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Convergence and differentiation processes in Swiss higher education: an empirical analysis

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The aim of this article is to contribute to the scholarly debate on differentiation processes in higher education, particularly in binary systems. The article builds on recent developments in institutional theory and organizational ecology regarding the nature of *organizational forms*, as well as on the mechanisms through which these forms impact on characteristics of individual higher education institutions, and highlight the role of isomorphic pressures and competitive differentiation. The approach emphasizes the relevance of segregation and blending processes between types of institution. An application to the relationship between the two main types in Swiss higher education confirms that these forces largely determine the dynamics of the populations, and that a distinction emerges between core features – which make the distinction between populations – and features for which individual strategies and local conditions are more relevant.

Keywords: binary systems; differentiation; academic drift; organizational forms; Switzerland

Introduction

The aim of this article is to contribute to the debate on differentiation processes in higher education systems (Huisman, Meek, and Wood 2007; Meek et al. 1996; Teichler 2008a) by focusing on convergence and differentiation in binary systems. Binary systems are composed of two legally-recognized types of higher education institutions, which are usually named universities and universities of applied sciences. Binary systems are common in many European countries (Kyvik 2004; de Lourdes Machado et al. 2008).

Most of the work on binary systems has adopted a neo-institutionalist approach, which argues that organizational fields inherently become more homogenous over time because of isomorphic pressures (DiMaggio and Powell 1983; Morphew and Huisman 2002). Accordingly, imitation of the dominant academic values would push universities of applied sciences to become more similar to universities, leading to convergence between the two sectors (Neave 1979). However, while blurring borders and convergence phenomena are well-documented in many countries (Huisman and Kaiser 2000), most countries did not follow the UK (Fulton 1996) and Australia (Meek 1991) in merging the two sectors. Also, new binary systems were created in the 1990s; in Finland, Austria and Switzerland.

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It is important to add that to some extent convergence and divergence is activity-specific: in education the Bologna reform is leading to increasing similarity and permeability between curricula in the two sectors (Teichler 2008b; Witte, van der Wende, and Huisman 2008), while, concerning research, it is argued that in some countries the emergence of a university of applied sciences research mission led to convergence, while in others to a reinforcement of the binary divide alongside the distinction between basic and applied research (Lepori and Kyvik 2010).

This article builds on recent developments in organizational institutionalism and in organizational ecology that address organizational forms and the relationships between forms and characteristics of populations (Hannan, Pòlos, and Carroll 2007; Rao and Kenney 2008). These perspectives allow for developing hypotheses on the relationship between the content of forms – related to the policy discourse on types of higher education institutions – on the one hand, and convergence and (competitive) differentiation processes between populations of higher education institutions on the other. Applying this perspective to the Swiss binary system, we quantitatively investigate the differentiation and convergence processes in the Swiss higher education system in the period 2000–2008. We explain the observed patterns as the outcome of isomorphic pressures and competitive differentiation, related to the extent to which public policies provide clear stipulations for the mission of each type of institution.

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Theoretical framework

Comparative studies have demonstrated that many higher education systems include different legally- defined types of higher education institutions, such as universities versus universities of applied sciences (Huisman and Kaiser 2000; Kyvik 2004). There are also softer distinctions between groups of organizations with the same legal status, but that audiences recognize as different types; as in the United Kingdom where the differentiation between pre-1992 (traditional) universities and post-1992 universities (former polytechnics) is still very much alive.

A central question concerns the relationship between these groups of higher education institutions. While there is some understanding that types function as a blueprint for individual organizations, there is also evidence of considerable differences between individual organizations within the same population. Further, if missions attributed by government to types of institutions are clearly distinct, one would expect this distinction to hold also for individual organizations of that type. Yet, existing studies provide substantial evidence of academic and vocational drift (see e.g. Meek et al. 1996; Neave 1979), of the blurring of boundaries between organizational populations (Huisman and Kaiser 2000), and of the emergence of 'hybrid' organizations situated somewhere between different types. Accordingly, a second set of questions relates to the extent to which differences between types are reflected in the characteristics of individual higher education institutions belonging to each population (as well as to variations between activity domains).

Finally, the impact of regulatory environments on system-level diversity processes has been widely discussed, but there is a notable lack of empirical investigations. Longitudinal studies have pointed at the influence of governmental regulations and market forces (Rossi 2009; Teixeira et al. forthcoming). Huisman, Meek, and Wood (2007) conclude that common sense expectations about the relationships between size and diversity of systems (the larger, the more diverse) and regulation (binary systems are less diverse than other types of systems) do not hold. Accordingly, a third set of questions relates to the impact of the binary divide and the level and structure of competition on diversity.

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Populations, forms, fields and audiences

Our level of analysis is constituted by the higher education *organizational field* – the set of organizations in the domain of higher education, like producers, suppliers, regulatory agencies, etc. (DiMaggio and Powell 1983; Scott et al. 2000; Scott 2003). Within the field, we focus on the *community* of higher education institutions and on the characteristics of different *populations* of higher education institutions. Accordingly, we are not investigating processes of institutionalization (e.g. the creation of a binary system), but we focus on the implications of regulatory and institutional frameworks for community structure and evolution.

For two reasons, we analyse the diversity of institutions according to the characteristics of products and services offered by these institutions, instead of focusing on structural characteristics (such as legal status). First, the position in the product space determines the interactions between individual organizations and the relevant audiences in the field, and this is crucial to determine organizational evolution (Boone, Wezel, and van Witteloostuijn 2007). Second, if looked at from the (policy) perspective of the ability of the higher education system to match social demands, the composition of products and services is more relevant than organizational features *per se*. In order to select the relevant dimensions, we rely on the U-Map project, which, based on an extensive stakeholder consultation and a pilot survey, developed a scheme for classifying European higher education institutions using six dimensions: educational profile, student profile, research involvement, knowledge exchange, international orientation and regional engagement (van Vught et al. 2008).

Binary systems are characterized by the definition of two distinct sectors of higher education, subject to different public regulations and in most cases funding rules. Hence, analysing differentiation processes requires a careful understanding of the nature of higher education institution types and the mechanisms that influence the behaviour of individual institutions. Most past research considered legal types of higher education institutions as *regulatory devices*, constraining organizational behaviour through legal rules; at the same time academic norms were considered as dominant and, accordingly, isomorphic pressures would make universities of applied sciences increasingly similar to universities until this distinction becomes so weak that the legal distinction is abolished.

Instead, we build on a thicker conception of *organizational forms* as institutional and socio-cognitive objects impacting on institutional behaviour – and thus on differentiation – through *two* distinct processes. Forms generate (normative and coercive) conformity pressures, while they influence at the same time the valuation of institutional services by the relevant audiences (students, societal stakeholders, economic stakeholders, funding agencies), hence impacting resource allocation.

Identifying core features of forms in higher education

To develop our conception of organizational forms, we draw on institutional theory and on the recent (cognitive-oriented) version of population ecology. These two converge in considering that forms are institutional and cognitive constructs, and that there are no straightforward relationships between the content of forms and the characteristics of individual organizations belonging to each population. However, they differ in two critical aspects: the mechanism for legitimization and the implications for organizational behaviour (Haveman and David 2008; Rao and Kenney 2008).

Neo-institutionalism considers forms as composed by cultural, normative and regulatory elements, and focuses on the sociopolitical processes by which forms are constructed and legitimized (DiMaggio 1988). Instead, population ecology considers forms as schemes for classifying organizations taken for granted by the relevant

audiences (Hannan, Pòlos, and Carroll 2007; Hsu and Hannan 2005). Key audiences (users, producers, regulators: public and/or private) determine which organizations are similar or different, and which organizations define a field.

In public sectors these two conceptions are largely complementary and closely related. Higher education institutions are mostly public organizations receiving resources from and being regulated by the state; thus, the policy discourse is likely to provide the basis for the identification of forms (Ruef 2000), and, accordingly, audiences may not differ that much in their socio-cognitive (re)construction of forms. Moreover, the main elements defining forms are endorsed and codified by public regulations, such as legal status and the right to award degrees, etc. Similarly, the institutionalization of forms critically depends on the existence of settlements between relevant audiences, which agree on their main defining features (Rao and Kenney 2008): the sociopolitical process leading to the establishment of binary systems requires at least some level of agreement between the relevant (powerful) audiences in the field.

Some features might be considered as more central to the identity of forms (Pòlos, Hannan, and Carroll 2002). For instance, university research activity might be considered constitutive, whereas a low level of internationality might not be considered core. Identifying core features is particularly relevant for multifunctional organizations like higher education institutions, as we expect that the potential for differentiating strategies will be larger for non-core features.

Moreover, when different populations compete in the same field, the relationships between forms and the characteristics of the boundaries dividing them are more relevant than the features of individual forms (Hannan and Freeman 1986). Most cognitive distinctions imply a comparison: in binary systems audiences are likely to identify a 'true' university by its degree of distinction from a university of applied sciences. Accordingly, we focus on the degree of segregation and blending between the two forms, meaning the extent to which they are considered as distinctive or similar.

Isomorphism and competitive differentiation

The first mechanism through which forms impact on individual organizations is *institutional isomorphism* (DiMaggio and Powell 1983). In order to operate, organizations need legitimacy at the societal level, and they tend to conform to 'rationalized myths' on what constitutes a 'proper' organization (Boxenbaum and Jonsson 2008); accordingly, organizations in a field tend to become increasingly similar. Three sources of isomorphism are usually distinguished, namely *coercive isomorphism* (i.e. pressures stemming from political power, like demands from the state to adopt specific structures), *mimetic isomorphism* (i.e. imitating the most successful organization in a field when faced with uncertain conditions) and *normative isomorphism* (i.e. pressures from peers and professions to follow some norm of conduct). In binary systems the basic elements of the institutional types are institutional facts, agreed through a sociopolitical decision-making process and codified through public regulation; accordingly, they provide rules and codes of conduct for individual institutions, and push organizations to become similar to the type they belong to through *coercive isomorphism*. By providing an alternative model (the non-university sector), the binary divide is also expected to increase institutional pluralism and to weaken (*normative*) isomorphic pressures towards the academic prototype.

The second mechanism through which forms impact on individual organizations is *competitive differentiation*: individual organizations define their own niche by differentiating from competitors and taking into account the valuation by relevant audiences. Thus, departing from the defining features might offer individual organizations a better positioning in product markets or access to particular resources. However,

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forms also provide the audiences – students, funding agencies, private companies – with taken-for-granted expectations on which kind of services they might expect, and 'being different' becomes risky because being perceived as non-compliant might entail devaluation by certain audiences. Thus, competitive differentiation is influenced by the content of forms and, especially, by their core features: if a core feature of the university form is to have a higher level of research intensity than a university of applied sciences, individual universities are expected to move towards or stick to higher levels of research intensity.

In binary systems, we expect the aggregated impact of these mechanisms to depend on the degree of segregation or blending between the forms specific to each activity dimension (see Table 1). For the dimensions for which segregation prevails, coercive isomorphic pressures will be stronger than normative isomorphism; at the same time, departing from the ideal type would imply strong devaluation by audiences and a loss of resources, whereas competition will rather help to stabilize the distinction between types. Both mechanisms converge in creating a strong differentiation between the two populations. When there is no distinction between forms, normative isomorphism towards the academic model and mimetic isomorphism are expected to take place; in non-competitive systems institutions will become very similar, while

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Table 1. General predictions on population structure by dimension.

	Characteristics of organizational forms		
Level of distinction for the dimension considered	Segregation. The two forms are considered as distinct and incompatible.	Blending. The two forms are considered as distinct, but blending is cognitively allowed.	No distinction.
	Mechanism impacting on the population structure		
Isomorphic forces	Strong coercive isomorphism towards the type the higher education institution belongs to.	Weak coercive and normative isomorphism. Mimetic isomorphism might take place.	Normative isomorphism towards the academic norm and mimetic towards the most successful higher education institutions.
Competitive differentiation	Competition pushes individual higher education institutions towards the type the institution belongs to.	Competition leads individual higher education institutions to differentiate; core market players will stay close to the type-specific norm, whereas peripheral market players will depart from these.	Competitive differentiation leads individual higher education institutions to differentiate and define their own niche.
	Implications on the population structure for each specific dimension		
Population structure	Two very distinct populations where the differences between are much larger than within.	The two populations will be distinct, but there will be much overlap.	In non-competitive systems higher education institutions become very similar, in competitive systems they differentiate.

in competitive systems competitive differentiation will take place. The latter applies especially to unitary systems.

The blending cases – where there is a distinction between the two forms, but some combination is considered as cognitively acceptable – are the most complex ones: first, some level of coercive isomorphism will be present (as there are different stipulations for each form), but normative isomorphism towards the academic model and imitation are also expected to be relevant. Second, as devaluation will be less relevant – students might be willing to enrol in a 'hybrid' organization – competition is expected to lead to some differentiation, but this will take place especially for the peripheral market players (e.g. smaller institutions) which are in greater need of finding a specific niche. Accordingly, we expect a more complex community structure, where the two populations will stay distinct but some overlap takes place, with less central higher education institutions differentiating more from each type and developing hybrid profiles.

Testing these predictions will be done in two steps. First, we look at policy documents defining the main organizational forms of Swiss higher education, and we investigate blending and segregation processes for different dimensions. We do not focus on regulations only, but also on cognitive and normative contents of forms. Further, we highlight the main elements of debate concerning the characteristics of the binary divide, as well as elements of disagreement between audiences in this respect. Second, we construct a set of quantitative indicators characterizing the population structure, and we calculate these for the period 2000–2008 in order to systematically test our predictions.

Organizational forms in Swiss higher education

Since the mid-1990s, the Swiss higher education system has been binary (Organisation for Economic Cooperation and Development [OECD] 2003; Conseil Fédéral 2009): the university sector is composed of cantonal universities and federal institutes of technology, while the non-university sector is composed of universities of applied sciences. The two sectors are ruled by different laws and public regulations and have largely separated funding streams (Lepori 2007). Our sample is composed of the twelve university institutions and seven universities of applied sciences. Taken together, they include 94% of all students in Swiss higher education (see Table 2). We excluded a couple of small-scale educational providers from the analysis.

All twelve universities award bachelor's, master's and doctoral degrees. Of the ten cantonal universities, seven are generalist, covering a broad spectrum of topics,

Table 2. Key data on higher education institutions in Swiss higher education (2008).

	N	Students ISCED5	Students ISCED6	Staff (FTE)
Federal institute of technology	2	15,113	4,826	10,711
Other university institution	2	405	Not applicable	54
University	10	80,751	14,250	21,986
University of applied sciences	9	50,659	Not applicable	10,651
University of teacher training	10	6,591	Not applicable	1,386
Grand Total	**33**	**153,519**	**19,076**	**44,788**

Source: Swiss Federal Statistical Office – http://www.bfs.admin.ch.

Note: ISCED levels (international standard classification of education) refers to stages of education, ISCED 5 refers to the first stage of tertiary education (bachelor's and master's) and ISCED 6 refers to the second stage (advanced research for a doctorate).

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whereas three are specialized. The two federal institutes of technology are specialized in natural sciences and technology. Universities are generally old, and the only recent changes have been the emergence of the University of Lugano (1996), the foundation of the Federal Institute of Technology in Lausanne (1969) and the Theological School of Lucerne becoming a university in 2000.

There are currently nine universities of applied sciences – seven public and two private. As the latter two started in 2007–2008 only, they will be disregarded in the quantitative analysis. The seven public universities of applied sciences were created in 1997 (based on the 1995 Universities of Applied Sciences Act) as a reform and merger of existing professional tertiary education institutions. The process started with a few fields (technology, economy, construction), but the universities of applied sciences extended to most professional domains (arts, social work, health, teacher training) after 2000. Teacher training institutions are also formally part of higher education, partly integrated in the universities of applied sciences system, others as stand-alone institutions. As these were established only recently and cover a very specific segment of tertiary education, we do not include these in the analysis.

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Organizational forms, tasks and interactions

In this section, we investigate which policy expectations were expressed regarding the activities to be performed, and if these expectations have changed (2000–2008). As the Swiss system is characterized by a consensus-driven development of public policies, where regulations by and large follow the creation of a consensus among relevant actors, we assume that policy documents reflect a broad agreement among the relevant audiences, like cantonal governments, social stakeholders, and stakeholders in business and industry.

These documents include the OECD reviews of Swiss tertiary education (OECD 1991, 2003) and the policy proposals for the Universities of Applied Sciences Act (Conseil Fédéral 1994), for the development of research in the universities of applied sciences sector (Conseil Fédéral 1997), the Research and Higher Education Plan 2007–2011 (Conseil Fédéral 2007), as well as the new Higher Education Act (Conseil Fédéral 2009). Additionally, we rely on descriptions on official websites, as well as of recent studies on Swiss higher education system (Lepori 2008; Perellon 2003).

All documents provide a view of strong distinction, as well as of significant internal coherence; moreover, there is no possibility of switching from one institutional type to the other. Frequent reference is made to the phrase ‘equal but different’, as well as a detailed presentation of (expected) differences between the two types of higher education institutions (Conseil Fédéral 1994). Further, the two types are also frequently presented as internally homogeneous groups, focusing on their commonalities rather than on internal differences. In the preparation of the new Higher Education Act, which should take effect in 2014, it was debated whether the Act itself should explicitly define the different nature and tasks of the two types of institutions. The new Act mentions explicitly the existence of two types, thus creating a basis for different mandates, but leaves the detailed definition to the Swiss University Council, allowing scope for future changes (Conseil Fédéral 2009).

Thus, the distinction made between the sectors in the documents has been remarkably stable, compared to tendencies of convergence in other European countries (Lepori and Kyvik 2010). However, a closer look of specific activity domains reveals some slightly different patterns.

The *educational profile* was a major element of distinction when the binary system was created, with universities of applied sciences offering education oriented towards professional practice, and universities general purpose education with a strong

theoretical component. However, already at that time overlap was mentioned, for universities offered some practice-oriented education, and some university curricula were of the same length as those in universities of applied sciences (Conseil Fédéral 1994). With the Bologna reform, both types of institutions now offer three-year bachelor degrees, while universities also offer master's programmes. Universities of applied sciences acquired, in 2007, the right to offer professionally oriented master diplomas, however only in selected areas and with very limited funding (Conseil Fédéral 2007).

In terms of *subject specialization*, there is a long-standing distinction within the university sector between the two federal institutes of technology, focusing on technology, and the comprehensive cantonal universities., which are taken together irrespectively of their level of specialization. The universities of applied sciences started with selected domains (engineering, economics), but it was foreseen that they would start to offer programmes in most professional sectors (Conseil Fédéral 1994).

Concerning the *students' profile*, university education is full-time, and students normally enrol upon leaving secondary education. Education in a university of applied sciences presupposes some professional experience and caters for working students and education is hence (also) offered in part-time mode. This difference between the two types goes back to different tracks in secondary education (OECD 2003). Little change has taken place, except that universities of applied sciences bachelor students can enrol for a university master's degree (Perellon 2003). There are no expectations concerning the optimal size of higher education institutions. Only a broad reference to achieve a critical mass (500 students) was provided as a rationale for the universities of applied sciences reform process (Conseil Fédéral 1994).

Regarding *research involvement*, both universities and universities of applied sciences have a research mission, but universities should focus on basic research aimed at developing new knowledge without a direct aim for application, whereas universities of applied sciences should develop applied research addressing economic and social needs (Conseil Fédéral 1994; OECD 2003). Advanced research training is a specific task of universities, and universities of applied sciences do not have the right to award doctorates. This distinction and the applied focus of universities of applied sciences research has been restated in recent documents (Conference of the Rectors of Swiss universities of applied sciences 2008; Conseil Fédéral 2009).

A further difference lies in the relative importance of teaching and research missions. Universities adhere to the Humboldtian ideal of unity of research and teaching, and, accordingly, research is considered the core activity (Conseil Fédéral 2009). For universities of applied sciences, research is a complementary task, and it is envisaged that in the longer term they would spend 20% of their resources on research (Conseil Fédéral 2007).

For Swiss universities *internationalization* is an important topic, emphasized in most public documents. Universities are supposed to develop relationships abroad and to be internationally competitive in terms of research quality (Conseil Fédéral 2009). This dimension thus refers essentially to research, as well as to the training of research staff, where international experience is increasingly considered as important. Reference to internationalization is not very prominent in documents related to the universities of applied sciences sector, as these are considered to have mostly regional missions. However, in the most recent strategic plan the goal of increasing international competitiveness of universities of applied sciences is explicitly mentioned (Conseil Fédéral 2009).

All official documents stipulate that *knowledge exchange* is a central mission of universities of applied sciences, for which cooperation with private companies and regional actors to transfer research results is considered as a prime objective (Conseil

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Fédéral 1994, 2009). Universities should focus on developing scientific knowledge without (necessarily) a direct applied goal. At the same time, it is acknowledged that in some domains – e.g. technology and management – universities have a tradition of cooperation with the private economy, and exploitation of research results should be strengthened in this sector (Conseil Fédéral 2009).

Developing predictions on population characteristics

In terms of competition for resources, the Swiss system can be characterized as moderately competitive, but with significant differences between activities and institutions. The binary structure and the division of competences between the confederation and the cantons lead also to a fragmented structure of the funding system (Baschung et al. 2009). Concerning the public core grant, universities are funded by their canton and co-financed by the confederation (based on the number of students and research grants) and by other cantons (based on the number of students), while the two federal institutes of technology receive their core grant from the confederation. Overall, core grant allocation is weakly competitive, but the share of competitive sources is higher for the universities in cantons with lower financial capacity. Core allocation to universities of applied sciences is mostly related to the number of students (based on fixed rates agreed nationally), but additional funds are provided by the cantons for research and other activities. Third-party funds are mostly attributed from the academically-oriented Swiss National Science Foundation (SNSF), from European Framework programmes and from the Swiss Innovation Agency (CTI). The share of third-party funding has remained remarkably stable in the last 15 years (Lepori 2006); however, due to the much smaller size of research funding in their core grant, universities of applied sciences are more dependent on third-party funding for their research activities. Overall, the universities of applied sciences funding system is much more competitive than that of universities. Competition in education is based on student numbers, while in research on the acquisition of third-party grants.

Based on the previous discussion, Table 3 shows predictions regarding the expected profiles of universities of applied sciences and universities. As most universities have existed for a long time, and have thus had time to develop their own individual profiles, the creation of a binary system is expected to impact on them to the extent it changed the content of their form and the competitive environment. Universities of applied sciences were created in the late 1990s from pre-existing schools, and thus it is likely that at the beginning of the period considered (2000) they were near to the position of their predecessors; accordingly, a more visible evolution is expected for some dimensions.

Methodology: measuring organizational diversity

There have been few attempts to systematically operationalize dimensions of diversity, including the US Carnegie classification (McCormick and Zhao 2005), as well as the European U-Map project (van Vught et al. 2008). The selection of indicators is however strongly limited by issues of data availability and quality (Bonaccorsi et al. 2007). In this article, we follow the dimensions and indicators selected in the U-Map project, with some adaptations: U-Map collected data through surveys and we use statistical data sources. We had to leave out the dimension of regional engagement, as none of the proposed indicators is available from statistical data sources. A similar choice was made by Bonaccorsi et al. (2010) in the Eumida (European Micro Data) census on higher education institutions.

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Table 3. Predictions concerning the population structure in the Swiss system.

	Level of segregation and blending between the two forms	Main policy instruments	Level of competition	Expected impact on the population structure
Educational profile	Strong segregation when universities of applied sciences where created, but blending has been allowed.	Regulation: universities of applied sciences did not have the right to offer master diplomas until 2008. Funding: limited availability of funding for universities of applied sciences masters.	Competition for students relevant for universities of applied sciences, less so for universities.	Reduction of the distance between the populations and increasing level of internal dispersion for universities of applied sciences. Lasting differences concerning the length of curricula.
Student profile	Stable distinction between the profiles of the two types of higher education institution, supported by distinctive access requirements.	Regulation: different access requirements for the two sectors. Normative: very different students and degree profiles. Funding: additional funding to support the universities of applied sciences expansion (core grant).	Competition for students relevant for universities of applied sciences, less so for universities.	Distinction between the two sectors is stable.
Research involvement	Stable distinction concerning research mission and intensity, including the offering of doctoral degrees.	Regulation. Universities of applied sciences have not the right to award the doctorate. Normative: clearly distinct research missions for the two sectors. Funding: lower share of research funding for universities of applied sciences in the core grant.	Moderate level of competition.	Differences between populations become stronger as universities of applied sciences develop their own profile. Universities of applied sciences are expected to become more similar across time.
International orientation	Strong segregation concerning internationalization of research. No specific guidance regarding education.	Normative: internationalization as a strong element characterizing universities.	Limited competition as international students does not impact funding significantly.	Research: strong and stable differences between populations. Education: some level of differentiation.
Knowledge exchange	For universities of applied sciences, knowledge exchange is a constitutive element, for universities this is not a core feature.	Normative: knowledge exchange as a core mission of universities of applied sciences. Funding: specific support measures for cooperation with the private sector targeted to universities of applied sciences.	Strongly competitive domain.	Universities of applied sciences develop a distinct profile with low internal differentiation, universities are more differentiated.

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Educational profile characterizes the offer of educational programmes and the level of the qualifications awarded; relevant dimensions considered are the level of the degree, the subject domains covered and the orientation towards academic vs. professional degrees. As all Swiss universities adopted the Bologna system, we measure degree level by the percentage of master's students over total undergraduate students (doctoral education is covered under research orientation). This indicator is, however, available only for recent years, as the Bologna system was adopted gradually after 2000. The subject domains can be measured by the repartition of undergraduate students by subject field (using the standard classification of subject domains in educational statistics; UNESCO/OECD/Eurostat 2006). We do not include an indicator on academic vs. professional orientation, as this cannot be measured through statistical data, while we use time of staff for education as a measure of the importance of this orientation in the institutional profile (data on time used by staff are usually more reliable than financial data).

Student profile characterizes the size and the composition of the student body. Concerning size, we include the total number of undergraduate students (headcount); the share of mature students is a second relevant indicator, as it provides information on the extent to which undergraduate education is oriented towards students with work experience (thus contributing to life-long learning). To this aim, we include the percentage of new students (first entries at bachelor or equivalent pre-Bologna level) older than 25 years. This criterion is chosen, as the average age of enrolled students is strongly affected by the length of the programmes. Two other indicators proposed by U-Map are the percentage of distance students and of part-time students, which both relate to involvement in life-long learning, as well as addressing working students, but no complete datasets are available on these characteristics.

Research involvement is one of the difficult dimensions to measure at the institutional level, given the limitations of international databases in the coverage of research output (Schmoch and Schubert 2009), and the different outputs produced by type of research (a relevant issue when analyzing binary systems). We do not use publication numbers, both for reasons of coverage and data availability, but we focus on three indicators: the number of PhD students, a widely used indicator of research intensity in PhD awarding-institutions (Bonaccorsi 2009) and the one also adopted in the US Carnegie classification; time of staff devoted to research and development measured through time-surveys (OECD 2002) as a measure of the effort invested in research; finally, academic grant funding from the SNSF, as these grants are based on peer review and thus provide a readily available measure of the academic reputation of institutions (and are less sensitive to disciplinary differences than publication numbers). We only have aggregate data on SNSF funding for the universities of applied sciences sector in 2000, thus we use a flat distribution by universities of applied sciences for that year. The level of funding was so low in that year that a different distribution would not significantly affect the results.

International orientation is a relevant dimension as higher education systems are characterized by an increasing level of internationalization, and higher education institutions are required to compete at the international level. The two indicators chosen cover different dimensions of this phenomenon: the share of foreign students enrolled at Isced 5 level (based on the country of prior education) focuses on attractiveness to international students, while the share of international staff (staff without Swiss nationality) is related to international reputation and openness, especially concerning research activities.

Knowledge exchange. Most indicators deemed suitable – like academic patents (Lissoni et al. 2008) and spin-off companies (Mustar et al. 2006) would require a

survey or extensive data cleaning. We adopt one broad indicator of knowledge exchange, namely the sum of revenues for services, continuing education, plus private funding of research and development – this can be interpreted as the total volume of activities related to knowledge exchange. Two further indicators focus more specifically on applied research and development, namely funding from private companies for research and development (private contracts) and funding for joint projects with industry from the CTI. These are rather simple indicators providing an aggregate view of the importance of these activities at the institutional level.

Indicators and normalization

Table 4 provides the list of indicators and their normalization to allow for meaningful comparisons. With the exception of the number of students, we choose normalized indicators independent of size. All data come from the Swiss Federal Statistical Office. We

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Table 4. Indicators and normalization of five higher education domains.

Domain	Variable	Definition	Normalization
Educational profile	Subject areas covered	Number of degrees by educational domain following the international classification of fields of education at the first level (9 fields) – (UNESCO/OECD/Eurostat, 2006). ISCED 5 level	Subject specialization (see text)
	Degree-level focus	Degrees at master's level	Total number of degrees ISCED 5
	Expenditure on teaching	Educational activities	% of time of staff
Student profile	Number of students	Total number of students enrolled at ISCED 5 level	Absolute numbers
	Mature learners	New students at licence/bachelor level older than 25 years	% of new students at this level
Research involvement	Doctorate production	Number of doctoral students	% of students at ISCED 5
	Research activities	Research and development activities	% of time of staff
	Academic funding	Swiss National Science Foundation funding	% of total expenditures
International orientation	International students	Students from abroad at ISCED 5 level (headcounts)	% of students at ISCED. 5
	International staff	Staff without Swiss citizenship (headcounts)	% of total staff
Knowledge exchange	Revenues from knowledge transfer	Revenues from services and continuing education, plus private funding of research and development	% of total expenditures
	Applied research projects	Funding from the Swiss Innovation Agency	% of total expenditures
	Private funding for research and development	Funding from private companies	% of total expenditures

compute indicators for the years 2000 and 2008, and use 2002 or 2004 data in some cases where earlier data are missing.

Concerning subject specialization, we build a specialization index (Rossi, 2009) for each institution based on the market specialization index:

$$\mathrm{Vj} = \sum_{j} \left(\frac{\mathrm{Xij}}{\mathrm{Xj}} \right)^2$$

where x_{ij} is the number of students in field i for higher education institution j, and x_j is the total number of students of higher education institution j. The sum runs across the nine subject domains of the classification of educational degrees. We then normalize the index as follows:

$$Sj = \frac{\frac{1}{Vj} - 1}{N - 1}$$

S_j runs between 0 and 1, where 0 is maximum specialization and 1 no specialization by field.

Based on these indicators, we construct the following measures.

a) *The distance between populations*, calculated as the distance between the median of the considered variable for the two populations, normalized by the largest value of the median. Scores for Dist (A, B) range from 0 to 1.

$$DIST(A, B) = \frac{ABS(MEDIAN(pop\,A) - MEDIAN(pop\,B))}{MAX(MEDIAN(pop\,A); MEDIAN(pop\,B))}$$

b) The level of internal dispersion of the two populations of higher education institutions by computing the standard deviation. The choice of normalization is somewhat complex here, as non-normalized values and normalising by the average of each population does not allow for comparison. We choose to normalize against the maximum of the averages for the two populations *for both years*, in order to allow for comparisons across indicators, populations and years.

$$\mathrm{DISPERSION(A)} = \frac{STDEV(popA)}{MAX(AVG(popA(2000)); AVG(popA(2008); AVG(popB(2000)); AVG(popB(2008))}$$

This choice is acceptable as the analysis covers a rather short period of time and the population averages do not vary very much for most indicators; in other cases using separate normalizations for comparisons across years and across indicators might be a more sensible choice.

c) The degree of overlap (U) between the two populations. We first rank the set of higher education institutions in increasing value of the considered variable and then, for each institution belonging to population A, we count the number of institutions in population B with lower ranks. We repeat the same procedure using population 2 and we take the smaller of the two values. U is comprised between 0 and N(A)*N(B)/2 – where N(A) = number of institutions in population A; N(B) = number of institutions in population B – and it is equivalent to the Mann-Whitney statistic; accordingly, it provides also a test of the significance of

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the two populations being different (in our case N(A) = 7, N(B) = 12, then if U < 18, $p < .05$ two-tailed).

d) The diversity at the level of whole community of higher education institutions. As all indicators we are using are continuous, we use the Euclidean distance rather than diversity indexes characterizing the distribution of individuals across classes (e.g. Simpson's λ), which would require defining classes from continuous measures (see Huisman 2000 for a discussion).

$$DIV = \frac{\sum_{ij} |x_i - x_j|}{(N(A) + N(B)) * (N(A) + N(B) - 1)}$$

where x_i is the value of considered variable for members of population A ($i = 1 \ldots N(A)$) and x_j is the value of considered variable for members of population B ($j = 1 \ldots N(B)$), the normalization at the denominator being the number of pairs in the sum.

We chose not to normalize Div against the population average as almost all our indicators are already normalized. This means, however, that the measure cannot be easily used for comparisons between different indicators. For this purpose, we compute the two following indicators. The rate of change of DIV between 2000 and 2008:

$$CHANGE\,(2000, 2008) = \frac{(DIV(2008) - DIV(2000)) * 100}{DIV(2000)}$$

The total diversity is partly generated by the distance between the two populations. It is interesting, though, to isolate the share of diversity explained by the overall internal diversity to the two populations. To this end, we subtract from the computed value of diversity the difference between the two population averages multiplied by the share of pairs where institutions belong to different populations.

$$INTDIV = \frac{DIV - |AVG(pop(A)) - AVG(pop(B))| * \frac{N(A) * N(B) * 2}{(N(A) + N(B)) * (N(A) + N(B) - 1)}}{DIV}$$

Intdiv is 1 if the two populations have the same average and is 0 if the two populations are composed of identical organizations, and the diversity is generated solely by the difference between the two population averages.

Empirical results

Table 5 provides an overview of the average scores of for each indicator for the two populations, while Table 6 characterizes the population structure using the measures defined previously.

To start off, we reiterate the meaning of the indicators. *Distance* provides information on the difference between the medians of the two populations. To account for differences between the two populations one needs to take into account their internal level of variability. This information is provided by *dispersion. Overlap* (U) combines these two dimensions in a single measure based on individual positions (and is thus less sensitive to distributional properties). It also allows testing of the extent to which observed differences are statistically significant (if U < 18 this is the case with 95% probability). Finally, the two diversity indicators provide us with a measure of the

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Table 5. Indicators by higher education domains 2000–2008.

Domain	Indicator	2000		2008	
		Universities	Universities of applied sciences	Universities	Universities of applied sciences*
Educational profile	% of master's students	NA	NA	20.0%	4.6%
	Average time of staff for education*	37.3%	47.1%	34.3%	45.1%
Student profile	Undergraduate students per institution	6,419	3,038	7,989	6,881
	% mature students	15.4%	33.2%	8.4%	25.1%
Research	% of PhD students	17.5%	0.0%	19.9%	0.0%
	Average time of staff for research*	43.8%	15.0%	48.0%	19.4%
	SNF funding	5.9%	0.15%	6.9%	0.45%
Internationality	% students from abroad	15.9%	14.5%	18.9%	17.6%
	% staff from abroad	29.5%	13.4%	37.6%	19.7%
Knowledge transfer	Revenues from knowledge transfer**	10.2%	12.5%	10.7%	20.1%
	Funding from private companies for R&D**	6.1%	2.4%	5.9%	5.2%
	Funding from CTI**	1.0%	1.9%	0.7%	1.9%

Source: designed by the authors according to Swiss Federal Statistical Office data.
Note: Unweighted average of individual values, *data refer to 2002 and 2008 **data refer to 2004 and 2008.

change in the level of diversity between the first and the last year, and of the contribution of the distance between the two populations to diversity at the community level (if Intdiv = 0 the whole community diversity is generated by the distance between the populations).

Blending factors

In Table 6, there are four indicators for which, in 2008, the two populations were not significantly different (U > 18), namely *subject specialization*, *number of students*, *funding from private companies and students from abroad*. For these indicators the level of overlap increases, dispersion is stable for universities and increasing for universities of applied sciences, while distance decreases. Finally, diversity increases significantly for two indicators (students and students from abroad) and stays stable for the other two. As expected, the share of internal population diversity is very high and increases in the considered period.

We interpret this pattern as follows: for these indicators there are very few or no clear policy stipulations. Other factors are determining the patterns, such as age and geographical position. Specialized institutions, such as the universities of Lucerne, Sankt Gallen and Lugano account for relatively high values of the dispersion indicator for *subject specialisation*. Accordingly, the two populations become more similar and overlapping. Competitive differentiation takes place especially for universities of applied sciences, for which competition was introduced with the reform (changes in universities of applied sciences sector dispersion are statistically significant for three out of four indicators). Accordingly, internal differentiation in each population becomes more important than population-level differences as a determinant of community-level diversity; the overall impact on diversity depends on the strength of these two processes.

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Table 6. Indicators for each dimension 2000–2008.

		DISTANCE		OVERLAP U		DISPERSION UNI		DISPERSION UAS		DIVERSITY		
Dimension	Indicator	2000	2008	2000	2008	2000	2008	2000	2008	CHANGE (2000,2008)	INTDIV (2000)	INTDIV (2008)
Educational profile	Subject specialisation	0.41	0.10	31	37	0.51	0.50	0.16^{++}	0.34	3%	69%	96%
	% of master's students	NA	0.83^{+}	NA	5	NA	0.36	NA	0.08	NA	NA	28%
	% of staff time for education*	*0.32^{+}*	*0.28^{+}*	17	14	0.26	0.21	0.12	0.10	$-12\%^{++++}$	62%	52%
Students profile	N. of students	0.58	0.48	21	36	0.54	0.62	*0.21^{++}*	*0.55*	$23\%^{++++}$	61%	89%
	Students above 25 years	*0.66^{+}*	*0.64^{+}*	7	1	*0.41^{++}*	*0.14*	0.23	0.16	$-34\%^{++++}$	45%	21%
Research involvement	% PhD students	*1.00^{+}*	*1.00^{+}*	0	0	0.30	0.38	0.00	0.00	$14\%^{++++}$	19%	22%
	Time for R&D*	*0.70^{+}*	*0.62^{+}*	2	0	0.23	0.20	*0.15^{+++}*	*0.08*	-7%	28%	23%
	SNF funding	*0.97^{+}*	*0.94^{+}*	0	0	*0.50*	*0.37*	NA	0.04	-3%	33%	24%
International orientation	Students ISCED 5 from abroad	0.37	0.42	23	26	0.39^{+++}	0.59	0.28	0.34	$35\%^{++++}$	71%	74%
	Staff from abroad	*0.60^{+}*	*0.44^{+}*	0	1	0.21	0.25	0.10	0.10	0%	28%	33%
Knowledge exchange	Revenues from knowledge transfer***	0.49	*0.59^{+}*	26	8	0.40	0.44	*0.23*	*0.20*	$38\%^{++++}$	60%	50%
	Funding from private companies***	*0.57^{+}*	0.02	15	41	0.70	0.65	*0.15^{++}*	*0.35*	-12%	52%	89%
	Funding from Swiss Innovation Agency**	*0.71^{+}*	*0.80^{+}*	16	9	*0.63*	*0.38*	*0.50*	*0.32*	$-22\%^{++++}$	65%	42%
Blending indicators	Average	0.49	0.26	22	35	0.54	*0.59*	*0.20*	*0.39*	12%	63%	87%
Segregating indicators	Average	*0.67^{+}*	*0.66^{+}*	9	7	0.37	*0.30*	0.17	*0.13*	-3%	43%	33%

Source: designed by the authors according to Swiss Federal Statistical Office data.

Note: *2000 refers to 2002. ** excluding the University of Zurich since the introduction of bachelor/master was not completed yet in 2008 ***2000 refers to 2004.

Segregating indicators: subject specialisation, number of students, students from abroad, funding from private companies. Blending indicators: all the others. $^{+}$ Distance is significantly different from 0 with 5% significance (bilateral Mann-Whitney test). $^{++}$ Change in dispersion between 2000 and 2008 is significant at 5% (F-test for variance; one-tailed). $^{+++}$ Change in dispersion between 2000 and 2008 is significant at 10% (F-test for variance; one-tailed). Give the very small sample, results of this test need to be taken with much care. $^{++++}$ Change in diversity between 2000 and 2008 is significant at 5%, Welch Two Sample t-test (one-tailed).

The role of *private company funding* in this group may look surprising, as particularly universities of applied sciences have a mission of transfer towards private economy. However, this indicator measures only *private research and development funding*, which is not related only to knowledge transfer, as, in Switzerland, private companies support more basic research, especially in technology. That for universities this indicator has the highest value of dispersion is related to subject specialization.

For the indicator *students from abroad*, the distance is rather large and stable, but there is also a large dispersion of individual values and overlap is significant. We explain this pattern as follows: first, while internationality is a distinctive characteristic of universities, this relates mostly to the research mission. Second, local market conditions have a significant impact, as higher education institutions near the border display a much higher share of students from abroad independent of institutional type. The indicators *staff from abroad* show a much strong internal coherence for the two populations. Against a general increase of the level of internationality of the whole system (see Table 5), the distinction between the two types of institutions remains stable.

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Segregating factors

The other nine indicators display a low and decreasing level of overlap, while distance is stable (for the indicator share of master-student only data for the last year are available) and segregation is strong. Our interpretation is that individual institutions are pushed to converge towards the average of the population they belong to. Each of the two populations is rather homogeneous internally, as the small value of dispersion shows, and tends to become more homogenous over time (even if most changes are not statistically significant). Diversity displays contrasting tendencies, with two indicators displaying a significant increase and three a significant decrease; as expected, the contribution of internal diversity is low and decreasing: for the segregating indicators most of the community-level diversity is generated by the difference between the two populations.

Segregating factors includes all three indicators concerning *research involvement* – share of PhD students, academic grant funding and time of staff devoted to research and development – two indicators on *knowledge exchange* – revenues from knowledge transfer and funding from the Swiss Innovation Agency – which is coherent with the existence of strong segregation of the mission of universities and universities of applied sciences in these respects, as well as two indicators on educational profile and staff from abroad.

As expected, universities of applied sciences achieve an extremely low share of the academically-oriented *SNSF funding*, whereas they outperform universities concerning *funding from the (application-oriented) CTI*. The definition of forms thus leads to different (and stable) positions in funding markets. PhD intensity displays strong segregation due to regulation (universities of applied sciences do not have the right to award doctorates); the increase in diversity is mostly due to universities further increasing their share of PhD students and thus the absolute distance between the two populations further increased.

Concerning *time devoted to research and development*, an increase of its share at universities of applied sciences was a policy objective in order to support research activities in these institutions. Hence, the average time devoted to research increased from 15% to 19% in universities of applied sciences, but the distance remained stable as the average time at universities increased from 44% to 48%. At the same time, universities of applied sciences have become more homogeneous over time – the range of values decreased from 24% to 12%, as an outcome of the increase in

the share of institutions below the population average (e.g. University of Applied Sciences Zentralschweiz), but also the decreasing research intensity of a previously above average institution (Scuola Professionale della Svizzera Italiana). For universities, a similar evolution can be observed with institutions below the population average catching up, as in the case of Lugano, Lucerne and Basel. The indicator *staff time for education* displays a similar pattern (with slightly less strong segregation), which is coherent with this being the prime mission of universities of applied sciences, and a secondary issue for the universities.

The indicator *knowledge exchange* displays an interesting mix between specificities of populations and outliers due to specific institutional strategies. For universities of applied sciences, knowledge transfer is a core task, and thus the increase in this activity does not go along an increase in internal differences in the population, whereas for universities this is not a defining feature. Accordingly, individual universities have considerable leeway to define the importance of these activities, depending also on subject specialization; the University of Sankt Gallen emerges as an exceptional outlier with a share of 38% (the second highest share being 25% for a university of applied sciences), as it is a business school with a strong focus on management and cooperation with the private sector. Expectedly, this indicator displays the highest increase in diversity as increasing segregation does not lead to a strong reduction of internal diversity of universities.

Finally, as predicted by the policy analysis, universities and universities of applied sciences remain quite distinct concerning the length of the curricula offered (share of master students) and *students older than 25 years* – universities of applied sciences having a much higher share (25% in 2008) than universities (8%). The two populations are clearly separated in this respect and their distance increases over time. Again, this is coherent with our predictions: universities and universities of applied sciences are expected to address different clienteles, and only the latter are expected to train students with some years of professional experience.

Overall pattern

Overall, the data and analysis confirm that segregation and blending processes take place in the Swiss binary higher education system, in line with our predictions. Much of the segregation takes place around areas that are signalled in the policy discourse as distinctive features of the two populations (*research for universities, knowledge transfer for universities of applied sciences*, to a lesser extent *internationality* and *students' profile*). The growth of the universities of applied sciences sector has undoubtedly contributed to blending processes (*number of students, subject specialisation*).

The university sector was rather stable over time with limited changes in their dispersion, except a slight (statistically non-significant) decrease in the dimensions where segregation is strongest (research and knowledge exchange): this can be interpreted as the presence of universities of applied sciences pushing universities to be more coherent internally. As a consequence of different historical institutional legacies and a more competitive funding regime, and also maybe as a consequence of the liability of newness - 'testing' the boundaries of their populations – universities of applied sciences display much stronger changes over time, as well as an increase of dispersion for those dimensions for which there are no strict policy stipulations.

Finally, diversity displays contrasting tendencies, as there is a statistically significant increase for four indicators – *number of students, percentage of PhD students, students from abroad* and *revenues from knowledge transfer* – and a decrease for three further indicators – *staff time for education, mature students* and *CTI funding*. This shows that changes in the level of diversity are determined both by segregation

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processes between the two populations and internal differentiation. The balance between the two varies by indicator. As expected, for the blending indicators internal differentiation accounts for the largest (and increasing) share of community-level diversity, whereas for the segregating indicators population-level segregation is the main driver of diversity, but nevertheless both processes are relevant for all indicators.

Discussion and conclusions

Before drawing some general conclusions, it is important to acknowledge the limitations of the data presented. The observation period is rather short, as the universities of applied sciences were only created in the late 1990s, and the number of institutions is rather small. However, we notice that these results are significant as this period saw a strong expansion of the universities of applied sciences sector, with a doubling of student numbers and a four-fold increase of research expenditures and, thus, there would have been ample room for changes.

The indicators display a coherent pattern, while the few departures from our predictions can readily be explained by specific contextual factors, such as the importance of cross-border flows of students in a small country sharing the same language with its (larger) neighbouring countries. They demonstrate that for the Swiss case the binary divide has been conductive in establishing and stabilizing a distinct profile for universities of applied sciences *for the dimensions for which this was agreed at the policy level*. For most dimensions, universities and universities of applied sciences are clearly separated and internal differences in each population are generally small. In the case of universities of applied sciences, this process is particularly visible concerning the two new missions these institutions were assigned: applied research and development and knowledge transfer. In both domains, we observed a rapid development of universities of applied sciences activities – for example the share of knowledge-transfer revenues in their budget doubled during the considered period. At the same time, universities of applied sciences became more coherent internally and their profile remained very different from universities. Finally, both segregation and competitive differentiation contribute to community-level diversity for all indicators, but the former is the dominant mechanism for segregating dimensions, the latter for the blending dimensions.

This pattern is related to how the two organizational forms are defined at the policy level, but also how certain dimensions were left to the discretion of higher education institutions (no clear stipulation leading to internal differentiation within the populations). Form definitions at the policy level are an effective tool to generate distinct populations: core dimensions promote stronger distinction and coherence of individual populations, while peripheral dimensions leave space for individual institutional strategies (related to competition for resources).

We argue that the success of the binary divide in creating distinct profiles of universities and universities of applied sciences was only partially due to the existence of different regulations for the two sectors; the strength of the normative distinction by a broader set of audiences was also central, as well as this distinction creating competitive pressures to keep the two populations apart – either through distinct funding rules or through the behaviour of some audiences like the academically-oriented Swiss National Science Foundation.

We consider that the approach developed in this article provides important directions to advance our understanding of differentiation and convergence processes in higher education systems. First, at the theoretical level, we showed that the concept of organizational forms provides a richer and deeper account of how institutional types are defined, including both regulative and normative elements. As the regulative

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dimension – the existence of legally-defined types – is only one component of the definition of forms, this would allow us to take into account (in further research) cases, such as the United Kingdom, where the legal distinction was abolished, but forms are still perceived as different and are likely to have lasting impacts on population structure.

Second, the notion of forms as settlements between relevant audiences goes beyond the idea that the definition of the binary divide is solely based on regulative interventions from the state. Instead, the institutionalization of higher education institutional types is a complex sociopolitical process, where some level of agreement between relevant audiences is required to make distinctions stable and effective. This paves the way for a more nuanced analysis of the factors explaining the stability of the binary divide, looking at the role of different audiences – students, private companies, academics – in shaping shared representations, to the degree of agreement between them in supporting distinctions between types of higher education institutions, and to the coherence (or incoherence) between the mechanisms through which forms affect individual institutions.

Third, forms provide an analytical link between the definition of types and missions on the one hand, and competition for resources on the other. Forms generate expectations of audiences that subsequently affect the allocation of resources, hence shaping the space for competition. Competition will therefore have different impacts on population structure depending on the extent to which audiences accept departures of individual institutions from the stipulations of 'ideal' types. This insight advances our theoretical and empirical understanding of the interplay between the forces of isomorphism and competition and how they shape population structures and levels of diversity.

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