs. Master programs were relatively heterogeneous.

Table 7: Diversity at first year bachelor level

	Year	2009	2010	2011	2012	2013
Measurement						
Herfindhal		0.7986	0.7997	0.7981	0.7978	0.8012
Gini coefficient		0.4679	0.4693	0.4666	0.4662	0.4735
Theil entropy		0.5014	0.5050	0.5026	0.5073	0.5220
Birnbaum		0.6637	0.6659	0.6626	0.6644	0.6705

Source: Authors' own calculations, based on the dataset from the Dutch Ministry of Education

The results refer to the number of first year bachelor's students. The Herfindahl index was high compared with other indices. The Gini coefficient was the lowest among the indices (below 0.5). The Herfindahl index had a high value. The high value indicates that diversity at the level of first year bachelor programs was high.

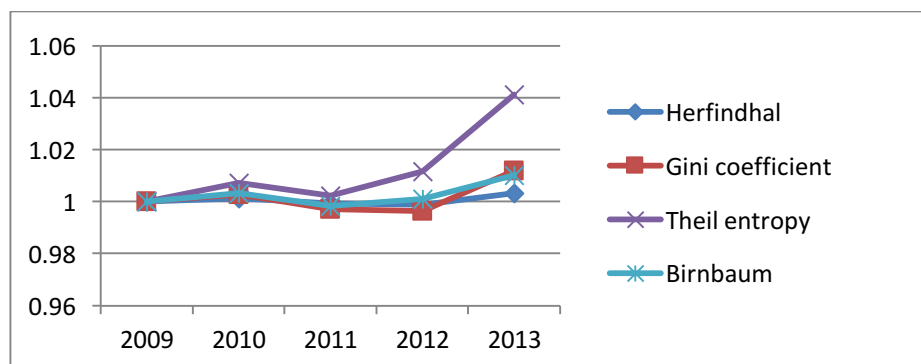


Figure 6: Comparison between indices based on first year bachelor's program (2008–2013)

The diversity indices presented a dynamic mixed trend movement at the level of first-year bachelor's programs. The diversity in first-year bachelor's programs increased between 2009 and 2010 but decreased in 2011. Moreover, the Herfindhal index and the Gini coefficient decreased somewhat between 2010 and to 2012 and then increased in 2012 and 2013. This dynamic mixed movement is probably due to the number of students enrolled in first-year bachelor's programs. Generally, the analysis concluded that diversity in first-year bachelor's programs was high.

Discussion

The Impact of Diversity

This paper focuses on recent changes that have taken place in the Netherlands' higher education system. Diversity is generally considered as an effective strategy in higher education systems, and in the Netherlands, increasing diversity responds to demands from stakeholders (Rossi, 2009). Scholars have disagreed on whether or not diversity improves higher education. The current debate between scholars and policy makers about the role of diversity in higher education has been mired in the ambiguity of whether diversity has a positive or negative effect. This ambiguity could be attributed to the lack of empirical evidence, theoretical approaches and methodologies (Mahat, 2014). The previous literature on diversity suggests that heterogeneity in the types of programs is feasible to study, but it is not clear whether there are empirical approaches to measure diversity adequately. This study exploits the empirical approaches by using four different methodologies (Gini coefficient, Herfindhal index, Theil entropy and Birnbaum method) to measure diversity. To our knowledge, this is the first study which suggests innovative approaches in the sense that we can measure diversity not only for all levels of higher education institutions but also for various programs offered and for several types of programs, such as bachelor's and master's programs. Like many other model-based measures, our approach ignores differences in program quality as well as the attractiveness of programs.

Differences between Institutions, Disciplines and Program Levels

This examination of the dynamics of the composition and the number of enrollments at the institutional level provides some insight about the causes for these differences. The analysis shows that the four concentration indices have decreased over time, although not monotonically (as shown in Figure 2). This indicates that universities have a tendency not to offer degree courses in specific markets. Universities encounter difficulties when diversifying in order to cater to a wide range of student preferences. Similar results are obtained when we consider differences at the level of disciplines. Overall, the variation of the four indices decreased monotonically during the period 2008–2013 (as demonstrated in Figure 3). The reasons for this decrease are arguably related to the decrease of diversity at discipline level and are mainly due to a lower number of students recruited to universities. Our analyses demonstrated the dynamics of the indices at the bachelor's level in the period 2008–2013. Furthermore, small universities and institutions with a good reputation have to compete among each other to increase enrollment in bachelor's programs. Competition between institutions decreased the number of students enrolling. In addition, our analyses examined program levels from bachelor's degree and master's degree. The number of students enrolled increased significantly because of the increase in the number of bachelor's and master's degree programs offered in the Dutch university system.

Improving Diversity

A major problem that clouds the debate on diversity in higher education systems is a lack of consensus on what is required to improve diversity in higher education. In order to research this question further, future research could construct the Boone-indicator. The Boone-indicator is a new measure of competition (Leuvensteijn, Bikker, Rixtel & Sorensen, 2007). This approach is able to measure competition at the program level. The main idea of the Boone-indicator is that more efficient programs achieve higher profit. The more negative the Boone indicator is, the higher the level of competition between programs in the market.

Conclusion

The call for more diversity among higher education institutions and programs has coincided with the democratization of higher education. One of the earliest studies on this topic was conducted by Birnbaum (1983), who analyzed the impact of diversity on the higher education system in the United States. The latest empirical research was conducted by Rossi (2009), who considered diversity as an effective strategy for the higher education system in Italy. The present study has contributed to this literature by applying and comparing four indices to measure diversity using data at different levels of higher education in the Netherlands during the period 2008–2013.

The study concluded that diversity at the level of master's and first year programs increased in higher education institutions in the Netherlands. The number of students increased and this has significantly driven the increase in diversity. However, results differ between institutions, disciplines and program levels. The study found that diversity at the bachelor's level decreased, but diversity increased at the master's level. The indices for the first-year bachelor's program level were more mixed over time. The development of diversity over time can be affected by the number of students who enroll in the programs.

Besides suggesting various ideas to measure diversity, this paper provides several lines for future research. First, the current study provides separate estimates on diversity between institution and program level. Additional research is necessary to explore the relation between diversity at the program level and the number of students. Second, the study measured diversity across institutions, disciplines and program types (bachelor's, master's and first-year bachelor's degree) using data on the number of students enrolled. In order to research this further, it is necessary to explore diversity for groups at the program level. Data on the number of students at the program level investigate the characteristics and attractiveness of program. Third, the study used a sample of Dutch higher education programs. It would be interesting to compare our results with results for other countries.

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