An analysis of efficiency and productivity change of performing arts firms in 11 EU countries

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PRELIMINARY VERSION

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1. Synopsis

This paper estimates the technical efficiency and its determinants for the performing arts (PA) firms in 11 EU countries, and it also obtains the total factor productivity (TFP) index for all PA firms to compare their total productivity change through time. Both parametric SFA and non-parametric DEA techniques are applied and the change in TFP is calculated using the Malmquist TFP index that is decomposed into three components: technical efficiency, scale efficiency and technological change. For this purpose, a novel and very rich panel data set for 6225 performing arts firms over 9 years period from 2009 until 2017, and for 11 European countries is applied. Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and UK are included in the analysis (see also Appendix 1). To our knowledge, this is the first empirical study which uses a large database on the EU PA firms, and estimates efficiency and productivity change, by applying both parametric and non-parametric methods.

2. Background

Firms' performance has been studied in different countries and regions from various perspectives, such as: labour and total factor productivity, technical efficiency, allocative and cost efficiency. However, scholars have usually concentrated on studying other sectors such as manufacturing, banking, health or education sector (see for example Agisisti, 2014), whilst very little attention has been paid to the cultural sector. In particular, the performing arts (PA) sector has been underestimated due to the lack of reliable data on inputs and outputs. The European PA sector is an interesting case study for many reasons. Firstly, the economic and public budget crises have reduced the subsidies that the sector has received in the past years in many EU countries as evidenced, for example for Italy

(Castiglione et al. 2018), Germany (Last and Wetzel 2011, Zieba and Newman 2013), Austria and Switzerland (Zieba 2011). Secondly, the PA sector is usually characterised by the absence of technological change and by increasing wages (Baumol and Bowen 1965). These two conditions make the PA sector an important research area because firms that operate in this sector, have to use their inputs efficiently if they want to survive in the market. Moreover, identifying the main sources of productivity change through time which can be either due to technical or scale efficiency, or due to the technological change, is also important for the EU performing arts market.

3. Economic Model

We define the technical efficiency (TE) as the firm's ability to obtain maximum output from a given input vector, using the radial measure of output-oriented TE according to Farell (1957).[1] The scale efficiency is that situation in which the firm is operating at its optimal scale of production, where the firm minimises its average cost. Performing arts firms that are not operating on the production frontier and/or not at the optimal scale, are technically and/or scale inefficient, enlarging their productivity gap from the rest of the economy. Furthermore, when one considers comparison of productivity through time, additional source of productivity change will be the technological (or technical) change. This involves advances in technology that may be represented by an upward shift in the production frontier. Baumol and Bowen (1965) argued that the PA sector is absent from the technological change and this argument might still be very valid today for the European PA firms during the examined period of time. For example, the recent technological advances in telecommunication, broadband, and IT are important productivity-enhancing factors for other (also cultural) sectors, but they might not contribute to an adequate output increase and hence higher productivity gains in the PA sector. Therefore, in this study, we extend the analysis of technical efficiency by applying the Malmquist total factor productivity (TFP) index to measure three sources of productivity change in the European PA sector: technical and scale efficiency change, and technological change (Coelli et al. 2005).

In line with previous studies (Castiglione et al. 2018, Zieba 2011, Zieba and Newman 2013), we also model technical efficiency as the function of different firm-level characteristics (firm size and wage rate) and environmental factors (subsidies on cultural services, population density, tourism and crime) in the region and country where the PA firm is located, using consolidated data set for the 11 EU countries. Individual country dummies are also included to directly control for other efficiency determinants that might be omitted from the analysis and/or they may differ between the examined EU countries.

4. Estimation Methods

[1] We focus on the measurement of technical efficiency, as opposed to economic or cost efficiency, owing to the difficulty of obtaining reliable information on the prices of inputs for the PA firms in the chosen 11 EU countries.

In this research, we apply a wide range of parametric and non-parametric methods to measuring both the technical efficiency and total factor productivity change. This research uses firstly the parametric stochastic frontier approach (SFA) proposed by Aigner et al. (1979) and an extension of this model which is the random-effects panel data SFA model of Greene (2004, 2005) that enables controlling for individual unobserved heterogeneity of the examined firms. We estimate technical efficiency by applying a flexible translog (logarithmic transcendental) production function, in order to account for the non-standard features of production associated with the PA sector. The SFA production function model recognizes that both the technical inefficiency component (deviations below the maximum output level) and the fact that random shocks beyond producers' control, may affect the production outputs and inputs. Moreover, estimation of technical efficiency using the SFA allows us, not only to appraise TE scores but also, to measure output elasticities and returns to scale of the PA firms. Moreover, we also examine the impact of various efficiency determining variables on TE of European PA firms, by directly parametrizing the variance of inefficiency in the SFA production function model. Furthermore, according to the generalized Malmquist productivity index approach proposed by Orea (2002), the estimated parameters of the stochastic production function can be used to calculate and decompose the TFP change into technical efficiency change, technological change, and scale efficiency change (Coelli et al. 2005). Last and Wetzel (2011) obtained the TFP using the parametric SFA model for German public theatres, applying an input distance function on different type of data. This study estimates the SFA production function using financial balance sheet data and additionally applies a non-parametric DEA model.

Secondly, we compare our findings obtained in the SFA production function model with the results obtained using the non-parametric DEA approach. The main advantage of DEA is its simplicity and flexibility as it does not require assumptions about the functional form of the production technology. On the other hand, in contrast to a fully parametric SFA, DEA does not control for noise which is outside the producer's control and which might lead to biased efficiency estimates. This research addresses this issue by applying the semi-parametric two-stage double bootstrap DEA technique of Simar and Wilson (2011). This method allows us not only to validate our nonparametric DEA scores but to also integrate the effects of potential determinants in estimating the technical efficiencies (similarly to the SFA approach discussed above). To obtain the TFP Malmquist index we use the DEA-like linear programming technique proposed by Färe et al. (1994) and apply the method under both CRS and VRS technology, where the latter allows for the decomposition of technical efficiency change into pure efficiency and scale efficiency change (Coelli et al. 2005).

5. Data sample and Variables

The panel data set on output, inputs and other firm-level characteristics comes from the Amadeus/Orbis database provided by the Moody's Analytics/Bureau van Dijk which contains data on firms' financial and productive activities from balance sheets and income statements for over 130

million companies across the world. From this database, we choose the sector *9001 - Performing arts* which displays comparable financial balance sheet information over the period 2009-2017. We restrict our data base to the old EU 15 countries as this is a sample of rather homogeneous countries. After examining the data the countries were reduced to 11, since Austria had only 5 firms with non-missing observations in the sample and therefore was excluded from the estimation, while the remaining EU 15 countries (Greece, Ireland and Luxembourg) where not available in the database and are also not examined in this study. For the remaining 11 EU countries, we assume that the PA firms should share a common technology, which increases their comparability. However, some heterogeneous aspects are taken into account by using the appropriate SFA panel data models as discussed in Section 4.
The Amadeus/Orbis data set had initially data entries for approximately 150 thousand PA firms in the 11 EU countries, however the majority of these data entries did not contain any financial information except for the name of a firm. Following this, we excluded those firms and observations from the initial dataset.[2] Furthermore, the number of observations with missing values for output and inputs and non-zero turnover had also to be dropped from the sample. As a result, the *effective sample* used in this study consists of 6225 firms which gives a total of 22,771 observations and which forms an unbalanced panel (see Appendix 1). [3]

In the PA sector, factors used as inputs (e.g. artistic labour and capital etc.) are transformed into a product which can be observed and measured only indirectly. In the previous efficiency literature, the real measures of artistic output such as the number of seats on offer or tickets sales were commonly applied. The novelty of our research is that we utilise financial accounting data, which are mainly used in efficiency studies for other sectors (e.g. Pieri and Zaninotto 2013). In the present paper output is measured by total annual earned revenues coming from different company activities (shows, renting, and others). Labour input is measured as the total number of employees at the end of the year and capital stock in a given year is proxied by the nominal value of tangible and intangible assets after depreciation. To transform the financial data measured in local currency into real values, the output (the earned revenues) was deflated using the 2-digit harmonised consumer price index (CPI) obtained in the Eurostat database for each EU country, whilst for the capital stock the 2-digit World Bank GDP deflator also at the country level was used. Moreover, to allow for comparison of output and inputs between the countries, the real values in local currency are converted for each EU country into constant 2011 dollars by applying the Purchasing Parity Power (PPP) conversion factors which are available in the World Bank database.

[2] The main reason for the missing financial information is that the historical data of the companies can be reported only for the last 10 recent years in Amadeus, and for the last 5 recent years in Orbis database. Moreover, whilst Amadeus will also delete the company from the database, if the firm did not report anything in the last 5 years, the Orbis will keep this company as long as the company is active in the business register (see discussion in Kalemli-Özcan et al. 2015)

[3] The unbalanced panel data implies that certain individual firms are not observed for some time periods. According to Baltagi and Song (2006), we can still use the standard panel data methods for consistent estimation if the selection rules leading to the attrition in the panel are ignorable for the parameters of interest. Given our final data sample, we assume, and also test empirically, that the attrition in the panel is for random rather than systematic reasons.

As for the efficiency determining variables, the size and wage rates are obtained on firm-individual level using the Orbis/Amadeus database, while the data on subsidies as measured by public expenditures for cultural services, but also data on crime, tourism and population density are collected from the Eurostat at different regional levels. While the subsidies for cultural services are on the country level, the crime rates and population density are gathered for the NUT3 regions and the data on tourist overnight stays are on the NUTS2 regional level. As already noted earlier, in order to allow comparability between the countries, we use the same data sources for the financial deflators and for the environmental variables that are included as the efficiency determinants. The advantage of our data set applied in this study is that we examine the efficiency and productivity of the PA firms at the individual firm level but for numerous EU countries, and we apply at the same time consolidated and comparable financial data for the examined PA companies.

6. Expected findings

This study provides an important contribution into the examination of both efficiency and efficiency factors of the PA firms in the EU, and it also compares the sources or decomposition of their total factor productivity change over the examined period from 2008-2017. We expect that the results obtained from applying both parametric and non-parametric techniques show that the technological progress is not present for the PA firms in the 11 EU countries, providing support to the presence of Baumol's disease in the sector as found by Last and Wetzel (2011) for the theatres in Germany. We also expect that the PA firms are technically inefficient which is in line with previous literature and that we will find certain differences in technical efficiency and total factor productivity index between the 11 EU countries. We also expect that while population density and tourism might increase technical efficiency and hence also the total factor productivity, the crime level will have an adverse effect on technical efficiency which is in line with Castiglione et al. (2018). We also expect that subsidies on cultural services could have different impacts on TE and TFP in different countries. Moreover, we also plan to compare if and how much the changes in the technical efficiency and other sources (i.e. scale efficiency and technical change) contributed to the TFP change of the PA firms in the EU between 2009 and 2017.

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Appendix 1 Effective data sample used for the PA firms in 11 EU countries.

Country	**No. firms**	**No. observations**
1. Belgium	84	341
2. Denmark	21	48
3. Finland	255	921
4. France	1,261	3,360
5. Germany	71	113
6. Italy	239	967
7. Netherlands	28	60
8. Portugal	915	3,743
9. Spain	1,388	3,360
10. Sweden	1,317	6,499
11. UK	646	2,859
Total	**6225**	**22271**