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# Measuring the convergence of national accounting standards with international financial reporting standards: The application of fuzzy clustering analysis

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**Abstract**

A single set of accounting standards is considered the path to achieving accounting convergence globally. Given the important role that formal harmonization/convergence plays in the accounting profession and global capital markets, this study focuses on the methods and methodology for the measurement of formal accounting convergence. Based on our review and evaluation of the existing methods for measuring the level of harmonization/convergence between any two sets of accounting standards, we propose using a new method of matching and fuzzy clustering analysis to assess the convergence progress of national accounting standards (NAS) with International Financial Reporting Standards (IFRS) from whole and single standards, respectively. Single standards are clustered according to their convergence level, which may indicate further convergence emphasis. As an illustrative example, the achievements made in China are evaluated using this new method. The results reveal that this new method can measure the convergence level of NAS with IFRS more clearly and informatively.


*Keywords:* Formal accounting convergence; Measurement; Fuzzy clustering analysis; Chinese accounting standards

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## 1. Introduction

The globalization of the world's economy has inevitably resulted in efforts to establish a single set of financial reporting standards, which is considered the path to achieving accounting convergence globally. In May 2000, the International Organization of Securities Commissions (IOSCO) completed the assessment of the International Accounting Standards Committee (IASC) core standards, including their related interpretations (the IASC, IAS2000). Members of IOSCO were encouraged to use the IASC standards to prepare their financial reporting for cross-border offerings and listings, supplemented where necessary to address outstanding substantive issues at a national or regional level, or to use waivers of particular aspects of IASC standards without requiring further reconciliation under exceptional circumstances. In 2001, after its reconstruction, the International Accounting Standards Board (IASB) adopted objectives[2] for developing and promoting the use and rigorous application of a single set of global accounting standards. Numerous countries and regions obliged or volunteered to accept completely or reconcile its NAS to international standards. Since 2005, listed companies in EU countries have been required to adopt IFRS for preparing their consolidated financial statements, and non-listed companies are encouraged to do so as well. In addition, financial statements ended after November 15, 2007 and prepared using IFRS by foreign private issuers in the United States have been accepted without reconciliation to U.S. generally accepted accounting principles (GAAP). By March 2008, 110 countries and regions had accepted IFRS completely or had set their NAS based on IFRS. Some of these countries, such as Australia, have directly converged their accounting model with IFRS, while some others have not because of environmental differences or legal processes.

China, a member of the IASB, is a country that has made progress toward convergence. On February 15, 2006, the Ministry of Finance issued a new set of accounting standards, which includes 1 fundamental standard and 38 specific standards. A joint statement[3] issued by the IASB and the China Accounting Standards Committee states that China has achieved substantial progress toward convergence with IFRS, although some differences remain (e.g., reversal of impairment losses, disclosure of related party relationships, and transactions). These new accounting standards were implemented for Chinese-listed companies beginning January 1, 2007. Implementation for large and mid-sized state-owned companies and other types of companies is expected to be ongoing.

Despite the progress, significant differences from IFRS still exist in many national accounting systems. And even for those countries that have adopted IFRS directly, certain

[2] IASB adopted the following reconstructed objectives in 2001: (a) to develop, in the public interest, a single set of high-quality, understandable, and enforceable global accounting standards, which require high-quality, transparent, and comparable information in financial statements and other financial reporting, to help participants in the world's capital markets and other users make economic decisions; (b) to promote the use and rigorous application of those standards; and (c) to bring about the convergence of national accounting standards and IAS to effect high-quality solutions. On June 21, 2005, the IASC Foundation added the following objective to its constitution: (c) in fulfilling the objectives associated with (a) and (b), to take account of, as appropriate, the special needs of small and medium-sized entities and emerging economies.

[3] IASB & China Ministry of Finance. 2005. Joint Statement of the Secretary-General of the China Accounting Standards Committee and the Chairman of the International Accounting Standards Board. 8 November, Beijing.

differences may still exist during the implementation of the standards. It is generally accepted that standards are not only the means of achieving the convergence of financial reports but also one of the objectives of convergence. In such circumstances, and given the important role of formal convergence, reliable measurements of the progress in achieving convergence are critical. Extant research in the evaluation of accounting convergence has mainly focused on the measurement of *material convergence*, while the methods and methodology for the measurement of *formal harmonization* are scarce and inconsistent. This study explores the method and methodology for measuring formal convergence and proposes a new method of matching and fuzzy clustering analysis to assess the convergence progress of NAS with IFRS from the perspectives of whole and single standards. As an example, the convergence of the latest China's accounting standards (CAS) with IFRS will be evaluated using this new method. We expect that this study could offer a more effective method to measure the convergence of NAS with IFRS clearly and informatively and could advance the study of formal convergence. This could benefit the globalizing capital markets and other users of financial reporting in helping them to assess the quality and comparability of the financial information provided by local and cross-bounder-listing and issuing companies.

For clarity, it is necessary to define the key terms used throughout this research. First, we need to differentiate the meanings of *harmonization, standardization*, and *convergence* so as to understand the target of our measurement. Van der Tas (1988) originally defined harmonization as "a coordination, a tuning of two or more objects." Tay and Parker (1990) made a further differentiation between harmonization and harmony, standardization, and uniformity. Harmonization is a process of "a movement away from total diversity of practice. Harmony (a *state)* is therefore indicated by a 'clustering' of companies around one or a few of the available methods." Standardization is conceived to be a process of "a movement towards uniformity (a *state*). It includes the clustering associated with harmony, and reduction in the number of available methods. Harmony and uniformity are therefore not dichotomous. The former is any point on the continuum between the two states of total diversity and uniformity" (Tay & Parker, 1990). "Convergence" is the act of moving toward one point, especially moving toward union or uniformity.[4] The destination of both standardization and convergence is uniformity. Similar to harmony and uniformity, the relationship of harmony and convergence is also not dichotomous. These terms reflect the subtleties of international accounting standards development at different stages. In fact, the IASB's development and promotion of a single set of accounting standards indicates a movement from international harmonization toward global convergence. This convergence could also be considered a standardization process. Both the degree of harmonization and the degree of convergence reveal the progress made in the accounting internationalization process.

Second, we need to distinguish between *formal harmonization* and *material harmonization*. There is consensus that accounting harmonization includes accounting standards harmonization and accounting practice (financial reporting) harmonization. Accounting standards harmonization refers to harmonization between regulations, called formal or *de jure* harmonization. Accounting practice harmonization refers to the similarity of financial information prepared by companies using either the same or different set of

[4] http://www.merriam-webster.com/dictionary/convergence.

accounting standards, and it is called material or *de facto* harmonization. Formal accounting harmonization is considered the basis for achieving material accounting harmonization. Material accounting harmonization could not be achieved without formal accounting harmonization. Given the importance of formal accounting harmonization, we focus on measuring the convergence of accounting standards, regardless of whether such standards are followed in practice or not (the convergence of accounting practice could be measured by using other appropriate methods). The methods employed in this study are those most suitable to the features of accounting standards.

With these terms defined, we begin the study by reviewing the methods in existing literature in order to measure the success achieved in effecting convergence between any two sets of accounting standards. We then propose and demonstrate matching and fuzzy clustering analysis methods for assessing the convergence progress of NAS with IFRS. Next, as an example, China's new accounting standards are examined, and its convergence level is measured using this new method.

## 2. Literature review

Most prior studies on assessment of accounting convergence have focused on the measurement of material harmonization. The indices, such as I and C, as well as H indices introduced by Van der Tas (1988), are popularly used in the literature. Several authors made further improvements or developments to those indices, such as Archer, Delvaille, and McLeay (1995), Herrmann and Thomas (1995), Morris and Parker (1998), Aisbitt (2001), Pierce and Weetman (2002), and Taplin (2004). In these studies, the data resource used to determine the level of harmonization among the practices and treatments was accounting information prepared by companies. However, because material versus formal harmonization studies are substantially different, indices used in the measurement of material harmonization are not valid for evaluating formal harmonization. Some researchers, such as Adhikari and Tondkar (1992), Lainez, Callao, and Jarne (1996), and Rahman, Perera, and Siva (1996), began developing new methods to measure advances in formal harmonization. In more recent years, further contributions have been made by Garrido, León, and Zorio (2002). and Fontes, Rodrigues, and Craig (2005). They advanced accounting harmonization studies from an experimental stage to a method and methodology stage, so that any accounting issues and countries could be evaluated within the framework of the research design, instead of only particular samples of accounting issues of different countries being tested by proposed methodology and analytical techniques.

The early exploration on formal harmonization concentrated on the requirement of regulations in different countries. Adhikari and Tondkar (1992) examined the listing requirements for 35 stock exchanges as the source for accounting regulation and identified some environmental factors for such listing requirements. Lainez et al. (1996) analyzed and quantified the discrepancies among the information requirements imposed by the stock exchanges of 13 countries and found that there are more differences among periodical reporting requirements than among additional information to be disclosed in the case of private offerings.

At the same time, Rahman et al. (1996) conducted early research on formal harmonization between countries, measuring the formal harmonization level that had

been achieved between the two "neighboring" countries of Australia and New Zealand. Using the disclosure and measurement requirements stipulated in accounting standards, legislative requirements, and stock-listing requirements as their data sources, they identified the different categories of requirements that had achieved lower or higher degrees of harmonization between the two countries by multiple-discriminating analysis. The requirements of disclosure and measurement in each item were considered discrete data. Mahalanobis-like distances were used to measure the distances among categories. The results indicated a higher level of harmony on measurement requirements and a lower level of harmony on disclosure requirements. The major problem with such measurement is that a Mahalanobis-like distance is primarily defined for continuous variables, whereas requirements of disclosure and measurement are discrete data, which should be treated purely in a descriptive fashion. In addition, it is difficult to explain the degree of harmonization by absolute distances. Despite these measurement issues, Rahman et al. (1996) research provided a new perspective on studying formal convergence.

Unlike the horizontal study presented by Rahman et al. (1996), Garrido et al. (2002) conducted a vertical study, (time) on formal harmonization, that is, researching the progress of one standard over time. In this case, they focused their study on evaluating the progress of IASC through all three stages of its standard-setting activity using Euclidian distances. The results proved that the IASC had made great progress in regard to the level of harmony achieved through the accounting standards it had issued or revised. Though this study represents progress in measuring formal harmonization, the use of Euclidian distances raises questions. As Euclidian distances are absolute, the results can only show the difference between the items compared. It cannot show the similarities or dissimilarities of the items compared. This flaw makes it unsuitable for use in analyzing the convergence among different standards (horizontal) or the progress achieved within one standard (vertical).

Awareness of the flaws existed in the literature. Fontes et al. (2005), for instance, proposed Jaccard's coefficient and Spearman's coefficient to assess the progress of formal harmonization between any two sets of accounting standards. They measured formal harmonization between Portuguese Accounting Standards (PAS) and IFRS in three phases of accounting convergence by using Euclidian distances, Jaccard's coefficients, and Spearman's coefficients. The results proved that coefficients methods are better than Euclidian distances. As Euclidian distances yield absolute values and are not easy to interpret, they can only be used to assess the progress in dynamic terms. In contrast, the results yielded by Jaccard's coefficients can be interpreted both in dynamic terms (increasing results over time denote formal harmonization advances) and static terms. The calculation of Spearman's correlation coefficients reinforced these results and provided further evidence of the progress achieved by converging PAS with IFRS. The use of coefficients offers similarity of standards between countries and makes up for the flaws of distances. This methodology is believed to be applicable to analyzing the level of convergence between different regulations at different points in time or among different countries.

Our recent study (Zhang & Qu, 2009) proposed a new method for measuring formal accounting convergence in a more informative and reasonable manner. This new approach relies on fuzzy clustering analysis to measure the formal accounting convergence and puts forward creative suggestions regarding the aspects of items for comparison, the choice of

measurement approaches, and the dimensions of measurement. This method will be described in detail in Section 3 of this paper.

Summarizing the methods and methodology employed in extant literature for measuring formal harmonization (including between standards and within standard), we find the following:

First, the data sources used in formal harmonization studies include mainly regulations, standards, and stock exchanges' listing requirements. These data possess the features of qualitative (nominal) variables rather than quantitative variables, which means that the measuring method used in evaluating formal accounting harmony should be the one that is most suitable to the features of nominal variables, which in this case are coefficients. Only Jaccard's coefficients and Spearman's coefficients proposed by Fontes et al. (2005) currently meet this requirement. Euclidian distances and Mahalanobis-like distances are mostly suitable for calculating ordinal or interval variables.

Second, most samples in formal harmonization studies focus on those accounting issues that have a variety of choices in accounting treatments. Since not every measurement and disclosure requirement in regulations is exhausted, there is the possibility that even though the accounting choices are exactly the same between standards compared, the two sets of standards may not actually be convergent when the scope, the terminologies, and the measurement criteria are not exactly the same. These differences would eventually affect material harmonization.

Third, variables chosen in formal harmonization studies are similar to variables chosen in material harmonization studies, in which accounting treatments are classified as "required," "recommended," "allowed," or "not permitted." This type of classification may work when measuring the convergence of material harmonization since the strength of accounting methods contemplated will affect accounting practice. However, for regulations, there will be no substantial difference regarding which treatment is required or allowed because there are no preferred regulations as there are preferred practices. We believe a better comparison between regulations would be similar or dissimilar requirements and stipulations (comparison items) in regulations compared, including details of a standard's scope, terminologies associated with the standard, measurement criteria on accounting elements, accounting methods, re-measurement, and disclosure, as these details will eventually affect reliability and relevance of financial reporting.

Fourth, each formal harmonization study in extant literature concluded from the whole without considering a single standard's effect on the convergence of two sets of accounting regulations. This leaves out some important information, such as which single standards have achieved higher convergence and which not. The latter is very important for researchers and standard-setters in their research and further harmonization efforts, and for financial information users in their understanding and assessment of accounting information as well.

Considering the limitations that exist in the literature of formal harmonization, this study explains the benefits of using the new method of fuzzy clustering analysis for measuring the convergence between any two sets of accounting standards both from totality and from single standard, and for clustering a single standard according to its level of convergence.

## 3. Fundamental principles of fuzzy clustering analysis

Fuzzy clustering analysis, a method used in multivariate statistical analysis, aims to divide a data set into groups or clusters that consist of similar data. Close or estranged

relationships of cases are classified objectively by the measurements of similarity or distance. The former is usually measured by simple relevant coefficients; the latter is measured by absolute distances. Our study aims to measure the similarity or dissimilarity between any two sets of accounting standards, so coefficients could be the most suitable method.

Matching coefficients are mostly used in measuring close or estranged relationships of nominal variables. The similarity degree ($d_{12}$) between any two cases of 1 and 2 is shown in formula (1).

$$d_{12} = \frac{m_1}{m_1 + m_2} \tag{1}$$

where $m_1$ denotes the numbers of indicators that matches and $m_2$ denotes the numbers of indicators that do not match. $d_{12}$ is between 0 and 1. If $d_{12}=1$, the two cases are exactly the same; if $d_{12}=0$, the two cases are completely different.

As the object per se possesses ambiguous features under many circumstances, it will correspond to reality further when a fuzzy algorithm is introduced into the clustering analysis. The essence of fuzzy clustering analysis is to construct a fuzzy matrix according to the attributes of the object studied. Classifications are then made according to assigned membership degrees based on the fuzzy matrix.

We suppose x as the overall domain. If A is a function of x with values of [0, 1], A is called the fuzzy set, and is denoted as:

$$A(x) = \begin{cases} 1 & x \in A \\ 0 & x \notin A \end{cases}. \tag{2}$$

Its membership grades are between close section of [0, 1].

The procedures of fuzzy clustering analysis are as follows:

Step 1: Choose indicators for fuzzy clustering analysis. Suppose $X:\{x_1, x_2, \cdots, x_n\}$ represents overall objects classified. Features of each object $x_i$ are labeled by a group of datum ($x_{i1}, x_{i2}, \cdots, x_{im}$).

Step 2: Eliminate the effect of different dimensions by transforming original data. The idea and methods of the transformation are the same as the ones used in systematic clustering analysis, which include standardization, gradation, and logarithm.

Step 3: Calculate fuzzy similarity matrix. Calculate statistical amount $r_{ij}(i, j=1,2, \cdots, n)$ that represents the similarity between the objects classified. *n* refers to the number of objects classified.

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{12} & \cdots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nn} \end{bmatrix} \tag{3}$$

The calculation method of $r_{ij}$ could be Euclidean distances, scalar product, relevant coefficients, Max–Min approach, arithmetic average, least geometric average, absolute value index, absolute value reciprocal, and cosine method.

Step 4: If fuzzy similarity relationship of R is also a fuzzy equivalent relationship, conduct the fuzzy clustering analysis directly. Otherwise, the fuzzy similarity matrix should be remolded into the fuzzy equivalent matrix, which can be judged by the following criteria: Suppose R is a set on $X \times Y$, if R satisfies simultaneously the following prerequisites: (1) reflexivity: $(x_i, x_i) \in R$; and (2) symmetry: if $(x, y) \in R$, then $(y, x) \in R$, R is in relationship of fuzzy similarity. If in addition to meeting (1) and (2), R also meets (3) transitivity: if $(x, y) \in R$ and $(y, z) \in R$, then $(x, z) \in R$, R is in relationship of fuzzy equivalent.
Assign different membership degrees $\lambda$ to get partition matrix $R_\lambda$ and acquire different clustering sets. When $\lambda = 1$, each case in the set becomes a single category. With the decreasing of $\lambda$, the categories get rough and finally merge into one.
Step 5: Draw the clustering graph.

## 4. Research design and measuring convergence of CAS with IFRS

The research design adopted in this study demonstrates how fuzzy clustering analysis is applied to measuring formal accounting convergence using the example of CAS convergence with IFRS. Overall and hierarchical convergence levels between CAS and IFRS are measured. CAS was chosen because China is a representative sample of transitional economy, the new CAS were based on IFRS, and the authors are very familiar with CAS. Also, the new set of CAS was issued in 2006, so it is timely and meaningful to evaluate the convergence levels of CAS with IFRS for capital markets, financial information users, standard-setters, and researchers. Since the new CAS blueprint was based on IFRS 2005, we use IFRS 2005 as comparison criteria for the measurement. For the purposes of our illustration, we will measure the convergence levels of new CAS with IFRS 2005 from single standard, clustering standards, and the standards as a whole set.

According to the theory of fuzzy clustering analysis mentioned above, we consider overall specific standards to be a set. Each pair of comparison standards of CAS and IFRS represents a case in the set. Comparison items, such as terminologies and measurement methods, act as feature indicators (variables) of cases. Based on assigned membership degree $\lambda$, levels of standards convergence are clustered into four categories: completely convergent, substantially convergent, substantially different, and completely different. Each comparison item may contain a number of sub-comparison items, such as FIFO and LIFO. In order to eliminate the impact of different dimensions(i.e., the number's effect of sub-comparison items between cases) matching coefficients are calculated for each comparison item that contains a number of sub-comparison items, and these matching coefficients form the fundamental data for fuzzy clustering analysis.

Detailed steps for calculation are described below:

Step 1: Determine the set of cases and their feature index (variables)
The outline and structure of CAS and IFRS should be considered first when we design the set of cases.
First, we need to define the scope of our calculation. The new CAS system includes 1 fundamental accounting standard and 38 specific accounting standards. The *fundamental accounting standard* in the CAS system is equivalent to *Framework for*

*the Preparation and Presentation of Financial Statement* in the IASB publications. It is the conceptual basis and principal guideline for establishing specific accounting standards and, therefore, does not fit our comparison and evaluation study purpose. CAS38, *First Time Implementation of the Accounting Standards for Business Enterprises*, is a time point standard, which is valid at first time implementation of new standards only and will not exert sustained effect on accounting treatment thereafter. Though it matches IFRS1, there is no sense in comparing it. We exclude it from our study as well. In addition, CAS12, *Debt Restructuring,* only exists in CAS as it pertains to the Chinese economic environment, in particular, and IAS29, *Financial Reporting in Hyperinflationary Economies,* only exists in IFRS since China denies the existence of hyperinflation in its economy. These two standards are also excluded from our set. Thus, we currently have 36 CASs to compare with 5 IFRSs and 31 IASs.

Second, we need to define comparison pairs for each single CAS and IFRS. CAS22, *Recognition and Measurement of Financial Instruments*, CAS23, *Transfer of Financial Assets,* and CAS24, *Hedging,* are standards about financial instruments and match IAS39, *Financial Instruments: Recognition and Measurement*; therefore we combine CAS22, CAS23, and CAS24 into one case to match IAS39. CAS25, *Original Insurance Contracts,* and CAS26, *Reinsurance Contracts,* match IFRS4, *Insurance Contracts*; thus, we combine CAS25 and CAS26 into one case. In addition, CAS2, *Long-term Investment on Stock Right*, matches IAS27, IAS28, and IAS31, so we combine IAS27, IAS28, and IAS31 into one case. CAS4, *Fixed Assets,* matches IAS16 and IFRS5; thus, we combine IAS16 and IFRS5 into one case. CAS7, *No-Monetary Assets Exchange,* matches IAS16, IAS38, and IAS40, so we combine IAS16, IAS38, and IAS40 into one case. CAS19, *Foreign Currency Translation,* matches IAS21 and IAS29, so IAS21 and IAS29 are combined into one case.

Finally, 33 cases are defined in the set, except for the above excluded standards from comparison, each group of combined standards and each of the remaining single CAS are paired with the corresponding IFRS. That is, $S = \{s_1, s_2, \cdots, s_{33}\}$, in which $s_i$ represents No. i standard case, i = 1, 2, …..33.

These 33 standard cases can be further grouped into three categories: standards for general transactions, standards for special industries, and standards for financial reporting. The first two categories specify criteria for accounting treatments and will influence the comparability and usefulness of financial information directly, which is the key for accounting convergence. Standards for financial reporting stipulate the financial statements and account notes, which will influence understandability and usefulness of financial information. Thus, all will be included in our evaluation.

In order to make the comparison possible, the comparison items of each single pair of standards (feature indicators) are confined by six factors based on the contents of the standards. They are terminologies underlying the standard, scope of the standard covered, recognition prerequisites, measurement criteria, measurement methods, and re-measurement by the end of the period. Considering disclosure requirements are quite different from measurement and recognition requirements, since they do not exert any influence on accounting treatment and comparability no matter how much information is disclosed but can improve the usefulness of financial information. In order to demonstrate and easily explain the new methods, this study will focus on the comparison

Table 1
Illustrative example of comparison items' selection and their matching details.

| Cases | Comparison Items between CAS and IFRS | Complete convergence | Substantial convergence | Substantial difference | Complete difference |
|---|---|---|---|---|---|
| | | 1 | 0.7 | 0.3 | 0 |
| No.1 Inventories CAS 1/IAS 2 | | | | | |
| Terminologies | (1) definition of inventories | (1) 3/6–8 | | | |
| | (2) net realizable value | (2) 15/6 | | | |
| Scope | (3) standards scope | | (3) 2/2–5 | | |
| Recognition prerequisites | (4) recognition prerequisites for inventories | (4) 4/in Framework | | | |
| | (5) recognition prerequisites for net realizable value | (5) 16, 17/30–32 | | | |
| Measurement criteria | (6) elements of inventories costs | (6) 5/10 | (7) 6/11 | | (13) 12/20 |
| | (7) purchase costs | | | | CAS recognizes it on book value, while IAS on fair value less selling expenses. |
| | (8) manufacturing costs | (8) 7/12–14 | Net price method is used in IAS. | | (14) 11/0 |
| | (9) other costs | (9) 8/15 | Total price method is used in CAS. | | (15) 12/0 |
| | (10) expenses excluded from inventories costs | (10) 9/16, 18 | | | (16) 12/0 |
| | (11) expenses included in inventories costs | (11) 10 (CAS17) /17 (IAS23) | | | |
| | (12) inventory costs from service providers | (12) 13/19 | | | |
| | (13) agricultural products costs from living assets | | | | |
| | (14) inventory costs from investors | | | | |
| | (15) inventory costs from debt restructuring and merge | | | | |
| | (16) inventory costs from non-monetary transactions | | | | |
| Measuring methods | (17) standard cost | (17) 0/21 not regulated in CAS | | | |
| | (18) retail method | (18) 0/22 not regulated in CAS | | | |
| | (19) specific identification | (19) 14/23–24 | | | |
| | (20) FIFO | (20) 14/25–27 | | | |
| | (21) weighted average cost | (21) 14/25–27 | | | |
| Re-measurement at the end of the period | (22) amortization on packages and supplies | | | | (22) 20/0 |
| | (23) damages and losses in inventories taking should be recognized as reporting period expense | (23) 21/34 | | | |
| | | (24) 14(rough)/34–35 | | | |
| | (24) adjustment on book value when sold | (25) 15/9, 28 | | | |
| | (25) measured at lower of cost and net realizable value | (26) 18/29 | | | |
| | (26) allowance method for inventories shrinkage | (27) 19/33 | | | |
| | (27) revision of allowance for inventories shrinkage | | | | |
| Total | | 20 | 2 | 0 | 1 |

Table 2
Evaluation for 33 comparative cases and their matching coefficients.

| No. | Feature indicator / Case(Sample) dj si | Matching Factor | Terminologies | | Scope | | Recognition prerequisites | | Measurement criterion | | Accounting methods | | Re-measurement | | Matching coefficients |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | |
| 1 | CAS1 Inventories /IAS2 | 1 | 2 | 1 | 0 | 0.7 | 2 | 1 | 6 | 0.609 | 5 | 1 | 5 | 0.833 | 0.793 |
| | | 0.7 | 0 | | 1 | | 0 | | 1 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | 4 | | 0 | | 1 | | |
| 2 | CAS2 Long-term Investment on Stock Right /IAS27/28/31 | 1 | 9 | 0.692 | 1 | 1 | 4 | 0.783 | 1 | 0.65 | 2 | 0.667 | 3 | 0.6 | 0.7 |
| | | 0.7 | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | |
| | | 0 | 4 | | 0 | | 1 | | 0 | | 1 | | 2 | | |
| 3 | CAS3 Investment Property /IAS40 | 1 | 1 | 1 | 0 | 0.7 | 2 | 0.667 | 5 | 0.833 | 5 | 0.833 | 2 | 0.767 | 0.815 |
| | | 0.7 | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 1 | | 0 | | 0 | | 1 | | |
| | | 0 | 0 | | 0 | | 0 | | 1 | | 1 | | 0 | | |
| 4 | CAS4 Fixed Assets /IAS16/IFRS5 | 1 | 3 | 1 | 1 | 1 | 8 | 0.9 | 6 | 0.617 | 5 | 0.833 | 4 | 0.556 | 0.741 |
| | | 0.7 | 0 | | 0 | | 1 | | 2 | | 0 | | 1 | | |
| | | 0.3 | 0 | | 0 | | 1 | | 0 | | 0 | | 1 | | |
| | | 0 | 0 | | 0 | | 0 | | 4 | | 1 | | 3 | | |
| 5 | CAS5 Living Assets /IAS41Agriculture | 1 | 1 | 0.85 | 0 | 0.7 | 0 | 0.35 | 0 | 0 | 1 | 0.4 | 0 | 0 | 0.214 |
| | | 0.7 | 1 | | 1 | | 1 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 2 | | 0 | | |
| | | 0 | 0 | | 0 | | 1 | | 11 | | 1 | | 2 | | |
| 6 | CAS6 Intangible Assets /IAS38 | 1 | 1 | 1 | 1 | 1 | 6 | 1 | 9 | 0.882 | 3 | 0.75 | 3 | 0.75 | 0.878 |
| | | 0.7 | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | 1 | | 1 | | 1 | | |
| 7 | CAS7 No-Monetary Assets Exchange /IAS16/38/40 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 0 | 0.7 | 0 | 1 | 0 | 1 | 0.914 |
| | | 0.7 | 0 | | 0 | | 0 | | 2 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| 8 | CAS8 Impairment of Assets /IAS36 | 1 | 4 | 1 | 0 | 0.7 | 4 | 0.94 | 4 | 1 | 3 | 0.6 | 1 | 0.5 | 0.829 |
| | | 0.7 | 0 | | 1 | | 1 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 2 | | 1 | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | CAS9 Employee Compensation /IAS19 | 1 | 3 | 0.429 | 1 | 1 | 2 | 0.4 | 1 | 0.567 | 1 | 0.5 | 0 | 0 | 0.414 |
| | | 0.7 | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 4 | | 0 | | 3 | | 1 | | 1 | | 3 | | |
| 10 | CAS10 Pensions /IAS26 | 1 | 0 | 0.175 | 1 | 0.5 | 1 | 1 | 1 | 0.5 | 0 | 0 | 1 | 1 | 0.362 |
| | | 0.7 | 1 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 3 | | 1 | | 0 | | 1 | | 3 | | 0 | | |
| 11 | CAS11 Share-based Payment /IFRS2 | 1 | 1 | 1 | 1 | 0.5 | 1 | 0.5 | 2 | 0.675 | 0 | 1 | 2 | 1 | 0.7 |
| | | 0.7 | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 1 | | 1 | | 1 | | 0 | | 0 | | |
| 12 | CAS13 Contingent Items /IAS37 | 1 | 4 | 0.667 | 0 | 0.7 | 5 | 1 | 5 | 0.833 | 3 | 1 | 1 | 1 | 0.85 |
| | | 0.7 | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 2 | | 0 | | 0 | | 1 | | 0 | | 0 | | |
| 13 | CAS14 Revenue /IAS18 | 1 | 1 | 1 | 0 | 0.7 | 4 | 1 | 1 | 1 | 3 | 0.88 | | 1 | 0.925 |
| | | 0.7 | 0 | | 1 | | 0 | | 0 | | 2 | | | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | | | |
| 14 | CAS15 Construction Contracts /IAS11 | 1 | 3 | 1 | 1 | 1 | 6 | 1 | 3 | 0.925 | 3 | 1 | 1 | 1 | 0.983 |
| | | 0.7 | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| 15 | CAS16 Government Grants /IAS20 | 1 | 1 | 0.6 | 0 | 0.7 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 0.827 |
| | | 0.7 | 2 | | 1 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 1 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| 16 | CAS17 Borrowing Costs /IAS23 | 1 | 2 | 1 | 0 | 0.7 | 3 | 0.733 | 2 | 1 | 1 | 0.85 | 2 | 1 | 0.853 |
| | | 0.7 | 0 | | 1 | | 2 | | 0 | | 1 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | | |
| 17 | CAS18 Income Taxes /IAS12 | 1 | 3 | 1 | 1 | 1 | 8 | 1 | 4 | 1 | 3 | 1 | 1 | 0.5 | 0.952 |
| | | 0.7 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | |

(continued on next page)

Table 2 (*continued*)

| No. | Feature indicator / Case(Sample) si / dj | Matching Factor | Terminologies | | Scope | | Recognition prerequisites | | Measurement criterion | | Accounting methods | | Re-measurement | | Matching coefficients |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | Number of matching | Assignment | |
| 18 | CAS19 Foreign Currency Translation /IAS21/29 | 1 | 4 | 1 | 0 | 0.7 | 4 | 0.8 | 3 | 0.75 | 5 | 1 | 1 | 0.5 | 0.843 |
| | | 0.7 | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 1 | | 1 | | 0 | | 1 | | |
| 19 | CAS20 Business Combinations /IFRS3 | 1 | 2 | 1 | 0 | 0.3 | 1 | 0.567 | 7 | 0.7 | 1 | 0.5 | 0 | 1 | 0.667 |
| | | 0.7 | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 1 | | 3 | | 1 | | 0 | | |
| 20 | CAS21 Leases /IAS17 | 1 | 10 | 1 | 0 | 0.7 | 1 | 0.567 | 3 | 0.522 | 5 | 0.714 | 1 | 0.5 | 0.722 |
| | | 0.7 | 0 | | 1 | | 1 | | 2 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 1 | | 3 | | 2 | | 1 | | |
| 21 | CAS22/23/24 Recognition and Measurement of Financial Instrument; Transfer of Financial Assets; Hedging/IAS 39 | 1 | 13 | 1 | 1 | 1 | 12 | 1 | 13 | 1 | 7 | 1 | 5 | 1 | 1 |
| | | 0.7 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| 22 | CAS25/26 Original Insurance Contracts; Reinsurance Contracts /IFRS4 | 1 | 3 | 0.375 | 0 | 0.7 | 2 | 0.386 | 1 | 0.077 | 1 | 0.2 | 0 | 0 | 0.215 |
| | | 0.7 | 0 | | 1 | | 1 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 5 | | 0 | | 4 | | 12 | | 4 | | 5 | | |
| 23 | CAS27 Oil and Gas Mining /IFRS6 | 1 | 0 | 0 | 0 | 0.3 | 0 | 0 | 3 | 0.5 | 2 | 0.667 | 2 | 0.5 | 0.348 |
| | | 0.7 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0.3 | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | | |
| | | 0 | 4 | | 0 | | 3 | | 3 | | 1 | | 2 | | |
| 24 | CAS28 Changes in Accounting Policies and Accounting Estimates, and Corrections of Errors/IAS8 | 1 | 6 | 1 | 1 | 1 | 2 | 0.9 | | 1 | 5 | 1 | 0 | 1 | 0.98 |
| | | 0.7 | 0 | | 0 | | 1 | | | | 0 | | 0 | | |
| | | 0.3 | 0 | | 0 | | 0 | | | | 0 | | 0 | | |
| | | 0 | 0 | | 0 | | 0 | | | | 0 | | 0 | | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | CAS29 Events After Balance Sheet Date /IAS10 | 1 | 1 | | 1 | | 1 | | 1 | | 2 | | 1 | | 0 | | | |
| | | 0.7 | 0 | 1 | 0 | 1 | 2 | 0.8 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0.925 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| 26 | CAS30 Presentation of Financial Statements /IAS1/IFRS 5 | 1 | 3 | | 1 | | 3 | | 6 | | 1 | | 0 | | 0 | | | |
| | | 0.7 | 0 | 1 | 0 | 1 | 1 | 0.925 | 1 | 0.957 | 0 | 0.5 | 0 | 0.5 | 0 | 1 | 0.901 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | | |
| 27 | CAS31 Cash Flow Statement /IAS7 | 1 | 5 | | 1 | | 3 | | 1 | | 1 | | 1 | | 1 | | | |
| | | 0.7 | 1 | 0.95 | 0 | 1 | 1 | 0.925 | 0 | 1 | 0 | 1 | 0 | 0.5 | 0 | 0.5 | 0.838 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | | |
| 28 | CAS32 Interim Financial Reporting /IAS34 | 1 | 2 | | 1 | | 0 | | 0 | | 4 | | 4 | | 0 | | | |
| | | 0.7 | 0 | 1 | 0 | 1 | 1 | 0.7 | 3 | 0.871 | 0 | 0.671 | 1 | 0.671 | 0 | 1 | 0.806 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 2 | | 0 | | 0 | | | |
| 29 | CAS33 Consolidated Financial Statements /IAS27 | 1 | 6 | | 0 | | 1 | | 2 | | 1 | | 1 | | 0 | | | |
| | | 0.7 | 0 | 1 | 1 | 0.7 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0.973 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| 30 | CAS34 Earnings Per Share /IAS33 | 1 | 2 | | 1 | | 1 | | 2 | | 2 | | 1 | | 0 | | | |
| | | 0.7 | 0 | 0.667 | 0 | 1 | 2 | 0.6 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0.669 | |
| | | 0.3 | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 3 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| 31 | CAS35 Segment Reporting /IAS14 | 1 | 8 | | 0 | | 4 | | 1 | | 1 | | 0 | | 0 | | | |
| | | 0.7 | 0 | 1 | 1 | 0.7 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0.979 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| 32 | CAS36 Related Party Disclosures /IAS24 | 1 | 7 | | 1 | | 1 | | 1 | | 0 | | 0 | | 0 | | | |
| | | 0.7 | 0 | 1 | 0 | 1 | 1 | 0.85 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0.97 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| 33 | CAS37 Presentation of Financial Instruments /IAS30/32 | 1 | 1 | | 1 | | 2 | | 4 | | 0 | | 0 | | 1 | | | |
| | | 0.7 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | |
| | | 0.3 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |
| | | 0 | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | |

of recognition and measurement, which is also the major study objective in most quantitative research. As for the measurement on the convergence of CAS with IFRS that includes disclosure requirements, the same procedures could be followed, but more complicated explanation is needed. We leave this for further study. Thus, we define six comparison items for each single case, which are denoted by $D=\{d_1, d_2, d_3, d_4, d_5, d_6\}$. The feature of No. j in standard of No. i could be indicated by $x_{ij}$, where i = 1, 2, …..33, and j = 1, 2, 3, 4, 5, 6.

Step 2: Assign a value to each of the comparison items and eliminate effects resulted from different dimensions

We assign 1 to the items that completely match, and 0.7, 0.3, and 0, respectively, for the items that substantially match, are substantially different, or are completely different. Matching coefficients are calculated when comparison items of a single case contained sub-comparison items, whose values are assigned by the same method as comparison items, so as to eliminate effects of different dimensions. We assign 1 to the items that are both absent in the comparison pair of CAS and IFRS. Examples of comparison items' selection and their matching details are shown in Table 1. Assignment for 33 comparative cases and their matching coefficients are shown in Table 2.

According to Table 2, we can use the matching coefficient method to calculate the overall convergence level for 33 cases.The overall convergence level for 33 cases

$$= (406 \times 1 + 53 \times 0.7 + 10 \times 0.3 + 126 \times 0) / (406 + 53 + 10 + 126) = 0.7497$$

Step 3: Calculate fuzzy similarity matrix

We use cosine to calculate $r_{ij}$, and construct fuzzy similarity matrix:$R=|r_{ij}|_{n\times n}$, which is shown in Eq. (1).

Step 4: Process matrix R to get fuzzy equivalent matrix R′

After three times convolution, $R^2 \bullet R^2 \bullet R^2 = R^2 \bullet R^2$, fuzzy equivalent matrix R′ is yielded, which is shown in Eq. (2).

Step 5: Cluster and draw fuzzy clustering graph

Give different membership degree λ to get partition matrix $R_\lambda$.

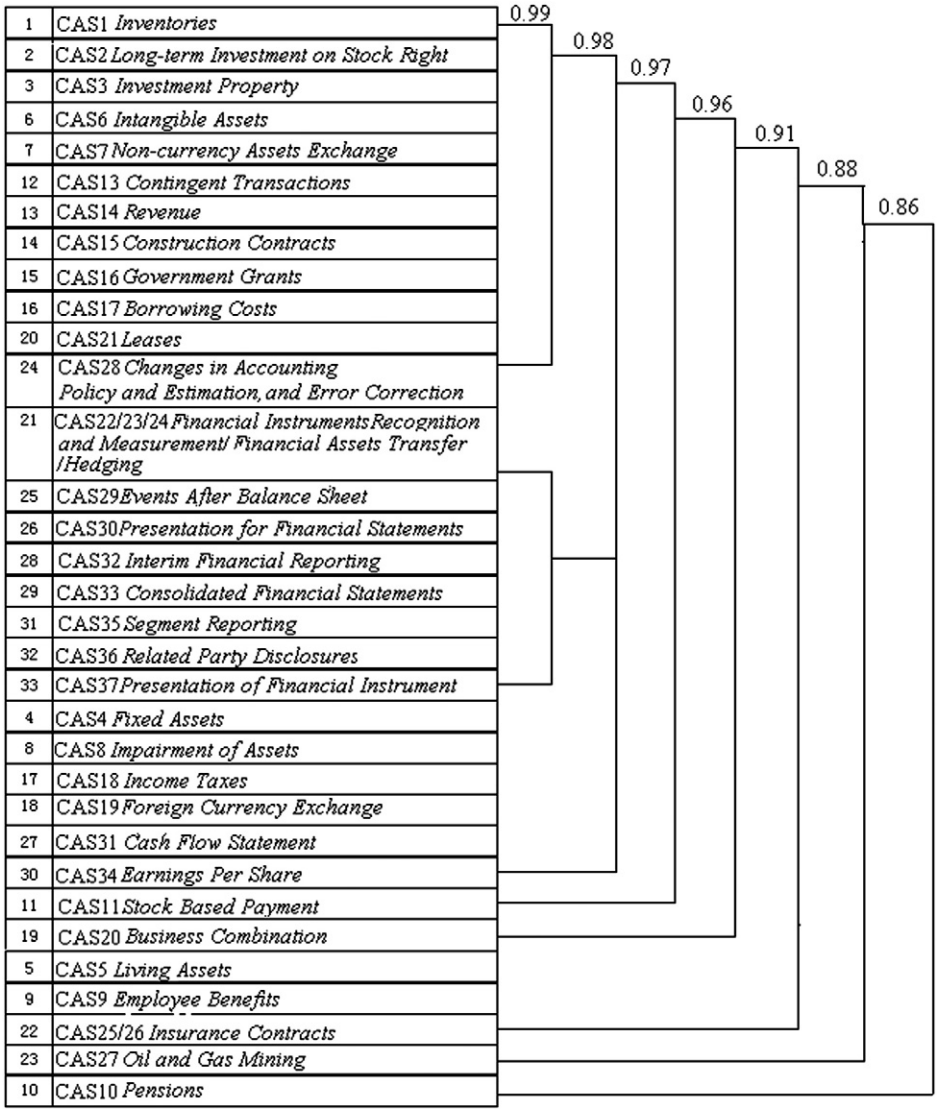
When λ = 1, each of 33 cases is in a single category.

$\{S_1\}\cup\{S_2\}\cup\{S_3\}\cup\{S_4\}\cup\{S_5\}\cup\{S_6\}\cup\{S_7\}\cup\{S_8\}\cup\{S_9\}\cup\{S_{10}\}\cup\{S_{11}\}\cup\{S_{12}\}\cup\{S_{13}\}\cup\{S_{14}\}\cup\{S_{15}\}\cup\{S_{16}\}\cup\{S_{17}\}\cup\{S_{18}\}\cup\{S_{19}\}\cup\{S_{20}\}\cup\{S_{21}\}\cup\{S_{22}\}\cup\{S_{23}\}\cup\{S_{24}\}\cup\{S_{25}\}\cup\{S_{26}\}\cup\{S_{27}\}\cup\{S_{28}\}\cup\{S_{29}\}\cup\{S_{30}\}\cup\{S_{31}\}\cup\{S_{32}\}\cup\{S_{33}\}$.

When λ = 0.99, 33 cases are categorized into 15, in which, the convergence of Case Nos. 1, 2, 3, 6, 7, 12, 13, 14, 15, 16, 20, and 24 and Case Nos. 21, 25, 26, 28, 29, 31, 32, and 33 are similar and are first categorized into one separately. Each of the remaining 13 cases is in a single category.

$\{S_1,S_2,S_3,S_6,S_7,S_{12},S_{13},S_{14},S_{15},S_{16},S_{20},S_{24}\}\cup\{S_{21},S_{25},S_{26},S_{28},S_{29},S_{31},S_{32},S_{33}\}\cup\{S_4\}\cup\{S_5\}\cup\{S_8\}\cup\{S_9\}\cup\{S_{10}\}\cup\{S_{11}\}\cup\{S_{17}\}\cup\{S_{18}\}\cup\{S_{19}\}\cup\{S_{22}\}\cup\{S_{23}\}\cup\{S_{27}\}\cup\{S_{30}\}$.

When λ = 0.98, 33 cases are categorized into 8. Case Nos. 1, 2, 3, 6, 7, 12, 13, 14, 15, 16, 20, and 24 and Case Nos. 21, 25, 26, 28, 29, 31, 32, and 33 combine into one category. Meanwhile, Case Nos. 4, 8, 17, 18, 27, and 30 also merge into this category. Each of the remaining 7 cases is in a single category.




Graph 1. Fuzzy clustering graph of CAS convergence with IFRS.

$\{S_1,S_2,S_3,S_6,S_7,S_{12},S_{13},S_{14},S_{15},S_{16},S_{20},S_{24},S_{21},S_{25},S_{26},S_{28},S_{29},S_{31},S_{32},S_{33},S_4,S_8,S_{17},S_{18},S_{27},S_{30}\}\cup\{S_5\}\cup\{S_9\}\cup\{S_{10}\}\cup\{S_{11}\}\cup\{S_{19}\}\cup\{S_{22}\}\cup\{S_{23}\}$.

When $\lambda=0.97$, 33 cases are categorized into 7. Case No. 11 merges into the categorized one. Each of the remaining 6 cases is in a single category.

$\{S_1,S_2,S_3,S_6,S_7,S_{12},S_{13},S_{14},S_{15},S_{16},S_{20},S_{24},S_{21},S_{25},S_{26},S_{28},S_{29},S_{31},S_{32},S_{33},S_4,S_8,S_{17},S_{27},S_{30},S_{11}\}\cup\{S_5\}\cup\{S_9\}\cup\{S_{10}\}\cup\{S_{19}\}\cup\{S_{22}\}\cup\{S_{23}\}$.

$$
R=\begin{pmatrix}
1 & 0.961 & 0.980 & 0.977 & 0.801 & 0.976 & 0.992 & 0.952 & 0.804 & 0.784 & 0.965 & 0.979 & 0.983 & 0.987 & 0.964 & 0.971 & 0.966 & 0.982 & 0.933 & 0.974 & 0.984 & 0.772 & 0.736 & 0.98 & 0.975 & 0.949 & 0.931 & 0.959 & 0.986 & 0.942 & 0.986 & 0.978 & 0.984 \\
0.961 & 1 & 0.640 & 0.988 & 0.821 & 0.991 & 0.983 & 0.957 & 0.917 & 0.804 & 0.908 & 0.957 & 0.960 & 0.985 & 0.951 & 0.953 & 0.980 & 0.960 & 0.873 & 0.961 & 0.984 & 0.873 & 0.739 & 0.982 & 0.979 & 0.973 & 0.975 & 0.976 & 0.959 & 0.964 & 0.959 & 0.981 & 0.984 \\
0.980 & 0.640 & 1 & 0.972 & 0.789 & 0.982 & 0.982 & 0.971 & 0.835 & 0.755 & 0.978 & 0.968 & 0.990 & 0.990 & 0.962 & 0.995 & 0.975 & 0.984 & 0.956 & 0.984 & 0.991 & 0.753 & 0.778 & 0.993 & 0.994 & 0.970 & 0.956 & 0.984 & 0.991 & 0.969 & 0.991 & 0.993 & 0.991 \\
0.977 & 0.988 & 0.972 & 1 & 0.878 & 0.989 & 0.984 & 0.964 & 0.902 & 0.749 & 0.922 & 0.946 & 0.959 & 0.981 & 0.933 & 0.950 & 0.986 & 0.982 & 0.884 & 0.986 & 0.978 & 0.880 & 0.692 & 0.976 & 0.972 & 0.958 & 0.969 & 0.965 & 0.96 & 0.939 & 0.960 & 0.974 & 0.978 \\
0.801 & 0.821 & 0.789 & 0.878 & 1 & 0.813 & 0.803 & 0.782 & 0.83 & 0.436 & 0.730 & 0.687 & 0.728 & 0.777 & 0.650 & 0.727 & 0.821 & 0.832 & 0.672 & 0.885 & 0.768 & 0.922 & 0.383 & 0.769 & 0.768 & 0.757 & 0.805 & 0.779 & 0.730 & 0.700 & 0.730 & 0.768 & 0.768 \\
0.976 & 0.991 & 0.982 & 0.989 & 0.813 & 1 & 0.986 & 0.984 & 0.882 & 0.814 & 0.930 & 0.966 & 0.983 & 0.992 & 0.960 & 0.974 & 0.987 & 0.975 & 0.918 & 0.974 & 0.992 & 0.835 & 0.718 & 0.990 & 0.985 & 0.986 & 0.986 & 0.984 & 0.980 & 0.958 & 0.980 & 0.988 & 0.992 \\
0.992 & 0.983 & 0.982 & 0.984 & 0.803 & 0.986 & 1 & 0.949 & 0.841 & 0.812 & 0.960 & 0.982 & 0.982 & 0.996 & 0.969 & 0.976 & 0.969 & 0.973 & 0.927 & 0.973 & 0.993 & 0.806 & 0.762 & 0.992 & 0.988 & 0.970 & 0.946 & 0.981 & 0.984 & 0.967 & 0.984 & 0.990 & 0.993 \\
0.952 & 0.957 & 0.971 & 0.964 & 0.782 & 0.984 & 0.949 & 1 & 0.859 & 0.776 & 0.906 & 0.938 & 0.973 & 0.966 & 0.940 & 0.963 & 0.982 & 0.969 & 0.915 & 0.958 & 0.970 & 0.786 & 0.67 & 0.966 & 0.96 & 0.967 & 0.988 & 0.955 & 0.969 & 0.921 & 0.969 & 0.963 & 0.970 \\
0.804 & 0.917 & 0.835 & 0.902 & 0.830 & 0.882 & 0.841 & 0.859 & 1 & 0.572 & 0.731 & 0.792 & 0.799 & 0.852 & 0.795 & 0.800 & 0.913 & 0.864 & 0.652 & 0.861 & 0.854 & 0.922 & 0.651 & 0.856 & 0.857 & 0.836 & 0.908 & 0.846 & 0.801 & 0.855 & 0.801 & 0.857 & 0.854 \\
0.784 & 0.804 & 0.755 & 0.749 & 0.436 & 0.814 & 0.812 & 0.776 & 0.572 & 1 & 0.715 & 0.842 & 0.829 & 0.815 & 0.843 & 0.796 & 0.734 & 0.697 & 0.794 & 0.691 & 0.815 & 0.581 & 0.556 & 0.802 & 0.787 & 0.864 & 0.789 & 0.815 & 0.812 & 0.779 & 0.812 & 0.795 & 0.815 \\
0.965 & 0.908 & 0.978 & 0.922 & 0.730 & 0.93 & 0.96 & 0.906 & 0.731 & 0.715 & 1 & 0.953 & 0.965 & 0.961 & 0.942 & 0.979 & 0.916 & 0.951 & 0.965 & 0.954 & 0.960 & 0.647 & 0.818 & 0.965 & 0.969 & 0.922 & 0.874 & 0.953 & 0.971 & 0.950 & 0.971 & 0.967 & 0.960 \\
0.979 & 0.957 & 0.968 & 0.946 & 0.687 & 0.966 & 0.982 & 0.938 & 0.792 & 0.842 & 0.953 & 1 & 0.987 & 0.997 & 0.975 & 0.953 & 0.955 & 0.923 & 0.930 & 0.987 & 0.711 & 0.819 & 0.983 & 0.979 & 0.952 & 0.922 & 0.957 & 0.990 & 0.971 & 0.990 & 0.981 & 0.987 \\
0.983 & 0.960 & 0.990 & 0.959 & 0.728 & 0.983 & 0.982 & 0.973 & 0.799 & 0.829 & 0.965 & 0.987 & 1 & 0.992 & 0.984 & 0.994 & 0.966 & 0.970 & 0.962 & 0.958 & 0.993 & 0.721 & 0.770 & 0.991 & 0.987 & 0.977 & 0.954 & 0.977 & 0.999 & 0.964 & 0.999 & 0.989 & 0.993 \\
0.987 & 0.985 & 0.990 & 0.981 & 0.777 & 0.992 & 0.996 & 0.966 & 0.852 & 0.815 & 0.961 & 0.987 & 0.992 & 1 & 0.980 & 0.988 & 0.978 & 0.977 & 0.935 & 0.971 & 1 & 0.788 & 0.784 & 0.999 & 0.996 & 0.979 & 0.961 & 0.987 & 0.992 & 0.979 & 0.992 & 0.998 & 1 \\
0.964 & 0.951 & 0.962 & 0.933 & 0.650 & 0.96 & 0.969 & 0.940 & 0.795 & 0.843 & 0.942 & 0.997 & 0.984 & 0.980 & 1 & 0.974 & 0.951 & 0.947 & 0.915 & 0.914 & 0.982 & 0.689 & 0.838 & 0.98 & 0.975 & 0.949 & 0.923 & 0.951 & 0.986 & 0.974 & 0.986 & 0.978 & 0.982 \\
0.971 & 0.953 & 0.995 & 0.950 & 0.727 & 0.974 & 0.976 & 0.963 & 0.8 & 0.796 & 0.979 & 0.975 & 0.994 & 0.988 & 0.974 & 1 & 0.958 & 0.965 & 0.969 & 0.962 & 0.99 & 0.704 & 0.801 & 0.992 & 0.992 & 0.975 & 0.946 & 0.985 & 0.993 & 0.975 & 0.993 & 0.992 & 0.990 \\
0.966 & 0.980 & 0.975 & 0.986 & 0.821 & 0.987 & 0.969 & 0.982 & 0.913 & 0.734 & 0.916 & 0.953 & 0.966 & 0.978 & 0.951 & 0.958 & 1 & 0.989 & 0.877 & 0.971 & 0.98 & 0.835 & 0.737 & 0.978 & 0.974 & 0.951 & 0.978 & 0.955 & 0.969 & 0.949 & 0.969 & 0.976 & 0.980 \\
0.982 & 0.960 & 0.984 & 0.982 & 0.832 & 0.975 & 0.973 & 0.969 & 0.864 & 0.697 & 0.951 & 0.955 & 0.97 & 0.977 & 0.947 & 0.965 & 0.989 & 1 & 0.905 & 0.985 & 0.977 & 0.794 & 0.744 & 0.976 & 0.973 & 0.934 & 0.949 & 0.949 & 0.979 & 0.941 & 0.976 & 0.975 & 0.977 \\
0.933 & 0.873 & 0.956 & 0.884 & 0.672 & 0.918 & 0.927 & 0.915 & 0.652 & 0.794 & 0.965 & 0.923 & 0.962 & 0.935 & 0.915 & 0.969 & 0.877 & 0.905 & 1 & 0.920 & 0.935 & 0.594 & 0.705 & 0.937 & 0.938 & 0.941 & 0.880 & 0.946 & 0.956 & 0.901 & 0.956 & 0.938 & 0.935 \\
0.974 & 0.961 & 0.984 & 0.986 & 0.885 & 0.974 & 0.973 & 0.958 & 0.861 & 0.691 & 0.954 & 0.93 & 0.958 & 0.971 & 0.914 & 0.962 & 0.971 & 0.985 & 0.920 & 1 & 0.969 & 0.827 & 0.698 & 0.971 & 0.971 & 0.948 & 0.949 & 0.966 & 0.966 & 0.931 & 0.960 & 0.971 & 0.969 \\
0.984 & 0.984 & 0.991 & 0.978 & 0.768 & 0.992 & 0.993 & 0.970 & 0.854 & 0.815 & 0.96 & 0.987 & 0.993 & 1 & 0.982 & 0.990 & 0.980 & 0.977 & 0.935 & 0.969 & 1 & 0.781 & 0.789 & 0.999 & 0.997 & 0.981 & 0.964 & 0.987 & 0.993 & 0.981 & 0.993 & 0.998 & 1 \\
0.772 & 0.873 & 0.753 & 0.880 & 0.922 & 0.835 & 0.806 & 0.786 & 0.922 & 0.581 & 0.647 & 0.711 & 0.721 & 0.788 & 0.689 & 0.704 & 0.835 & 0.794 & 0.594 & 0.827 & 0.781 & 1 & 0.413 & 0.776 & 0.770 & 0.789 & 0.848 & 0.785 & 0.718 & 0.732 & 0.718 & 0.773 & 0.781 \\
0.736 & 0.739 & 0.778 & 0.692 & 0.383 & 0.718 & 0.762 & 0.670 & 0.651 & 0.556 & 0.818 & 0.819 & 0.77 & 0.784 & 0.838 & 0.801 & 0.737 & 0.744 & 0.705 & 0.698 & 0.789 & 0.413 & 1 & 0.802 & 0.814 & 0.707 & 0.659 & 0.763 & 0.787 & 0.882 & 0.787 & 0.808 & 0.789 \\
0.980 & 0.982 & 0.993 & 0.976 & 0.769 & 0.99 & 0.992 & 0.966 & 0.856 & 0.802 & 0.965 & 0.983 & 0.991 & 0.999 & 0.98 & 0.992 & 0.978 & 0.976 & 0.937 & 0.971 & 0.999 & 0.776 & 0.802 & 1 & 0.999 & 0.979 & 0.962 & 0.990 & 0.992 & 0.986 & 0.992 & 1 & 0.999 \\
0.975 & 0.979 & 0.994 & 0.972 & 0.768 & 0.985 & 0.988 & 0.960 & 0.857 & 0.787 & 0.969 & 0.979 & 0.987 & 0.996 & 0.975 & 0.992 & 0.974 & 0.973 & 0.938 & 0.971 & 0.997 & 0.77 & 0.814 & 0.999 & 1 & 0.977 & 0.957 & 0.991 & 0.988 & 0.989 & 0.988 & 1 & 0.997 \\
0.949 & 0.973 & 0.970 & 0.958 & 0.757 & 0.986 & 0.97 & 0.967 & 0.836 & 0.864 & 0.922 & 0.952 & 0.977 & 0.979 & 0.949 & 0.975 & 0.951 & 0.934 & 0.941 & 0.948 & 0.981 & 0.789 & 0.707 & 0.979 & 0.977 & 1 & 0.976 & 0.992 & 0.968 & 0.953 & 0.968 & 0.978 & 0.981 \\
0.931 & 0.975 & 0.956 & 0.969 & 0.805 & 0.986 & 0.946 & 0.988 & 0.908 & 0.789 & 0.874 & 0.922 & 0.954 & 0.961 & 0.923 & 0.946 & 0.978 & 0.949 & 0.88 & 0.949 & 0.964 & 0.848 & 0.659 & 0.962 & 0.957 & 0.976 & 1 & 0.962 & 0.946 & 0.926 & 0.946 & 0.959 & 0.964 \\
0.959 & 0.976 & 0.984 & 0.965 & 0.779 & 0.984 & 0.981 & 0.955 & 0.846 & 0.815 & 0.953 & 0.957 & 0.977 & 0.987 & 0.951 & 0.985 & 0.955 & 0.949 & 0.946 & 0.966 & 0.987 & 0.785 & 0.763 & 0.990 & 0.991 & 0.992 & 0.962 & 1 & 0.973 & 0.974 & 0.973 & 0.991 & 0.987 \\
0.986 & 0.959 & 0.991 & 0.960 & 0.730 & 0.98 & 0.984 & 0.969 & 0.801 & 0.812 & 0.971 & 0.990 & 0.999 & 0.992 & 0.986 & 0.993 & 0.969 & 0.979 & 0.956 & 0.966 & 0.993 & 0.718 & 0.787 & 0.992 & 0.988 & 0.968 & 0.946 & 0.973 & 1 & 0.967 & 1 & 0.99 & 0.993 \\
0.942 & 0.964 & 0.969 & 0.939 & 0.700 & 0.958 & 0.967 & 0.921 & 0.855 & 0.779 & 0.950 & 0.971 & 0.964 & 0.979 & 0.974 & 0.975 & 0.949 & 0.941 & 0.901 & 0.931 & 0.981 & 0.732 & 0.882 & 0.986 & 0.989 & 0.953 & 0.926 & 0.974 & 0.967 & 1 & 0.967 & 0.987 & 0.981 \\
0.986 & 0.959 & 0.991 & 0.96 & 0.730 & 0.98 & 0.984 & 0.969 & 0.801 & 0.812 & 0.971 & 0.990 & 0.999 & 0.992 & 0.986 & 0.993 & 0.969 & 0.976 & 0.956 & 0.960 & 0.993 & 0.718 & 0.787 & 0.992 & 0.988 & 0.968 & 0.946 & 0.973 & 1 & 0.967 & 1 & 0.99 & 0.993 \\
0.978 & 0.981 & 0.993 & 0.974 & 0.768 & 0.988 & 0.99 & 0.963 & 0.857 & 0.795 & 0.967 & 0.981 & 0.989 & 0.998 & 0.978 & 0.992 & 0.976 & 0.975 & 0.938 & 0.971 & 0.998 & 0.773 & 0.808 & 1 & 1 & 0.978 & 0.959 & 0.991 & 0.990 & 0.987 & 0.990 & 1 & 0.998 \\
0.984 & 0.984 & 0.991 & 0.978 & 0.768 & 0.992 & 0.993 & 0.97 & 0.854 & 0.815 & 0.96 & 0.987 & 0.993 & 1 & 0.982 & 0.990 & 0.980 & 0.977 & 0.935 & 0.969 & 1 & 0.781 & 0.789 & 0.999 & 0.997 & 0.981 & 0.964 & 0.987 & 0.993 & 0.981 & 0.993 & 0.998 & 1
\end{pmatrix}
$$

Eq. 1. Fuzzy similarity matrix.

When λ = 0.96, 33 cases are categorized into 6. Case No. 19 merges into the categorized one. Each of the remaining 5 cases is still in a single category.
$\{S_1,S_2,S_3,S_6,S_7,S_{12},S_{13},S_{14},S_{15},S_{16},S_{20},S_{24},S_{21},S_{25},S_{26},S_{28},S_{29},S_{31},S_{32},S_{33},S_4,S_8,S_{17},S_{18},S_{27},S_{30},S_{11},S_{19}\}\cup\{S_5\}\cup\{S_9\}\cup\{S_{10}\}\cup\{S_{22}\}\cup\{S_{23}\}$.
When λ = 0.91, 33 cases are categorized into 3. Case Nos. 5, 9, and 22 are categorized into the one of similarity. Each of the remaining 2 cases is still in a single category.
$\{S_1,S_2,S_3,S_6,S_7,S_{12},S_{13},S_{14},S_{15},S_{16},S_{20},S_{24},S_{21},S_{25},S_{26},S_{28},S_{29},S_{31},S_{32},S_{33},S_4,S_8,S_{17},S_{18},S_{27},S_{30},S_{11},S_{19},S_5,S_9,S_{22}\}\cup\{S_{10}\}\cup\{S_{23}\}$.
When λ = 0.88, 33 cases are categorized into 2. With the exception of Case No.10, which is still in a separate category, the others have merged into one category.
$\{S_1,S_2,S_3,S_6,S_7,S_{12},S_{13},S_{14},S_{15},S_{16},S_{20},S_{24},S_{21},S_{25},S_{26},S_{28},S_{29},S_{31},S_{32},S_{33},S_4,S_8,S_{17},S_{18},S_{27},S_{30},S_{11},S_{19},S_5,S_9,S_{22},S_{23}\}\cup\{S_{10}\}$.
When λ = 0.86, 33 cases are categorized into 1.
$\{S_1,S_2,S_3,S_6,S_7,S_{12},S_{13},S_{14},S_{15},S_{16},S_{20},S_{24},S_{21},S_{25},S_{26},S_{28},S_{29},S_{31},S_{32},S_{33},S_4,S_8,S_{17},S_{18},S_{27},S_{30},S_{11},S_{19},S_5,S_9,S_{22},S_{23},S_{10}\}$.
The fuzzy clustering graph is shown in Graph 1.

## 5. Results and analysis

Based on the above fuzzy clustering algorithm, we found the convergence levels of new CAS with IFRS to be as follows:

First, new CAS have achieved substantial convergence with IFRS. The overall convergence level of CAS with IFRS calculated by matching coefficients is 0.7497, larger than 0.7, which proves substantial convergence of CAS with IFRS.

Second, differences in convergence levels among most of the 33 standard cases are moderate when the single case convergence level is calculated separately (see Table 2), except for Case Nos. 5, 9, 22, 10, and 23. A very small interval of membership degree demonstrates minor differences of convergence levels between each case. From the fuzzy clustering graph (see Graph 1), we find that when the membership degree λ is 0.99, 12 cases and 8 cases have been categorized into one, respectively. When the membership degree λ is 0.97, 27 cases have been categorized into one. The smallest strides of membership degree is 0.01, and the largest strides of membership degree is 0.14, that is, when λ = 1, each case is in a single category, and when λ = 0.86, all cases are categorized into one. This means that the convergence level of majority cases is similar,; only minority cases, that is, the last 5 cases in Graph 1, show a dissimilar convergence level. This can also be proved by the convergence level of a single case (see Table 1), which indicates that more effort is required to bring them closer toward international convergence.

Third, the convergence level of reporting standards is larger than those of general transaction standards and special industries standards, and the convergence level of general standards is larger than that of special industries standards. This is demonstrated by the results of matching coefficients (see Table 2) and the clustering graph (see Graph 1). From the clustering graph, we recognize that standards for reporting, including Case Nos. 25, 26, 28, 29, 31, 32, and 33 (CAS29, CAS30, CAS 32, CAS33, CAS35, CAS36, and CAS37) are categorized into one group first, except Case Nos. 27 and 30 (CAS31 and CAS34), while

$$R' = \begin{pmatrix}
1 & 0.991 & 0.992 & 0.989 & 0.917 & 0.992 & 0.992 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.992 & 0.992 & 0.990 & 0.992 & 0.987 & 0.987 & 0.969 & 0.992 & 0.992 & 0.917 & 0.882 & 0.992 & 0.992 & 0.991 & 0.986 & 0.991 & 0.992 & 0.989 & 0.992 & 0.992 & 0.992 \\
0.991 & 1 & 0.991 & 0.989 & 0.917 & 0.991 & 0.991 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.991 & 0.991 & 0.990 & 0.991 & 0.987 & 0.987 & 0.969 & 0.991 & 0.991 & 0.917 & 0.882 & 0.991 & 0.991 & 0.991 & 0.986 & 0.991 & 0.991 & 0.989 & 0.991 & 0.991 & 0.991 \\
0.992 & 0.991 & 1 & 0.989 & 0.917 & 0.992 & 0.994 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 0.994 & 0.990 & 0.995 & 0.987 & 0.987 & 0.969 & 0.994 & 0.994 & 0.917 & 0.882 & 0.994 & 0.994 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 0.994 & 0.994 \\
0.989 & 0.989 & 0.989 & 1 & 0.917 & 0.989 & 0.989 & 0.986 & 0.917 & 0.864 & 0.979 & 0.989 & 0.989 & 0.989 & 0.989 & 0.989 & 0.987 & 0.987 & 0.969 & 0.989 & 0.989 & 0.882 & 0.989 & 0.989 & 0.989 & 0.986 & 0.989 & 0.989 & 0.989 & 0.989 & 0.989 & 0.989 & 0.989 \\
0.917 & 0.917 & 0.917 & 0.917 & 1 & 0.917 & 0.917 & 0.917 & 0.922 & 0.864 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.922 & 0.882 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 \\
0.992 & 0.991 & 0.992 & 0.989 & 0.917 & 1 & 0.992 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.992 & 0.992 & 0.990 & 0.992 & 0.987 & 0.987 & 0.969 & 0.992 & 0.992 & 0.917 & 0.882 & 0.992 & 0.992 & 0.991 & 0.986 & 0.991 & 0.992 & 0.989 & 0.992 & 0.992 & 0.992 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 1 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 0.996 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.996 & 0.996 & 0.917 & 0.882 & 0.996 & 0.996 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 0.996 & 0.996 \\
0.986 & 0.986 & 0.986 & 0.986 & 0.917 & 0.986 & 0.986 & 1 & 0.917 & 0.864 & 0.979 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.969 & 0.986 & 0.986 & 0.917 & 0.882 & 0.986 & 0.986 & 0.986 & 0.988 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 \\
0.917 & 0.917 & 0.917 & 0.917 & 0.922 & 0.917 & 0.917 & 0.917 & 1 & 0.864 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.922 & 0.882 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 \\
0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 1 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 & 0.864 \\
0.979 & 0.979 & 0.979 & 0.979 & 0.917 & 0.979 & 0.979 & 0.979 & 0.917 & 0.864 & 1 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.969 & 0.979 & 0.979 & 0.917 & 0.882 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 & 0.979 \\
0.990 & 0.990 & 0.990 & 0.989 & 0.917 & 0.990 & 0.990 & 0.986 & 0.917 & 0.864 & 0.979 & 1 & 0.990 & 0.990 & 0.997 & 0.990 & 0.987 & 0.987 & 0.969 & 0.990 & 0.990 & 0.917 & 0.882 & 0.990 & 0.990 & 0.990 & 0.986 & 0.990 & 0.990 & 0.989 & 0.990 & 0.990 & 0.990 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.994 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 1 & 0.994 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.994 & 0.994 & 0.917 & 0.882 & 0.994 & 0.994 & 0.991 & 0.986 & 0.991 & 0.999 & 0.989 & 0.999 & 0.994 & 0.994 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.996 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 1 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.999 & 1 & 0.917 & 0.882 & 0.999 & 0.999 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 0.999 & 1 \\
0.990 & 0.990 & 0.990 & 0.989 & 0.917 & 0.990 & 0.990 & 0.986 & 0.917 & 0.864 & 0.979 & 0.997 & 0.990 & 0.990 & 1 & 0.990 & 0.987 & 0.987 & 0.969 & 0.990 & 0.990 & 0.917 & 0.882 & 0.990 & 0.990 & 0.990 & 0.986 & 0.990 & 0.990 & 0.989 & 0.990 & 0.990 & 0.990 \\
0.992 & 0.991 & 0.995 & 0.989 & 0.917 & 0.992 & 0.994 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 0.994 & 0.990 & 1 & 0.987 & 0.987 & 0.969 & 0.994 & 0.994 & 0.917 & 0.882 & 0.994 & 0.994 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 0.994 & 0.994 \\
0.987 & 0.987 & 0.987 & 0.987 & 0.917 & 0.987 & 0.987 & 0.986 & 0.917 & 0.864 & 0.979 & 0.987 & 0.987 & 0.987 & 0.987 & 0.987 & 1 & 0.989 & 0.969 & 0.987 & 0.987 & 0.917 & 0.882 & 0.987 & 0.987 & 0.987 & 0.986 & 0.987 & 0.987 & 0.987 & 0.987 & 0.987 & 0.987 \\
0.987 & 0.987 & 0.987 & 0.987 & 0.917 & 0.987 & 0.987 & 0.986 & 0.917 & 0.864 & 0.979 & 0.987 & 0.987 & 0.987 & 0.987 & 0.987 & 0.989 & 1 & 0.969 & 0.987 & 0.987 & 0.917 & 0.882 & 0.987 & 0.987 & 0.987 & 0.986 & 0.987 & 0.987 & 0.987 & 0.987 & 0.987 & 0.987 \\
0.969 & 0.969 & 0.969 & 0.969 & 0.917 & 0.969 & 0.969 & 0.969 & 0.917 & 0.864 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 1 & 0.969 & 0.969 & 0.917 & 0.882 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 & 0.969 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.996 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 0.999 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 1 & 0.999 & 0.917 & 0.882 & 1 & 1 & 0.99 & 0.986 & 0.991 & 0.994 & 0.986 & 0.994 & 1 & 0.999 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.996 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 1 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.986 & 1 & 0.917 & 0.882 & 0.999 & 0.999 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 0.999 & 1 \\
0.917 & 0.917 & 0.917 & 0.917 & 0.922 & 0.917 & 0.917 & 0.917 & 0.922 & 0.864 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 1 & 0.882 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 & 0.917 \\
0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.864 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 1 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 & 0.882 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.996 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 0.999 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 1 & 0.999 & 0.917 & 0.882 & 1 & 1 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 1 & 0.999 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.996 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 0.999 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.986 & 0.999 & 0.917 & 0.882 & 1 & 1 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 1 & 0.999 \\
0.991 & 0.991 & 0.991 & 0.989 & 0.917 & 0.991 & 0.991 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.991 & 0.991 & 0.990 & 0.991 & 0.987 & 0.987 & 0.969 & 0.986 & 0.991 & 0.917 & 0.882 & 0.991 & 0.991 & 1 & 0.986 & 0.992 & 0.991 & 0.989 & 0.991 & 0.991 & 0.991 \\
0.986 & 0.986 & 0.986 & 0.986 & 0.917 & 0.986 & 0.986 & 0.988 & 0.917 & 0.864 & 0.979 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.969 & 0.986 & 0.986 & 0.917 & 0.882 & 0.986 & 0.986 & 0.986 & 1 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 & 0.986 \\
0.991 & 0.991 & 0.991 & 0.989 & 0.917 & 0.991 & 0.991 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.991 & 0.991 & 0.990 & 0.991 & 0.987 & 0.987 & 0.969 & 0.986 & 0.991 & 0.917 & 0.882 & 0.991 & 0.991 & 0.992 & 0.986 & 1 & 0.991 & 0.989 & 0.991 & 0.991 & 0.991 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.994 & 0.986 & 0.917 & 0.864 & 0.979 & 0.99 & 0.999 & 0.994 & 0.99 & 0.994 & 0.987 & 0.987 & 0.969 & 0.986 & 0.994 & 0.917 & 0.882 & 0.994 & 0.994 & 0.991 & 0.986 & 0.991 & 1 & 0.989 & 1 & 0.994 & 0.994 \\
0.989 & 0.989 & 0.989 & 0.989 & 0.917 & 0.989 & 0.989 & 0.986 & 0.917 & 0.864 & 0.979 & 0.989 & 0.989 & 0.989 & 0.989 & 0.989 & 0.987 & 0.987 & 0.969 & 0.986 & 0.989 & 0.917 & 0.882 & 0.989 & 0.989 & 0.989 & 0.986 & 0.989 & 0.989 & 1 & 0.989 & 0.989 & 0.989 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.994 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.999 & 0.994 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.986 & 0.994 & 0.917 & 0.882 & 0.994 & 0.994 & 0.991 & 0.986 & 0.991 & 1 & 0.989 & 1 & 0.994 & 0.994 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.996 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 0.999 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.986 & 0.999 & 0.917 & 0.882 & 1 & 1 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 1 & 0.999 \\
0.992 & 0.991 & 0.994 & 0.989 & 0.917 & 0.992 & 0.996 & 0.986 & 0.917 & 0.864 & 0.979 & 0.990 & 0.994 & 1 & 0.990 & 0.994 & 0.987 & 0.987 & 0.969 & 0.986 & 1 & 0.917 & 0.882 & 0.999 & 0.999 & 0.991 & 0.986 & 0.991 & 0.994 & 0.989 & 0.994 & 0.999 & 1
\end{pmatrix}$$

Eq. 2. Fuzzy equilibrium matrix.

convergence levels of cases for special industries, including Case No. 5 (CAS5 *Living Assets*), Case No. 9 (CAS9 *Employee Compensation),* Case No. 10 (CAS10 *Pensions*), Case No. 22 (CAS25 *Original Insurance Contracts* and CAS26 *Reinsurance Contracts*), and Case No. 23 (CAS27 *Oil and Gas Mining*) rank last.The above results indicate that from a quantitative perspective\ CAS have achieved the goal of substantial convergence with IFRS. Though certain differences still exist (e.g., scope of related party disclosures, reversion of impairments, business combinations, etc.), they may not significantly impact the convergence level of CAS with IFRS. All the comparison features in the Chinese standard for *Related Party Disclosures* are matched with IAS24, except the state-controlled, substantially influenced, and jointly controlled feature of disclosure; thus it displays high convergence when the single case convergence level is calculated. While the reversion of impaired assets is prohibited in the Chinese standard for *Impairment of Assets*, which will impact features of recognition, measurement, and re-measurement, its convergence level is influenced somewhat. Another example is the Chinese standard *for Business Combinations*. Because the difference concerns the scope of combinations under ultimate control, it eventually affects those features of recognition, measurement, and re-measurement, thus lowering the convergence level displayed.

Among all the standards studied in this paper, convergence level of standards for special industries ranks last, mainly because of economic differences, which result in differences in the contents of transactions. Take the standard for *Oil and Gas Mining,* for example. Only transactions during the exploration period are included in IFRS, while transactions during the development and production periods are also included in CAS; thus a larger difference is shown in this case comparison. Other examples are the standards for *Insurance Contracts*, for *Pensions*, and for *Employee Benefits*, which are newly extended into CAS. As these business transactions are new for China and the Chinese labor compensation system is quite different from that of the West, the differences in transaction contents result in a low convergence level of CAS with IFRS. On the other hand, the characteristics of this category are responsible for the high convergence level of reporting standards. Stipulations for financial disclosure other than in financial statements mostly belong to the requirements on principles and fundamental contents; CAS is therefore in accordance with IFRS in principles. As disclosure requirements on detailed transactions have been stipulated in other standards of detailed transactions, these differences in requirements will not be reflected in reporting standards. Hence, it shows a high convergence level for reporting standards. There are a variety of other reasons for different convergence levels of single cases. Some of them come from the applications of fair value, such as the standard for *Non-Monetary Assets Exchange* and the standard for *Leases*. Other reasons may be a result of differences in recognition of revenue and expenses (examples include: the standard for *Fixed Assets*, the standard for *Government Grants*, and the standard for *Borrowing Costs)*. Some of these differences could be eliminated by revising the standards, such as recognizing differences on revenue or expenses, which mainly originated from standards setting. Others may not be eliminated by standard revising, such as the application of fair value and some special transactions in special industries, mostly because of the transitional economy in China. These differences in the contents of business transactions will not be eliminated soon.

We made a further test by changing the sample order; the result is still invariant.

## 6. Conclusion and remarks

Based on the previous calculation and analysis, we conclude that CAS has achieved its goal of substantial convergence with IFRS from the whole. The overall convergence level of CAS with IFRS calculated by matching coefficients is 0.7497, larger than 0.7, thus proving the substantial convergence of CAS with IFRS. When membership degree λ is assigned at 0.86, all cases are categorized into one. The result also reveals the ranks of a single standard's convergence level and indicates the emphasis of future efforts in bringing CAS further toward international convergence, even though the results reveal that the convergent level of CAS with IFRS is very high. However, in the long run, differences between CAS and IFRS will remain. The substantial convergence for most standards and the subtle differences for few also embodies characteristics of CAS in its development, especially considering the ongoing cooperation between IASB and FASB. Meanwhile, the revising processes of the IASB on IAS24, IFRS3, and others have been reducing and, in some cases, even eliminating the relative differences.

Our example demonstrates that the new method of fuzzy clustering analysis cannot only assess the convergence progress of NAS with IFRS from the whole, but can cluster single standards according to their convergence level and can even indicate further convergence emphasis. This makes up for the flaws existing in the extant research, and makes it suitable for use in analyzing the convergence among different standards (horizontal) or the progress achieved within one standard (vertical).

Measuring formal accounting standards convergence by fuzzy clustering analysis remains in an exploratory stage. Due to the fact that there are still some personal judgments in comparison items' choosing and value assignment, although achievements made by other researchers are also referenced in our study, there still may exist some bias of researchers. We hope our study will make a contribution in advancing the study of formal convergence and enable other researchers to make further progress in this field.

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