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Approaching effects of the economic crisis on university efficiency: A comparative study of Germany and Italy

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Keywords: higher education; economic crisis; governance; data envelopment analysis; scale efficiency.

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Approaching effects of the economic crisis on university efficiency

A comparative study of Germany and Italy

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Abstract:

In this paper, we compare the efficiency of the Italian and German universities in the process of transforming public funding into the multiple outputs of a university, i.e. graduating students, publishing research, and patenting activity. We do this with a particular focus on the policies implemented following the financial crisis in 2008. Using a sample of 133 public universities, of which 73 public universities in Germany and 60 public universities in Italy observed over the period 2006-2011 we find that Italian universities perform significantly better in terms of output maximization than German universities. The crisis does not show a general impact, while the treatment effect indicates that Italian universities coped better during the crisis than their German counterparts at a highly significant level.

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This project benefitted from presentations at the XVII Annual Scientific Meeting of the Associazione italiana Ingegneria Gestionale on October 13th and 14th, 2016, as well as at the 4th Workshop on Education in Efficiency in Milan on October 20th and 21st, 2016. In particular, we are grateful to Mattia Cattaneo (University of Bergamo), Cristina Rossi-Lamastra (Technical University of Milan), Tommaso Agasisti (Technical University of Milan) and two anonymous reviewers for their very constructive comments and suggestions. Of course, the authors are responsible for any remaining error. Parts of the project were kindly funded by the competence center for Global Business Management in Augsburg.

1. Introduction

Universities, in particular public universities, are dichotomous institutions. On the one hand, they are recognized as important drivers of regional competitiveness, as the most important sources of new ideas, knowledge spillovers and providers of human capital (Audretsch, Lehmann, & Paleari, 2014; Lehmann & Menter, 2015; Meoli, Paleari, & Vismara, 2013). On the other hand, they are criticized often as a static and bureaucratic institution, unable to cope with challenges, changes and exogenous shocks (Sav, 2016). This criticism is at the basis of the large wave of reforms that has characterized the field worldwide in the last two decades. This study focuses on this dichotomous role by analyzing whether and how universities belonging to different university systems react to an exogenous shock like the financial crisis in 2008. The financial crisis manifested itself in a drastically decline in national budgets, resulting in a drop of public spending, like spending in the higher education sector or public R&D (e.g. student by tertiary educational institutions (OECD, 2016)). This hampered public universities to fulfill their mission, as public spending are the main financial sources in continental Europe. University managers, Rectors or Presidents, have thus to cope with this exogenous shock and reorganize their universities.

The Bologna process, initiated in 1999, is one policy approach to put the European university system towards a more market-based system. Standardizing Bachelor and Master Degrees should stimulate the mobility of students within and between countries, fostering the competition of universities to attract the best students and thus, enhance efficiency (Froehlich, 2016). Studies, evaluating whether policy initiatives in Italy influenced by the crisis led to an increase in efficiency are scarce. This paper tries to cope with this topic by estimating the efficiency of universities in two main countries of Europe, Italy and Germany. Relying on a unique panel dataset consisting of all comparable (excluding specialized ones) public state universities in Italy and Germany, we apply a non-parametric approach – Data Envelopment Analysis (DEA, see Charnes, Cooper, and Rhodes (1978)) – to estimate efficiency scores of universities and to evaluate how they differ across the two countries before and after the financial crisis. The financial crisis in 2008 is taken as a treatment effect to estimate difference-in-differences estimations.

We select these two countries for several reasons. First, university systems are characterized by path dependencies. In these respects, both countries are characterized by a joint historical development since the foundation of the first university in Bologna in 1088. Both countries show similarities in the restructuring of the university landscape following the Bologna reform,

a change from a Diploma system to the Bachelor/Master system. Today, both countries are also characterized by large regional inequalities. While Germany is faced with a large and increasing disparity between the West (the former FRG) and the East (former GDR) gap (Agasisti & Pohl, 2012; Audretsch & Lehmann, 2016), Italy is faced with a North-Middle-South gap, which seems to be cemented since decades. Finally, both university systems – different from e.g. Anglo-Saxon systems – follow the *Humboldtian* vision and mission: the interrelatedness of research and teaching.

Besides these similarities, both systems differ in an important way in their governance structures. While universities in Germany are rather autonomous and under the authority of the 16 Federal States (Audretsch & Lehmann, 2016), the Italian system is characterized by a centralized governance system. Further, Italy suffered considerably more during the financial crisis and thus, adjusted university budgets and started to introduce market-oriented measures like performance-based funding. This difference in the governance structure – centralized in Italy and decentralized in Germany – makes a comparison of the two countries a special one. First, because the effects of a centralized/decentralized approach of higher university policy could be directly measured. The question “Does university policy matter” could be analyzed on a national level instead of just relying on different types of universities (Audretsch & Lehmann, 2005).

Our paper adds to previous research in several ways. The study closest to ours is the contribution of Agasisti and Pohl (2012). They also compare Italy and Germany using DEA showing that efficiency scores of public universities in Germany are on a higher level compared to those in Italy, but that both systems converge between 2001 and 2007. We add to this study by including a full sample of all comparable public universities in Germany and Italy and, since they are drawing on two years (2001 and 2007) ending before the economic crisis, a longer time period from 2006 to 2011 capturing the treatment effect. Another important study is Sav (2016), the only study we are aware that focuses directly on the effect of the impact of economic crisis on the efficiency of universities. Our study adds to this work in several ways. Firstly, we place our study in a less market-based context, continental Europe. Secondly, we compare two different governance regimes and include a broader set of universities over a longer period.

The findings of our study are of relevance to three target groups: politicians, university managers and academics as such. Politicians might benefit from understanding mechanisms and effects of political actions that come to term in a system of relative stability when unforeseen shocks are intervening. University managers can prepare university structures for

the effects of exogenous shocks and academics might get a better understanding of the system in which they are embedded. The reminder of this proposal is as follows: The next section provides a review of the literature. Section 3 gives insights to our theoretical arguments. In the fourth section, we introduce the data set, the DEA and estimation methods as well as a short overview on the research design. Our results are discussed in section 5, before we summarize and conclude in section 6.

2. Literature Review

A fruitful and promising literature has been emerged analyzing the performance of universities in the last decades focusing on performance rather than the evaluation of policy initiatives (Emrouznejad, Parker, & Tavares, 2008). In the lack of market prices and the specific type of production function, measuring performance of universities has been a challenge for academic research, leading to an often more qualitative than quantitative literature. In their seminal paper Charnes et al. (1978) introduced a nonlinear, nonconvex programming method with a new definition of efficiency which enables the evaluation of activities of not-for-profit entities, like departments or universities. Since then the method has not only gained several improvements, like considering fixed or variable economies of scale or including bootstrapping techniques, but has been the starting point of a new and promising field of research: New public management, and in particular, the economics and management of the education sector and its institutions (J. Johnes, 2006a, 2006b; Molin, Turri, & Agasisti, 2016).

Subsequently, academic research has focused on the evaluation of individuals, departments or different types of universities, either private or public business schools (Thursby & Kemp, 2002), comparing different governance systems like Anglo-Saxon systems (Lehmann & Warning, 2004; Thursby & Thursby, 2002) and the European system (Agasisti, Catalano, Landoni, & Verganti, 2012; Agasisti & Johnes, 2009; Kempkes & Pohl, 2010), considering institutional and systematic differences (Agasisti & Pérez-Esparrells, 2010; Agasisti & Pohl, 2012), or the impact of environmental endowment (Agasisti & Pohl, 2012).

Departmental DEA studies have in common that they are emphasizing the need to evaluate departments in order to not disadvantage or privilege well performing or underperforming departments (Agasisti et al., 2012; Beasley, 1990; G. Johnes & Johnes, 1993). However, we argue that firstly, we do acknowledge the need to have comparable entities what we ensure by focusing on public universities. This is also explained e.g. by the different production and utility functions of private and public universities (Ahn & Seiford, 1993). Secondly, evaluating

universities is of special interest because they represent a coherent organizational entity that is e.g. negotiation partner for the government. They are located in between a homogenous institutionalized setting and heterogeneous accumulation of faculties. The university level appears to be the only level that provides the possibility of examining the interplay and relation of the three missions – to which we will come back later – as they are consistent among countries (Bonaccorsi, Daraio, & Simar, 2006). Considering strategic orientation and institutional as well as regional factors that are affecting universities is nowadays essential with regards to the positioning in the higher education context, an advantageous allocation of scarce resources and the development of group-specific strategies (Warning, 2004). Taking this one step further, it is beneficial to compare among different countries in a timeframe: universities are influenced by their countries' actions and put into practice diverse strategies to cope with surrounding policies and influence factors based on their individual position (Agasisti & Haelermans, 2016; Agasisti & Pérez-Esparrells, 2010).

The DEA approach allows to measure efficiency and to compare units – such as universities – with the dilemma of multi-product character and heterogeneous in- and outputs (J. Johnes, 2006a). This is specifically advantageous because universities are considered to fulfill three missions: the classical Humboldtian missions (i) teaching and (ii) research as well as the emergent third mission meaning the contribution of universities to society by (iii) innovation (Etzkowitz & Leydesdorff, 2000). Thus, previous contributions evaluate efficiency in terms of teaching (Afonso & Santos, 2005; J. Johnes, 2006b), research (Agasisti et al., 2012; Chu Ng & Li, 2000) or innovation (Caldera & Debande, 2010; Thursby & Kemp, 2002; Thursby & Thursby, 2002). However, due to the advantage of including heterogeneous factors, the focus in university DEA research lies on a combination of research and teaching (Abbott & Doucouliagos, 2003; Arcelus & Coleman, 1997; Athanassopoulos & Shale, 1997; Lehmann & Warning, 2004). Until now the third mission is increasingly examined in detail but barely or not explicitly included in combined efficiency evaluations (Agasisti & Pérez-Esparrells, 2010). Considering the third mission not only individually but also in the interplay with teaching and research is crucial particularly for knowledge societies. This form of society is typical for developed countries – such as Italy and Germany – and depends on (i) generation of highly qualified human capital ensured by university teaching, (ii) generation of future-oriented knowledge ensured by basic research and (iii) the translation of academic knowledge to industrial applicability ensured by entrepreneurial activities of universities (Audretsch & Lehmann, 2016). Even though, universities do not have the explicit aim to achieve efficiency,

using an efficiency score like DEA is an unbiased measure of the performance in translating state efforts to universities' missions which is a basic interest of society.

Our study builds on these important findings, so in the following we will base our theoretical arguments on the existing DEA literature that corresponds to our research project with regards to exogenous shocks and university systems, regional factors, as well as institutional factors.

3. Theory

While the analysis of exogenous shocks is widespread in business related research, e.g. in terms of financial crises, company announcements or scandals and so forth, it is emergent for university related research (Agrawal & Cooper, 2015; Erkens, Hung, & Matos, 2012). As investments in education are investments in the future labor market it is standing to reason that exogenous shocks that are affecting the university system today will have a lagged effect in the future, e.g. in terms of human capital. Further, the analysis of exogenous shocks implies policy and management implications to improve and prepare Higher Education systems for unforeseen challenges.

In fact, one of the greatest challenges in the past decade was the financial crisis starting in 2008. Proceeding from the subprime mortgage crisis in the US the crisis also had enormous effects on Europe, especially Southeastern countries of the European Union and its economically weaker members. In this time, Italy suffered from a sharp decline of the GDP by over 15% (Germany: decline by 5% with rapid recuperation), followed by severe budget cuts and tax increases (Bozio, Emmerson, Peichl, & Tetlow, 2015). This affected also the formerly introduced formula-based funding models in the Italian Higher Education context (Agasisti & Pérez-Esparrells, 2010). The effects of that policy especially on the Italian Higher Education system compared to a more continuous (in terms of funding development) system like in Germany have not been analyzed yet. We do not know which effect those policies had and thus, several outcomes of our research design are possible.

In the following we outline the expected impact of the economic crisis as well as the influence of governance scope (decentral / central). We describe benefits and costs of a decentralized system, which is found in the German case, as well as of a centralized system, which is depicted in the Italian case.

Economic Crisis

Findings of Gawellek and Sunder (2016) regarding the Excellence initiative¹ or Brown, Dimmock, Kang, and Weisbenner (2014) regarding donation deductions show that systems react to both, positive and negative stimuli. Also applying DEA, Sav (2016) analyses descriptively the effects of the crisis on US-American universities' efficiency. The results show a decline in the scores caused by the crisis, and that over time universities seem to very slightly gain efficiency (2010/11), followed by a new decline in the latter period (2012/13). Considering the nature of different directions – positive rewarded incentives (Gawellek & Sunder, 2016) vs. negative budget cutting (Brown et al., 2014; Sav, 2016) – it is interesting, that the strongly differing US-American and German system seem to experience similar effects.

Hypothesis 1: The economic crisis influences efficiency in general negatively.

Decentralization versus Centralization

In the German decentralized university system we assume that universities have a stronger negotiation power regarding financial resources due to a less informed negotiation partner in the states' ministries (the federal states in Germany manage at a minimum one and at a maximum twelve universities). Consequently, decision makers are subject to incomplete contracts, asymmetric information and bounded rationality (Simon, 1959, 1972; Williamson, 1973). This results in universities having a better opportunity to negotiate, to enforce their own interests in a decentralized system and ultimately have room for opportunistic behavior. The interest of university managers is not necessarily being efficient – as this is not a compulsory task of universities – but allocating resources to “fun” activities like research excellence or prestigious study programs that are usually quality related as well as time- and money-consuming (Leitner, Prikoszovits, Schaffhauser-Linzatti, Stowasser, & Wagner, 2007).

In other words, federal states might have an advantage by knowing about local interests within their states but are relatively loose from the other states which leads to oversupply. Additionally, the actors are subject to asymmetric information allowing an eventual opportunistic behavior by universities. Both points could result in a poorly informed incentive strategy that is realized in the respective state but not cross-borders.

Centrally organized systems like Italy benefit from better and more direct steering possibilities due to a faster response time for all-systemic changes, wide ranging implementation

¹ German federal and state governments launched the Excellence Initiative in 2005 to support outstanding research and to enable selected universities competing worldwide.

competence and less asymmetric information (Besley & Coate, 2000). The authority collects aggregated information of universities centrally and negotiates with universities on this basis. This makes it easier to distribute resources equally or unequally if one knows about all the other actors, here universities, their prerequisites, possibilities and negotiation subjects. This implies that obtaining reliable information is beneficial to prevent opportunistic behavior. Centralized governance simply makes it possible to follow a macrosocial approach rather than a scattered one. To generate a comparative advantage in the global competition we assume that a centralized system would strategically specialize the respective universities in its system generating efficiency effects. However, this is in the European-Continental context bound to the principle of unity of research and teaching which is different e.g. to the Anglo-American systems. The before mentioned strategy might be implicit by actions of decision-makers or explicit by a specific planning process (Porter, 2008).

Hypothesis 2: A decentral governance (Germany) of universities results in less efficiency compared to a central governance (Italy).

Exogenous Shock in differing systems

In the context of university systems and their reactions to exogenous shocks, we look to the before outlined general system arrangement (centralization / decentralization) and the differing policy approaches during and after the crisis which might help to handle disadvantages in the efficient allocation of resources of (de)centralized systems.

The policy initiatives in Italy during the crisis, e.g. the first national research assessment in 2005/06 or the allocation of half of the public resources in 2008 for new researchers based on measures of research quality (Rostan & Vaira, 2011), resulted in a decrease of public funds in Italy (European University Association, 2016). A connection of financial support to performance outcomes in research and teaching could have forced the management to allocate the scarce resources in a more efficient way, i.e. reducing organizational slack or X-inefficiency or a shift towards those units which are the most critical for the output. Thus, the financial crises could lead to an increase in the efficiency level. This effect could e.g. be found in the European airline industry that had to deal with several shocks but steadily improved due to changing business models and reduction of inefficiencies (Duygun, Prior, Shaban, & Tortosa-Ausina, 2016).

The more state-oriented case can be observed in the German system where budgets are negotiated on a 3-5 years basis. Although, performance agreements are mostly installed they

remain vague and act often more as a guideline (der Smitten & Jaeger, 2012). An adjustment is barely possible if an exogenous shock like the financial crisis comes up. Although decentralization is considered as factor of local implementation rapidity (due to faster processes of planning and coordination in smaller units), the coordination between states and central government, the strong dependency on state funds and the comparably fast economic recovery results in a relatively stable setting. Thus, Germany is seen as a relevant reference group for testing the treatment – i.e. economic crisis – on Italy with the difference-in-differences estimation.

Hypothesis 3: Regarding efficiency, Italy (central governance) develops better after the crisis than Germany (decentral governance).

4. Dataset and methodology

Our empirical analysis relies on a dataset comprising 133 public universities, of which 73 public universities in Germany and 60 public Italian universities. From the full list of German and Italian universities, we excluded specialized universities, like those only focusing on arts, like music or theatre or those turning from private to public university in the respective timeframe. The dataset is in a balanced panel structure ranging from 2006-2011. We follow previous literature and characterize universities by different input and output variables, like the number of graduates, staff or financial endowment, as provided by the Federal Statistic Office Germany and the Italian Ministry for University and Research. Performance measures like publications or patents were extracted from Scopus. Eurostat provided control variables for the regression analysis like GDP per capita (Purchasing Power Standard) and unemployment rate by NUTS-2 level. The variables, their sources and descriptive statistics are depicted by country in table 1.

Our approach is a two-step analysis by using DEA in the first and a regression analysis in the second step. For our DEA analysis we define output variables according to previous studies and the three missions of universities: teaching measured by graduates, research measured by publications and the third mission measured by patents (Acs, Anselin, & Varga, 2002; Agasisti & Pohl, 2012; Charnes et al., 1978; Toutkoushian, Porter, Danielson, & Hollis, 2003; Warning, 2004). A difficulty of using DEA is that zero values cannot be handled properly. Some universities do not generate patents or publications in some points of time in the observed timeframe. We orientate on Sueyoshi and Goto (2013) and Thompson, Dharmapala, and Thrall (1993) and add a small number (0.1) for zero values. As our main goal consists in measuring the efficient translation of state efforts to the three missions, we will use state funding as an

input (Agasisti & Pohl, 2012; Kempkes & Pohl, 2010). In both systems, state funding is the main income source of universities and in addition the one that is most influenceable by politics. However, we are aware that varying funding mechanisms beyond governmental financing (e.g. tuition fees, third-party funds) might have an influence, thus, we expect a strong impact of country-specific variations for which we control in the second stage. The output-oriented constant returns to scales (CRS) and variable returns to scales (VRS) assuming models are described by Charnes et al. (1978), Cooper, Seiford, and Tone (2006) or Lehmann and Warning (2002). We apply bootstrapping techniques and use the bias-corrected scores as proposed by Simar and Wilson (1998) for our second stage analysis. We will further distinguish between scale efficiency and operations above or under optimal scale size according to Bogetoft and Otto (2010, p. 99 ff.).

As we observe a significant difference between CRS and VRS assumption we continue our analysis using the VRS assumption scores (Bogetoft & Otto, 2010, p. 156). Based on the retrieved output-oriented, bias-corrected, VRS efficiency scores we apply difference-in-differences estimation methods with the financial crisis as an exogenous event or treatment effect (Angrist & Pischke, 2014; Lehmann & Menter, 2015). The parallel trend assumption was tested as suggested by Autor (2003).

$$DEA_{i,t} = \beta_0 + \beta_1 \text{Treatment group (Italy)}_i + \beta_2 \text{Treatment period (2009-2011)}_{i,t} + \beta_3 \text{Treatment effect (Italy/2009-2011)}_{i,t} + \beta_4 \text{Hospital}_{i,t} + \beta_5 \text{University size}_{i,t} + \beta_6 \text{University size}^2_{i,t} + \beta_7 \text{Shanghai100} + \beta_8 \text{Regional development}_{i,t} + (\alpha_i + \varepsilon_{i,t})$$

In our estimation the reference group is Germany (0) whereas the treatment group is Italy (1). We assume that Germany is a relevant control group as public funding for universities was not notably changing after the crisis (European University Association, 2012). The treatment period “economic crisis” is starting in 2009 representing the policy intervention of cutting-off financial measures in Italy after 2008 as a consequence. The treatment effect is the interaction of the treatment group Italy during the treatment time 2009-2011. Our first model will focus on this national treatment effect and the second model will additionally include our control variables. As previous studies suggest, we control for university hospital (Agasisti & Pohl, 2012; Warning, 2004), the size of university (students and students², in order to control for non-linear effects of size) (Agasisti & Pérez-Esparrells, 2010; Kempkes & Pohl, 2008), being in the top 100 universities in the Shanghai ranking as a measure of prestige, the type-specific workload of professors (student/professor) and for the economic development of the region (growth rate of GDP/capita and unemployment rate on NUTS2 level) (Agasisti & Pohl, 2012; Kempkes & Pohl, 2010).

Our estimates are based on panel regressions. We will firstly use the random-effects panel regression that is capturing the country effect. This implies that unobserved heterogeneity (a_i) is uncorrelated with the observed characteristics and thus, component of the residues ($\varepsilon_{i,t}$). Additionally, this allows us to control for time consistent variables in contrast to the fixed-effects model like country, one of our main interests. To test for robustness we employ and contrast our results by two different regression models: (a) a two-stage fixed-effects and (b) a cluster-robust OLS estimation (results can be found in the attachment).

(a) For the two-stage-fixed-effects model we (i) estimate the fixed-effects regression which is obviously not possible for our time-invariant variables like country and university hospital. The country effect is a strong determinant in our models. As unobserved time-invariant factors are considered to enter the error term ($\varepsilon_{i,t}$) we (ii) predict the error term and regress as a second step our time-invariant variables on $\varepsilon_{i,t}$ (applied similarly e.g. by Froehlich, 2016).

(b) As a second robustness check, we use an OLS estimation with cluster-robust standard errors and year dummies. This allows to consider errors that exist and correlate within a cluster – in our case one university across each observation period – but is uncorrelated across clusters (Cameron & Trivedi, 2009).

5. Results and discussion

We first derive the efficiency scores using DEA techniques. Considering Scale Efficiency (see table 1) (which is the ratio of CRS and VRS assumption scores) we find that Italian universities (0.89) are by far more scale efficient than their German counterparts (0.68). As this ratio only shows if universities are scale (in)efficient we further examine whether they are too small or too large like suggested by Bogetoft and Otto (2010). Interestingly, while both countries have on average universities with a similar size (in terms of students around 17,500-18,000) Italian universities have a greater variability of university size and they tend to have universities that are operating below the optimal scale size meaning they are too small while German universities tend to operate above optimal scale size meaning they are too large. Figure 1 depicts the trends for German and Italian universities showing that Italian universities are in general more efficient than German universities in transforming public resources into the defined outputs.

[INSERT SOMEWHERE HERE FIGURE 1]

Our results show that German universities loose consistently efficiency starting from 2009. This results partly contrast with the results of Agasisti and Pohl (2012), though their selection of inputs differ from our analysis, focused on efficient translation from state funds. The financial

measures for the Italian system were in relation considerably lower while outputs were relatively on a similar or higher level than for the German system which causes less efficiency for the latter. The constant improvement of Italian universities could be driven by a decreasing input of state funds compared to the steady input level of German universities. Indeed, following the financial crisis at the end of the years 2000', the cuts to government funding for higher education systems have been particularly severe in Italy, up to a -16% inflation-adjusted change between 2010 and 2013 (European University Association, 2016).

In Table 2 we present our empirical results for the influence of the economic crisis on Italy and Germany using random-effects panel regression. The two-stage fixed effects (table 3a and 3b) and cluster-robust OLS (table 4) estimations substantiate the robustness of our core results:

[INSERT SOMEWHERE HERE TABLE 2] [INSERT SOMEWHERE HERE TABLE 3a]
 [INSERT SOMEWHERE HERE TABLE 3b] [INSERT SOMEWHERE HERE TABLE 4]

The country effect is the most influential and highly significant what seems reasonable looking at the DEA scores in Figure 1. This means that Italian universities are significantly better in terms of output maximization than German universities supporting Hypothesis 2. The crisis as such taking place from 2009-2011 does not show a general impact (unless a significant negative impact in the cluster-robust estimation) what leads to the preliminary rejection of Hypothesis 1. The treatment effect, meaning the interaction of Italian universities during the crisis, is significantly positive and robust in both models and all estimations and become even stronger by including our control variables (table 2 and 4). This indicates that Italian universities cope better during the crisis than their German counterparts at a highly significant level and supports Hypothesis 3.

Although austerity might have had negative effects in other fields, the introduction of various higher education reforms in Italy influenced the development of the output maximization of Italian universities positively. The implementation of competitive funding mechanisms with the *Valutazione triennale della Ricerca, VTR*, in 2003 affected the strategic behavior and research productivity of universities significantly (see Cattaneo, Meoli, and Signori (2016) for an analysis of the reforms). Even though, Germany introduced e.g. the *Exzellenzinitiative* to provide additional funding by federal government and states, a non-performance or non-participation did not have consequences on the general funding process. While Germany is thus, steering at state level with guaranteed autonomy for universities, the Italian system is centralized and monitors universities comparably more regulated e.g. by formulas (Agasisti,

2009). In terms of efficiency, the Italian system created an advantage by introducing competition-oriented measures compared to the relatively stable and more classical European continental German system.

6. Conclusions

The focus of this study is to empirically estimate whether and how public universities in Germany and Italy were affected by the financial crisis in 2008. We use DEA techniques to shed light on the efficiency of universities in both countries and employ difference-in-differences estimation models to discover the influence of the financial crisis. Using a unique panel data set covering all comparable public state universities in Germany and Italy from 2006-2011, our results strongly point out that the efficiency of universities is significantly shaped by the national governance structure. While universities in Italy are in general under the authority of the government, their individual negotiation power in parts depends on their individual strength and endowment. This seems to shape efficiency positively in times of relative uncertainty like the financial crisis. In contrast, universities in Germany, which are under a federal authority, but less independent in their negotiation power suffer more during the economic crisis in terms of efficiency. To put it another way, reforms and restructuring during the financial crisis caused Italian universities to cope better during the crisis than their German counterparts in terms of efficiency.

Does this mean that German university budgets should be cut? The uncomfortable truth is that either cutting input or improving output would be mandatory if the aim is to become efficient. For responsible politicians this means that either they cut budget and risk to destroy existing production processes or they encourage universities to change underlying processes to generate more output, e.g. by providing incentives. The Italian way shows that the introduction of market-oriented mechanisms helped to change to more efficient production processes which ultimately lead to a more flexible reaction to an exogenous shock. With the introduction of the Excellence initiative one-step towards this direction has already been made without ultimate sanctioning those not willing or able to adjust – which might be more socially acceptable.

Our study provides first results analyzing whether and how a financial crisis affects public universities. However, the study is characterized by several potential limitations, like the omitted variable problem, the miss-specification of the estimation techniques, or the theoretically motivated choice of in- and output variables. We also acknowledge that the time span might be expanded for future research.

In the context of our study, a discussion of politicians, university managers and society on if, how and why efficiency should play a role in Higher Education is overdue. Not only quantity also excellence and the price of excellence should be regarded in efficiency research. Especially, the role of quality in research and teaching as a factor that is cost-intensive should be considered as ranking data might not have caught excellence sufficiently. Our conclusions and findings might have been quite different if we had observed a quality increase over time for Germany and a decrease for Italy. Then, a discussion on the relation of quantity and quality, in particular with view on investments for the future and possible ways to ensure a good balance would be unavoidable. However, measuring quality in a university context is a multi-faceted and highly discussed topic as well as challenging to operationalize with data but should be considered in further research.

7. Bibliography

- Abbott, M., & Doucouliagos, C. (2003). The efficiency of Australian universities: a data envelopment analysis. *Economics of Education Review*, 22(1), 89-97.
- Acs, Z. J., Anselin, L., & Varga, A. (2002). Patents and innovation counts as measures of regional production of new knowledge. *Research Policy*, 31(7), 1069-1085.
- Afonso, A., & Santos, M. (2005). Students and teachers: A DEA approach to the relative efficiency of portuguese public universities. *ISEG-UTL Economics Working Paper*(07).
- Agasisti, T. (2009). Market forces and competition in university systems: theoretical reflections and empirical evidence from Italy. *International Review of applied economics*, 23(4), 463-483.
- Agasisti, T., Catalano, G., Landoni, P., & Verganti, R. (2012). Evaluating the performance of academic departments: an analysis of research-related output efficiency. *Research Evaluation*, 21(1), 2-14.
- Agasisti, T., & Haelermans, C. (2016). Comparing efficiency of public universities among European countries: Different incentives lead to different performances. *Higher Education Quarterly*, 70(1), 81-104.
- Agasisti, T., & Johnes, G. (2009). Beyond frontiers: comparing the efficiency of higher education decision-making units across more than one country. *Education economics*, 17(1), 59-79.
- Agasisti, T., & Pérez-Esparrells, C. (2010). Comparing efficiency in a cross-country perspective: the case of Italian and Spanish state universities. *Higher Education*, 59(1), 85-103.
- Agasisti, T., & Pohl, C. (2012). Comparing German and Italian public universities: Convergence or divergence in the higher education landscape? *Managerial and Decision Economics*, 33(2), 71-85.
- Agrawal, A., & Cooper, T. (2015). Insider trading before accounting scandals. *Journal of Corporate Finance*, 34, 169-190.
- Ahn, T., & Seiford, L. M. (1993). Sensitivity of DEA to models and variable sets in a hypothesis test setting: The efficiency of university operations. In Y. Ijiri (Ed.), *Creative and innovative approaches to the science of management* (pp. 191-208). New York: Quorum Books.
- Angrist, J. D., & Pischke, J.-S. (2014). *Mastering metrics: the path from cause to effect*. Princeton/Oxford: Princeton University Press.
- Arcelus, F., & Coleman, D. (1997). An efficiency review of university departments. *International Journal of Systems Science*, 28(7), 721-729.
- Athanassopoulos, A. D., & Shale, E. (1997). Assessing the comparative efficiency of higher education institutions in the UK by the means of data envelopment analysis. *Education economics*, 5(2), 117-134.
- Audretsch, D. B., & Lehmann, E. E. (2005). Do University policies make a difference? *Research Policy*, 34(3), 343-347.
- Audretsch, D. B., & Lehmann, E. E. (2016). *The seven secrets of Germany: Economic resilience in an era of global turbulence*: Oxford University Press.
- Audretsch, D. B., Lehmann, E. E., & Paleari, S. (2014). Academic policy and entrepreneurship: a European perspective. *The Journal of Technology Transfer*, 40(3), 363-368.
- Autor, D. H. (2003). Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing. *Journal of labor economics*, 21(1), 1-42.
- Beasley, J. E. (1990). Comparing university departments. *Omega*, 18(2), 171-183.

- Besley, T., & Coate, S. (2000). Centralized versus Decentralized Provision of Local Public Goods: A Political Economy Analysis. *NBER Working Paper Series*, 7084.
- Bogetoft, P., & Otto, L. (2010). *Benchmarking with Dea, Sfa, and R*. New York: Springer Science & Business Media.
- Bonaccorsi, A., Daraio, C., & Simar, L. (2006). Advanced indicators of productivity of universities: An application of robust nonparametric methods to Italian data. *Scientometrics*, 66(2), 389-410.
- Bozio, A., Emmerson, C., Peichl, A., & Tetlow, G. (2015). European Public Finances and the Great Recession: France, Germany, Ireland, Italy, Spain and the United Kingdom Compared. *Fiscal Studies*, 36(4), 405-430.
- Brown, J. R., Dimmock, S. G., Kang, J.-K., & Weisbenner, S. J. (2014). How university endowments respond to financial market shocks: Evidence and implications. *The American Economic Review*, 104(3), 931-962.
- Caldera, A., & Debande, O. (2010). Performance of Spanish universities in technology transfer: An empirical analysis. *Research Policy*, 39(9), 1160-1173.
- Cameron, A. C., & Trivedi, P. K. (2009). *Microeconometrics using stata* (Vol. 5): Stata press College Station, TX.
- Cattaneo, M., Meoli, M., & Signori, A. (2016). Performance-based funding and university research productivity: the moderating effect of university legitimacy. *The Journal of Technology Transfer*, 41(1), 85-104.
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, 2(6), 429-444.
- Chu Ng, Y., & Li, S. K. (2000). Measuring the research performance of Chinese higher education institutions: an application of data envelopment analysis. *Education economics*, 8(2), 139-156.
- Cooper, W. W., Seiford, L. M., & Tone, K. (2006). *Introduction to data envelopment analysis and its uses: with DEA-solver software and references*: Springer Science & Business Media.
- der Smitten, S. I., & Jaeger, M. (2012). *Ziel-und Leistungsvereinbarungen als Instrument der Hochschulfinanzierung*. Hannover: HIS Hochschul-Informationen-System GmbH.
- Duygun, M., Prior, D., Shaban, M., & Tortosa-Ausina, E. (2016). Disentangling the European airlines efficiency puzzle: A network data envelopment analysis approach. *Omega*, 60(1), 2-14.
- Emrouznejad, A., Parker, B. R., & Tavares, G. (2008). Evaluation of research in efficiency and productivity: A survey and analysis of the first 30 years of scholarly literature in DEA. *Socio-economic planning sciences*, 42(3), 151-157.
- Erkens, D. H., Hung, M., & Matos, P. (2012). Corporate governance in the 2007–2008 financial crisis: Evidence from financial institutions worldwide. *Journal of Corporate Finance*, 18(2), 389-411.
- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Research Policy*, 29(2), 109-123.
- European University Association. (2012). EUA’s public funding observatory June 2012. Retrieved from http://www.eua.be/Libraries/governance-autonomy-funding/June_2012_report_FINAL.pdf?sfvrsn=0. Accessed 22.02.2017.
- European University Association. (2016). EUA's monitoring of the impact of the economic crisis on public funding for universities in Europe. Retrieved from <http://www.eua.be/activities-services/projects/eua-online-tools/public-funding-observatory-tool.aspx>. Accessed 08.09.2016.
- Froehlich, A. C. (2016). Does the curricular structure affect doctoral enrolment? *Journal of Business Economics*, 86(9), 1-23.

- Gawellek, B., & Sunder, M. (2016). *The German excellence initiative and efficiency change among universities, 2001-2011*. Working Paper, Universität Leipzig, Wirtschaftswissenschaftliche Fakultät.
- Johnes, G., & Johnes, J. (1993). Measuring the research performance of UK economics departments: an application of data envelopment analysis. *Oxford economic papers*, 332-347.
- Johnes, J. (2006a). Data envelopment analysis and its application to the measurement of efficiency in higher education. *Economics of Education Review*, 25(3), 273-288.
- Johnes, J. (2006b). Measuring teaching efficiency in higher education: An application of data envelopment analysis to economics graduates from UK Universities 1993. *European Journal of Operational Research*, 174(1), 443-456.
- Kempkes, G., & Pohl, C. (2008). Do institutions matter for university cost efficiency? Evidence from Germany. *CESifo economic studies*, 54(2), 177-203.
- Kempkes, G., & Pohl, C. (2010). The efficiency of German universities—some evidence from nonparametric and parametric methods. *Applied Economics*, 42(16), 2063-2079.
- Lehmann, E. E., & Menter, M. (2015). University–industry collaboration and regional wealth. *The Journal of Technology Transfer*, 41(6), 1-24.
- Lehmann, E. E., & Warning, S. (2002). *Teaching or research? What affects the efficiency of universities*. Diskussionsbeiträge: Serie 1, Fachbereich Wirtschaftswissenschaften, Universität Konstanz.
- Lehmann, E. E., & Warning, S. (2004). Effizienz von Universitäten: Anwendung der Data Envelopment Analyse für britische Hochschulen *Jahrbuch für Handlungs-und Entscheidungstheorie* (pp. 69-93): Springer.
- Leitner, K.-H., Prikoszovits, J., Schaffhauser-Linzatti, M., Stowasser, R., & Wagner, K. (2007). The impact of size and specialisation on universities' department performance: A DEA analysis applied to Austrian universities. *Higher Education*, 53(4), 517-538.
- Meoli, M., Paleari, S., & Vismara, S. (2013). Completing the technology transfer process: M&As of science-based IPOs. *Small Business Economics*, 40(2), 227-248.
- Molin, M. D., Turri, M., & Agasisti, T. (2016). New Public Management Reforms in the Italian Universities: Managerial Tools, Accountability Mechanisms or Simply Compliance? *International Journal of Public Administration*, 1-14.
- OECD. (2016). Education at a Glance OECD Indicators. Retrieved from <http://www.oecd-ilibrary.org/docserver/download/9614011e.pdf?expires=1465979696&id=id&accname=guest&checksum=FA97055454B5ABB281E2101539F14669>. Accessed 15.06.2016.
- Porter, M. E. (2008). *Competitive strategy: Techniques for analyzing industries and competitors*. New York: The Free Press.
- Rostan, M., & Vaira, M. (2011). Faltering Effects of Market-Oriented Reforms on Italian Higher Education *Public Vices, Private Virtues?*. 327-343. Cham: Springer.
- Sav, G. T. (2016). Recession and Post-Recession Efficiency and Productivity Changes in United States Public Universities: The Good, Bad, and Ugly. *Advances in Management and Applied Economics*, 6(3), 1-15.
- Simar, L., & Wilson, P. W. (1998). Sensitivity analysis of efficiency scores: How to bootstrap in nonparametric frontier models. *Management science*, 44(1), 49-61.
- Simon, H. A. (1959). Theories of decision-making in economics and behavioral science. *The American Economic Review*, 49(3), 253-283.
- Simon, H. A. (1972). Theories of bounded rationality. *Decision and organization*, 1(1), 161-176.
- Sueyoshi, T., & Goto, M. (2013). Pitfalls and remedies in DEA applications: how to handle an occurrence of zero in multipliers by strong complementary slackness conditions. *Engineering*, 5(1), 29-34.

- Thompson, R. G., Dharmapala, P., & Thrall, R. M. (1993). Importance for DEA of zeros in data, multipliers, and solutions. *Journal of Productivity Analysis*, 4(4), 379-390.
- Thursby, J. G., & Kemp, S. (2002). Growth and productive efficiency of university intellectual property licensing. *Research Policy*, 31(1), 109-124.
- Thursby, J. G., & Thursby, M. C. (2002). Who is selling the ivory tower? Sources of growth in university licensing. *Management science*, 48(1), 90-104.
- Toutkoushian, R. K., Porter, S. R., Danielson, C., & Hollis, P. R. (2003). Using publications counts to measure an institution's research productivity. *Research in Higher Education*, 44(2), 121-148.
- Warning, S. (2004). Performance differences in German higher education: Empirical analysis of strategic groups. *Review of Industrial Organization*, 24(4), 393-408.
- Williamson, O. E. (1973). Markets and hierarchies: some elementary considerations. *The American Economic Review*, 63(2), 316-325.

8. Tables and Figures

Table 1: Descriptives Germany and Italy

	Germany					Italy				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
CRS (bootstrapped, b.) ¹	438	0.24	0.11	0.09	0.78	360	0.64	0.14	0.10	.92
CRS (non- bootstrapped, n.b.) ¹	438	0.29	0.16	0.09	1	360	0.72	0.16	0.12	1
VRS (b.) ¹	438	0.39	0.16	0.11	0.94	360	0.68	0.14	-0.01	.93
VRS (n.b.) ¹	438	0.46	0.20	0.13	1	360	0.81	0.14	0.41	1
Scale Efficiency (n.b.)	438	0.68	0.28	0.18	1	360	0.89	0.14	0.12	1
Below optimal scale size (n.b.)	438	-0.17	0.20	-0.82	0.01	360	-0.05	0.08	-0.43	0.03
Above optimal scale size (n.b.)	438	0.01	0.02	-0.00	0.19	360	0.05	0.12	-0.00	0.91
State Funding ² (in TEUR)	438	423,915	360,450	16,897	1,501,371	360	116,047	104,737	7,705	582,840
Graduates ²	438	2,658	1,587	256	8,437	360	4,474	3,886	60	21,517
Patents ³	438	18	35	0	243	360	6	9	0	69
Publications ³	438	1,060	903	7	4,317	360	818	823	0	3,988
Students ²	438	17,976	10,503	2,432	46,948	360	17,629	14,684	401	78,529
Students/ Professor ²	438	63	14	19	100	360	19	5	9	43
Growth GDP/capita ⁴	438	0.03	.05	-0.12	0.15	360	0.01	0.04	-0.09	0.08
Unemployment rate ⁴	438	8.16	3.53	2.7	19.2	360	7.86	3.67	2.8	15.4

Sources: ¹ Own calculation (MaxDEA) ²Federal Statistic Office Germany (Destatis); Italian Ministry for University and Research (MIUR)
³Scopus ⁴Eurostat

Table 2: Regression Results

		VRS Efficiency (bootstrapped)	
		(1)	(2)
Diff-in-Diff	Treatment Group (Italy)	0.27*** (0.03)	0.22*** (0.04)
	Treatment Period (2009-2011)	0.01 (0.01)	-0.00 (0.01)
	Treatment Effect (Nation x Crisis)	0.03*** (0.01)	0.04*** (0.01)
University characteristics	Hospital		0.03 (0.03)
	Students		0.00** (0.00)
	Students ²		-0.00 (0.00)
	Students/Professor		-0.00** (0.00)
	Shanghai Top 100		0.03 (0.03)
Regional factors	Growth GDP/capita		-0.13*** (0.05)
	Unemployment		-0.00 (0.00)
_cons		0.38*** (0.02)	0.41*** (0.05)
Number of observations		798	798
Number of universities		133	133
Observations per university		6	6

Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01;

Random-effects panel regression with output-oriented, VRS, bias-corrected DEA-Scores as dependent variable

Table 3a: Regression Results

		VRS Efficiency (bootstrapped)	
		(3a)	(4a)
Diff-in-Diff	Treatment Group (Italy)	omitted	omitted
	Treatment Period (2009-2011)	0.01 (0.01)	0.01 (0.01)
	Treatment Effect (Nation x Crisis)	0.03*** (0.01)	0.03** (0.01)
University characteristics	Hospital		omitted
	Students		-0.00 (0.00)
	Students ²		0.00 (0.00)
	Students/Professor		-0.00** (0.00)
	Shanghai Top 100		-0.01 (0.03)
Regional factors	Growth GDP/capita		-0.12** (0.05)
	Unemployment		-0.01 (0.00)
_cons		0.51*** (0.00)	0.61*** (0.06)
Number of observations		798	798
Number of universities		133	133
Observations per university		6	6

Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01;

Fixed-effects panel regression with output-oriented, VRS, bias-corrected DEA-Scores as dependent variable

Table 3b: Regression on residuals

	Residuals	
	(3b)	(4b)
Treatment Group (Italy)	0.18*** (0.03)	0.17*** (0.03)
Hospital		0.06** (0.03)
_cons	0.46*** (0.00)	-0.12*** (0.02)

Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01;

Between regression with residuals of Table 3a regression as dependent variable

Table 4: Regression Results

		VRS Efficiency (bootstrapped)	
		(5)	(6)
Diff-in-Diff	Treatment Group (Italy)	0.28*** (0.03)	0.33*** (0.04)
	Treatment Period (2009-2011)	-0.02*** (0.01)	-0.04*** (0.01)
	Treatment Effect (Nation x Crisis)	0.03*** (0.01)	0.06*** (0.02)
University characteristics	Hospital		0.03 (0.03)
	Students		0.00** (0.00)
	Students ²		-0.00** (0.00)
	Students/Professor		0.00 (0.00)
	Shanghai Top 100		0.22** (0.10)
Regional factors	Growth GDP/capita		-0.15 (0.21)
	Unemployment		-0.01** (0.00)
Year	Year dummies	included	included
_cons		0.41*** (0.02)	0.29*** (0.07)
Number of observations		798	798
Number of universities		133	133
Observations per university		6	6

Cluster-robust standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01;

Ordinary least squares regression with output-oriented, VRS, bias-corrected DEA-Scores as dependent variable

Figure 1: Trends of mean bootstrapped DEA scores with variable returns to scale and output-orientation of Italy and Germany 2006-2011. Source: Own calculations using MaxDEA.

