Determinants of firm's technical efficiency in the Italian performing arts sector. A panel data approach over the period 2005-2012

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Abstract
The aim of this paper is to evaluate the determinants of firm's efficiency in the Italian performing arts sector. We focus on the measurement of technical efficiency as opposed to economic or cost efficiency. The analysis is carried out by estimating a stochastic production frontier for an unbalanced panel of 107 Italian performing arts firms that are observed over a 8-years period from the 2005 to 2012. The stochastic production frontier is a parametric method which, in contrast to non-parametric methods, assumes that any deviation from the frontier (maximum output) is composed of two parts, one representing inefficiency and the other randomness or statistical noise. The panel data setting also allows us to control for unobserved heterogeneity by introducing a firm-specific stochastic term, following Greene (2005). Moreover, we control for observed heterogeneity by treating the efficiency determinants as heteroscedastic variables in the inefficiency function, directly parameterising the variance of inefficiency. This paper reaches several interesting and robust findings. Firstly, through the estimated production function elasticities, it is found that both in the case of translog and Cobb-Douglas stochastic frontiers, the Italian performing arts firms operate in a decreasing return to scale landscape. Secondly, it shows that the efficiency score is on average 65%, demonstrating that output of performing arts firms could be substantially increased without the use of new inputs. Thirdly, in investigating the impact of environmental factors on technical efficiency, it confirms that the quality and reputation increases efficiency in the performing arts firms. Fourthly, we found that the institutions play a strong role. In fact, whilst the level of crime, as expected, increases the mean of inefficiency (i.e. decreases technical efficiency); the quality of life index negatively affects the inefficiency. Finally, we have demonstrated that regional differences also exist for the technical efficiency of firms operating in the cultural sector.

1. Introduction

Firm's performance has been studied from different perspectives (e.g. labour and total factor productivity, and technical efficiency) in different countries and regions. However, scholars usually concentrate on the study of the manufacturing sector, whilst the cultural sector has been left in the shade, due to the economic underestimation of the sector, the lack of reliable data on inputs and outputs, and the cost disease that afflicts that sector.

To the best of our knowledge, only a few studies focus on the determinants of technical efficiency for cultural firms. For what concerns theatre, whereas Taalas (1997) focuses on Finnish theatres, Zieba and Newman (2007, 2013), and Zieba (2011) examine production function and technical efficiency for German, and Austrian and Swiss theatres, respectively. The results of Taalas (1997) suggest that, in managing Finnish theatre, inputs are not combined in optimal proportions in light of prevailing market prices, the relative shares of inputs utilisation vary when output expands, and there are scale economies in the production of theatrical performances. Zieba and Newman's (2007) results suggest that while German public theatres are economic, they do not behave optimally from a market perspective given their obligation to fulfil other non-private benefits. Zieba (2011) demonstrates that theatre efficiency estimates are very sensitive to the econometric specification of the unobserved heterogeneity of Austrian and Swiss theatres. In particular, econometric techniques which do not account for this heterogeneity produce much lower efficiency levels. Mairesse and Vanden Eeckaut (2002) focus on a network of French-speaking regional museums in Belgium. Their results are not univocal. They observe that the same museums can react in very different ways, being efficient in one model and not in another. Two other studies focus on specific Spanish cultural organizations. Fernandez-Blanco and Rodriguez-Alvarez (2015) measure the allocative efficiency of the *Fundación Princesa de Asturias*, a Spanish non-governmental organization devoted to promote cultural, scientific and humanistic values of universal heritage. Their results indicate that, although the *Fundación* is not efficient (the same output could be produced with less inputs), both technical and allocative efficiencies have clearly improved during the analysed period. Marco-Serrano (2006), using data on the *Theatrical Circuit of Valencia*, a Spanish regional theatres network, develops the concept of managerial efficiency and applies a non-parametric DEA method. The author finds decreasing trends for the managerial efficiency, caused by the progressive incorporation of new municipal theatres into the network, due to either by the existence of a saturation point or because these incorporations drastically affect the structure of the cultural production frontier.

For what concerns Italy, in the cultural sector, the attention has been limited to few works and devoted to local institutions (theatre and museum) and to public historical archives

(Guccio et al., 2014). Fazioli and Filippini (1997), using data on 28 Italian theatres, localized in Emilia Romagna region, demonstrate the presence of economies of scale and scope. Their results provide evidence to the effects that theatre shows which are already prepared should be more frequently given in different location. Bassi and Funaro (2004) focus on a set of municipal museums localized in three Italian cities: Bologna, Florence and Venice. Their results show that four out of the fifteen museums have a DEA index equal to one and therefore can be considered as relatively efficient. Within the cultural institution Guccio et al. (2014) analyse the public archives as a primary source for historical research exhibiting quite interesting features from an economic point of view. To address such an issue the authors use a nonparametric approach to measure the efficiency in the production of archival services, and find that there are wide margins for improving Italian public historical archives average efficiency.

Similar to previous studies, we focus on the measurement of technical efficiency as opposed to economic or cost efficiency as it is difficult to obtain reliable information on the costs (prices) of inputs in the performing arts sector. The novelty of this paper is that we estimate the production function and evaluate the technical efficiency of the overall performing arts sector using balance sheet data from capital stock companies that operate in the sector. Furthermore, we also estimate the determinants of the technical efficiency in the performing arts sector over the period 2005-2012 using an unbalanced panel of Italian firms. Data are derived mainly from the AIDA (Analisi Informatizzata delle Aziende - Computerized Analysis of Firms) dataset carried out by Bureau van Dijk. The use of balance sheet data overcome the problem of selecting reliable measures for inputs and outputs in cultural services as highlighted by Taalas (2003), since we use information on performing arts capital stock companies (private, public and cooperative) that are obliged to yearly deposit and publish their accounts.

The focus on Italy is important since the identity of the Italian culture is widely recognized in different fields. Roman and Renaissance heritages are the bases on which the contemporary culture has been built on. Cinema, performing and visual arts produced in Italy have its own characteristics that are worldwide recognized. However, the importance of performing arts are widely recognized and present peculiar characteristics that are relevant from economic and social perspectives.

Until recently, the technical efficiency approach has been scarcely applied to the performing arts since the technological progress was not so high to offset the cost disease that was afflicting the sector. However, the upsurge of new technologies (e.g. sound of music, computer graphics, holography and video), that can be applied to the performing arts, plays a new role in reducing the fixed cost of scenes, rehearsing and performing a play or a concert, thus permitting to estimate theatre companies productivity/efficiency introducing new inputs, such as immaterial assets in the production function.

We explore and apply diverse stochastic frontier estimation techniques (e.g. Aigner et al., 1977, Battese and Coelli, 1995; Greene, 2004), which in contrast to non-parametric techniques, such as Data Envelopment Analysis methods, recognise not only the technical inefficiency component (deviations below the optimal output level) but also the fact that random shocks beyond producers' control may affect the production output. Furthermore, the recent stochastic frontier techniques also control for the fact that the companies under investigation are very heterogenous. For example, companies may operate in different regions with various environmental factors and characteristics that are only partially observed. Thus, the recent stochastic frontier approach techniques remove from the estimated inefficiency component also those factors that may be related not to the efficiency but rather to the specific characteristics of the companies.

Estimation of technical efficiency using the stochastic production frontier which is a parametric method, allows us not only to appraise technical efficiency scores but also to measure output elasticities and returns to scale of the performing arts sector. We further demonstrate the environmental factors that strongly influence the efficiency of Italian firms. In conclusion we can say that also for the performing arts sector the econometric techniques, which are widely applied for other sectors such as manufacturing, health or education, can prove to be important public policy instruments to examine the efficiency of performing arts companies provided that detailed data on output and inputs are now available.

The remainder of the paper is structured as follows. Section 2 introduces the economic model setting and section 3 encompasses the methodology and the empirical approach used to evaluate technical efficiency. Section 4 briefly presents the dataset, while Section 5 focuses on the results. Some conclusions are presented in Section 6.

2. Economic model

The first aim of this work is to measure the technical efficiency of the Italian performing arts firms using a stochastic production frontier approach for panel data. The parametric estimation of the stochastic production frontier firstly requires a given functional form for the relationship between inputs and an output. The simplest and the most common functional form used in many Stochastic Frontier Approach (SFA) applications is the Cobb-Douglas production function which imposes certain restrictions on the production structure, such as fixed returns to scale and unitary elasticity of substitution. Therefore, in order to take into account the nonstandard features of production associated with the performing arts, a flexible functional form is preferred (see Zieba and Newman 2007 for a detailed discussion). We apply a translog (logarithmic transcendental) function as proposed by Christensen et al. (1973). Expressing output and inputs in natural log values, the translog production function can be written as:

$$\ln Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k \ln X_{ikt} + 0.5 \sum_{k=1}^{K} \sum_{l=1}^{L} \beta_{kl} \ln X_{ikt} \ln X_{ilt} + d_t + v_{it} - u_{it} \qquad \text{Eq. (1)}$$

where Y_{it} is the real output of the i^{th} performing arts firm in year t ($i=1,2,\ldots,N$ and $t=1,2,\ldots T$) measured as total revenues obtained from ticket sales, X_{ikt} and X_{ilt} are the capital and labour inputs used in the artistic production with $l=1,\ldots,L$ and $k=1,\ldots,K$, respectively. Capital (X_1) is measured by total assets, and labour (X_2) is measured by the number of employees (see Table A1 in the Appendix). Furthermore, d_t is the time dummy for each year that might cause the shift in the production function. Thus, it captures the effects of neutral technological change, changes in government policy and other exogenous shocks that are common to all performing arts firms in the sample. Moreover, v_{it} and u_{it} form together a composite error term discussed in the next section. It should also be noted that the Cobb-Douglas production technology can be obtained from the translog function by setting $\beta_{ll}=\beta_{kk}= \beta_{lk}=0$. For the Cobb-Douglas function the restriction of a homogenous function is imposed. Furthermore, for the translog function, all variables have been rescaled to have unit means, so the first-order coefficients can be interpreted as elasticities of output with respect to inputs when evaluated at the variable means (Coelli et al., 2005).

The second step of this work is to verify whether the economic environment significantly affect the distance of firms operating in the performing arts sector from the optimal production frontier. To this aim the inefficiency equation, in both cases (Translog and Cobb–Douglas production frontier), in addition to factors traditionally considered in the literature, we consider a set of variables linked to the local economic environment. Henceforth, the inefficient equation is specified as:

$$u_{it} = \alpha_0 + \delta_1 inst_{it} + \delta_2 age_{it} + \delta_3 size_{it} + \delta_4 \ln wages_{it} + \delta_5 area_i + \delta_6 d_t + \varepsilon_{it} \qquad \text{Eq. (2)}$$

where *inst* measures the institutional setting for the firm discussed below, and indicates either the index of quality of life (*IQL*) or the number of car thefts (*car_thefts*) in the province, *age* is the age of the firm, *wages* is the cost of the labour incurred by the firm and is a proxy for quality and reputation, *size* is firm's size: small if the firm has 10-50 employees, medium and large if the firm has more than 51 employees; and $area_i$, and d_t indicate, respectively, the dummy variables for the four Italian macro territorial area (*North_West*, *North_East*, *Centre*, and *South and Islands*) and the time period.

For what concerns the expected sign, for the first order β-coefficients of the translog function and the β-parameters of the Cobb-Douglas function, a positive sign is expected as they denote the output elasticities with respect to each of the inputs. For the δ-parameters the economic theory is taken into account. Usually, performing arts companies have their roots in the local environment and a better institutional context largely influences the environment in which companies operate, influencing their efficiency. In this study, the impact of the institutional context on technical efficiency is measured in two different and opposite ways. Firstly, we consider a quality of life index and, secondly the number of car thefts in the provinces. Whilst in the first case, the hypothesis is that a better quality of life may reduce firm's inefficiency, in the second case with the increase of the number of crimes this should negatively impact efficiency (i.e. positively the inefficiency).

We also test whether older and bigger firms are more efficient than younger ones. According to Castiglione (2012) a positive relationship between age and TE can be expected due to 'learning by doing' which occurs through production experience. Over time, firms become more efficient as a result of a growing stock of experience in the production process. However, other economists argue that when an innovation is introduced, older firms may have to delay adoption as it may be too costly to substitute old methods, thus implying that efficiency may decrease with age (Assefa and Matambalya, 2002; Infante, 1990). At Italian level Castiglione and Infante (2014) find a positive effect of age on firm efficiency for the manufacturing sector.

The effect of firm size on efficiency is ambiguous since empirical evidence does not suggest a strong link between efficiency and firm size in either direction. Assefa and Matambalya (2002) assert that whilst a positive effect may be expected due to the economies of scale, the firm size may be negatively linked to efficiency if large firms experience management and supervision problems. On the other side, Jha et al. (1998) find that large firm size is associated with higher technical as well as allocative efficiency.

A company is efficient if it has also quality and reputation that can be recognized through the wages. Labour is the factor that prevails in the performing arts production processes and positively may influence company efficiency. The introduction of the wages in the in(efficiency) equation is a proxy to see if the labour cost affect company efficiency.

In our model we take also into account the characteristics of Italian cultural sector. According to Castiglione and Infante (2016), the theatre market is characterised by important differences across the Italian regions, both from demand (i.e. numbers of tickets sold) and supply (i.e. number of theatres and performances) factors.

3. Estimation method

3.1 Modelling technical efficiency

The technical efficiency can be modelled as either output-oriented or input-oriented technical efficiency. In this research, given the available data, we estimate an output-oriented technical efficiency for the production frontier model which is widely used in the single equation stochastic production frontier literature. Following Kumbhakar et al. (2015), a stochastic production frontier model with output-oriented technical efficiency for our model can be defined as:

$$\ln y_{it} = \ln y_{it}^{*} - u_{it}, \; u_{it} \geq 0 \qquad \text{Eq. (3)}$$

$$\ln y_{it}^{*} = f(x_{it};\beta) + v_{it} \qquad \text{Eq. (4)}$$

where y_{it} is a scalar of observed output of the firm i in year t, and x_{it} as a J x 1 vector of input variables; β is a J x 1 vector of the corresponding input coefficients, as defined by Eq. (1). Furthermore, v_{it} is the statistical noise term with zero mean and constant variance; u_{it} is a non-negative stochastic term that represents technical inefficiency. Given that $u_{it} \geq 0$, observed output, y_{it}, is bounded below the frontier output (y_{it}^{*}) which is the maximum possible output. The term u_i is the log-difference between the maximum and the actual output ($u_i = lny_i^{*} - lny_i$), so that the technical inefficiency equals to u_i x 100% which is the percentage by which the actual output could be increased without increasing the inputs of production. Rearranging Eq. (3) we obtain technical efficiency measure (TE_{it}):

$$TE_{it} = \exp(-u_{it}) = \frac{y_{it}}{y_{it}^{*}} \qquad \text{Eq. (5)}$$

which gives the ratio of actual output to the maximum possible output defined by the frontier production function in Eq. (1). Furthermore, substituting Eq. (4) into (3) we obtain the stochastic production frontier model as follows:

$$\ln y_{it} = f(x_{it};\beta) + \varepsilon_{it}, \; \varepsilon_{it} = v_{it} - u_{it} \qquad \text{Eq. (6)}$$

where ε_{it} is the composite error term including the two random variables u_{it} and v_{it}. The estimation of the stochastic frontier model involves estimation of both the parameters of the production frontier function, *f(x)*, and the inefficiency term, u_{it}. Thus, we impose parametric distributions not only on the statistical noise, v_{it} but also on the inefficiency term, u_{it}, and apply the Maximum Likelihood Method to estimate the model parameters. We follow Aigner et al. (1977) and assume that the inefficiency term u_{it} has a half-normal distribution so that $u_{it} \sim N^{+}\left(0, \sigma_u^2\right)$ and the inefficiency term is computed using the conditional mean of the inefficiency term in line with Jondrow et al. (1982) so that $E[-u_{it} \mid v_{it} - u_{it}]$. Furthermore, Aigner et al. (1977) parameterised the log-likelihood function for this half-normal model in terms of $\lambda^2 = \sigma_u^2 / \sigma_v^2$ and $\lambda^2 = \sigma_u^2 / \sigma_v^2 \geq 0$. If $\lambda = 0$ then there are no technical inefficiency effects and all deviations from the production frontier are due to noise.

We define the stochastic frontier model specified in Eq. (6) as the *pooled* model due to the fact that it considers each observation as an independent cross-section. This property implies that the inefficiency of performing arts firm is time-varying which is an appropriate assumption given the fact that the inefficiency is a dynamic phenomenon. This holds especially for our analysis when we use the repeated observations on every performing arts firm over the 8 years maximum on average. However, the main disadvantage of the pooled model is that any firm-specific effects are assumed to be zero. As discussed in Zieba and Newman (2007), there may be time-invariant individual unobservable characteristics which may influence the output of the performing arts firm. These can be for example, the geographical location, population, infrastructure of the region and other environmental factors. Furthermore, the managerial style, prestige of the performing arts institution or the quality of the inputs may be firm-specific. As noted in Zieba (2011), the inclusion of time-invariant unobserved heterogeneity in the efficiency model for the performing arts firms is essential as their output is very heterogeneous due to the importance of its artistic quality. Last and Wetzel (2010) also note that the theatres operate in different regions with various environmental factors and characteristics that are only partially observed.

According to Kumbhakar et al. (2015) and Farsi et al. (2006), the omission of such heterogeneity may lead to biased estimates of parameters describing the production frontier and also to an overstatement of technical inefficiency, u_{it} and hence understatement of technical efficiency, TE_{it}. One solution to controlling for heterogeneity in the panel data setting would be to apply a time-invariant model such as the random effects model of Pit and Lee (1981) which assumes that the inefficiency term is company-specific so that u_i is constant over time and replaced in equations (1) and (3) by $u_i \sim N^{+}\left(0, \sigma_u^2\right)$.[1] Under the assumption that the firm-specific

[1] Schmidt and Sickles (1984) proposed the fixed-effects approach to estimate technical efficiency. However, this approach is flawed in that the inefficiency term is not random and is estimated as an intercept for each firm. Hence, this model does not provide realistic estimates of inefficiency.

effects are uncorrelated with the explanatory variables, the time-invariant efficiency model for panel data has an advantage over the pooled model in that it provides unbiased estimates of the production function parameters. This model is, however, not applied to our data for two important reasons. First, both models assume constant inefficiency over time which is rather an unrealistic assumption in relatively long panels. Second, the inefficiency term u_i is absorbing any time-invariant heterogeneity of performing arts, leading to an overestimate of inefficiency and a downward bias of the estimated technical efficiency scores (Farsi et al. 2005; Greene 2005).

There are also numerous extensions of the Pit and Lee's (1981) specification to take into account the time dimension of the panel data (Battese and Coelli, 1992; Kumbhakar and Wang, 2005). However, these models assume that the inefficiency is a systematic function of time. For example, in the Battese and Coelli (1992) model the u_{it} is replaced by $u_{it} = u_i \times \exp[-\eta(t-T)]$ and η is an unknown scalar parameter to be estimated. In this specification the inefficiency is, however, forced to be monotonous function of time and hence the temporal pattern of efficiency is the same for all firms in the sample. Furthermore Greene (2004) points out that the scale factor, η, brings only a very minor change in the year to year estimates of u_{it} and the underlying component of inefficiency actually remains time-invariant.[2] Thus, in this method we expect a downward bias in the estimates of the technical efficiency scores in the similar way as in the Pit and Lee (1981)'s specification.

The limitations of the previous specifications can be overcome with the true-random effects model, proposed by Greene (2004; 2005). In line with this specification, the pooled model presented in Eq. (3) is extended by adding a firm-specific stochastic term, w_i, which is an i.i.d. random component. This model is presented in Eq. (7):

$$\ln y_{it} = w_i + f(x_{it};\beta) + \varepsilon_{it}, \quad \varepsilon_{it} = v_{it} - u_{it} \qquad \text{Eq. (7)}$$

where ε_{it} is interpreted as the two-part composite error which is not normally distributed as before, and the model is estimated by applying simulated maximum likelihood procedure proposed by Greene (2005). For this specification, the inefficiency term, u_{it}, is obtained by the conditional mean of the inefficiency term so that $E[-u_{it} \mid w_i+\varepsilon_{it}]$ and the TE_{it} score is obtained in line with Eq. (6) as before. Due to the inclusion of unobserved heterogeneity term, w_i, the true-random effects model has two important advantages. Firstly, in contrast to the pooled model, it controls for any omitted variable biases. Secondly, in contrast to the Pit and Lee's

[2] Following this, for $\eta>0$, the inefficiency term is always decreasing and for $\eta>0$ the inefficiency is always increasing with time. If $\eta=0$, this model reduces to the Pitt and Lee's (1981) version.

(1981) specification, it not only controls for time-varying inefficiency but also avoids heterogeneity biases in the estimates of technical inefficiency. This model has had in fact numerous applications in recent studies on cultural sector as it allows for both time-varying inefficiency and the firm-specific heterogeneity of performing arts firms (see for example Last and Wetzel, 2010; Zieba, 2011; Zieba and Newman, 2013).

It should be noted that by this specification, all time-invariant effects are treated as unobserved heterogeneity and are captured by the firm-specific constant, and hence any persistent inefficiency is not included in the inefficiency term. However, we believe that imposing the time varying inefficiency only, is a right assumption for the performing arts sector as it would be difficult to distinguish between time-invariant heterogeneity and the permanent inefficiency for this sector. Furthermore, the true-random effects model provides unbiased estimates of the production functions parameters under the assumption of no correlation between firm-specific effects (w_i) and the explanatory variables. However, as Farsi et al. (2005) point out, at least time-variant efficiency measures are not very sensitive to such a correlation because the latter may be captured by the coefficients of the production function and not affect the residuals.

3.2 Heteroscedasticity and determinants of technical efficiency

The purpose of this research was not only estimation of technical efficiency for the performing arts sector in Italy but also to examine the determinants of efficiency which relate to the observed heterogeneity of performing arts firms. Hence, we are interested in models in which observable exogenous variables directly affect the inefficiency, u_{it} and which can be incorporated in the estimates of inefficiency. The original pooled model of Aigner et al. (1977) and the original true-random effects model of Greene (2005) assume that the v_{it} and u_{it} are homoscedastic. Unlike the classical linear model in which heteroscedasticity affects only the efficiency of the estimators and not their consistency, ignoring heteroscedasticity in u_{it} in the SFA framework leads to biased estimates of not only the technical efficiency but also of the production frontier function’s parameters (see Kumbhakar and Lovell, 2000).

Following Greene (2007), Hadri et al. (2003), Caudill et al. (1995), Hadri (1999) and Wang (2002), we include the efficiency determinants Z_k as heteroscedastic variables in the inefficiency function, directly parameterising the variance of the inefficiency. Formally, this specification is given by Eq. (8):

$$\sigma_{u_{it}}^2 = \exp(\delta' z_{it}) \qquad \text{Eq. (8)}$$

where z_{it} is a vector of variables defined in the data section, including a constant, that influence the inefficiency of performing arts firm *i* in year *t* and δ is a vector of unknown parameters to be estimated. An important advantage of the specification given by Eq. (8) is that it facilitates the estimation of the inefficiency effects simultaneously, as a one-step procedure, with the parameters of the stochastic frontier given by Eq. (6) and Eq. (7). This procedure has an advantage over the alternative two-stage method where the first stage involves estimation of a conventional frontier model with environmental variables omitted, and the second stage involves regressing these predicted technical efficiencies on the environmental variables. This procedure arouses the inconsistency in the assumptions about the distribution of the inefficiency since the estimates of u_{it} will be biased by the omission of Z_k-variables in the first step regression. Thus, failure to include environmental variables in the first stage leads not only to biased estimators of the parameters of the deterministic part of the production frontier but also to biased predictors of technical efficiency.[3]

Moreover, applying the one-stage method within the true-random effects framework, we are able to control for both observed and unobserved heterogeneity of performing arts firms. As noticed by Greene (2007), allowing $\sigma^2_{u_{it}}$ to vary over individuals and/or time induces not only the heteroscedasticity but also the variation in the mean of u_{it}.[4] Other studies (e.g. Wang 2002) include the inefficiency factors in line with Battese and Coelli's (1995) method, directly in the mean of the inefficiency function where u_{it} is assumed to be independently distributed as truncations at zero of the $N(-Z_{it}\delta,\ \sigma_u^2)$ distribution. However, this approach becomes highly unstable in practice within the true-random effects model framework. Thus, it is not followed here due to its complexity and issues with convergence.[5] Moreover, including the environmental variables as efficiency factors in the mean of inefficiency may raise endogeneity issues in the applied econometrics.

4 Data

To estimate the (in)efficiency of performing arts firms, we use an unbalanced panel of 107 Italian firms for the period of 2005–2012. The data were collected from two sources: the Analisi Informatizzata delle Aziende - Computerized Analysis of Firms, (AIDA) and Il Sole 24 ore databases.

[3] The predicted technical inefficiencies are only a function of environmental variables if the latter are incorporated into the first stage, and doing so makes the second stage unnecessary, because the relationship between the predicted inefficiency effects and the environmental variables is known (see Coelli et al., 2005)

[4] For the half-normal model, regardless of how $\sigma_{u,it}$ varies, the mean of the u_{it} becomes $E[u_{it}]=\sigma_{u,it}\phi(0)/\Phi(0)=0.798$ where ϕ is the normal PDF and Φ is the normal CDF (see Greene 2007).

[5] The truncated model in line with Battese and Coelli's (1995) method was also applied in our study and it does not converge in the estimations regardless of the initial values we have tried.

The AIDA database is carried out by Bureau van Dijk and contains detailed accounts following the scheme of the 4th Directive EEL, indicators and trade description of Italian companies, divided by economic sector and geographical area. Other information are: year of incorporation, ownership and number of employees. From the 99 sectors present in AIDA we choose the sector 9001 - Performing arts.

Data on the number of car thefts and the quality of life index are taken from the annual survey published by the most authoritative Italian financial and economic newspaper, *Il Sole 24 ore*. According to this data the number of car thefts are complementary with the quality of life index. In fact, in the year 2012 the provinces with the highest number of car thefts are all located in the South of Italy. The first provinces is Catania (Sicily), followed by Bari (Apulia) Naples (Campania) and Roma (Lazio). On the other hand, the province with the highest value of the quality of life index is Bolzano (Trentino-Alto Adige), followed by several provinces located in the Northern regions (especially in Emilia-Romagna). To find the first Southern province we have to reach the 64^{th} position (out of 104) with Teramo (Abruzzo).

Table A1 in Appendix includes definitions of variables and sources of data, whilst Table 1 provides the sample summary statistics of the variables used in the analysis. There is a considerable variation in output and inputs about their means. As regards the labour input, the number of employees varies from 1 to 405. The high variability in output and inputs confirms that controlling for both unobserved and observed heterogeneity is an important extension of this research. The efficiency determinants that affect the variability and hence the mean of the inefficiency, further affecting technical efficiency, are also presented in Table 1. The IQL index, the *lnCar_thefts* and *lnwages* also show very high variability. The average age of the firm is about 11 years with zero being the minimum age. It should be also noted that majority of the performing arts firms in the sample (about 92%) are the firms with the number of employees smaller than 50. Furthermore, as regards the legal form, cooperatives and corporations are equally spread throughout the sample. The same rule applies to the area in which the performing arts firms are located as the companies are roughly equally distributed among the four different regions in Italy.

[Insert Table 1 about here]

5. Empirical Results

5.1. Parameter estimates of basic SFA frontier

The parameter estimates of stochastic production functions for Italian performing arts firms are presented in Table 2 for both the translog (columns 1 and 2) and the Cobb-Douglas production function (columns 3 and 4), respectively. The results are also presented for the pooled model given in Eq. (5) and for the true random-effects model given in Eq. (6).[6] The coefficients of the Cobb-Douglas function and the first-order coefficients of the translog function are interpreted as the partial output elasticities evaluated at the sample mean and they show the percentage change of output in response to one per cent change in input. All estimated output elasticities are positive and mostly significant at the one per cent level indicating that the increase in inputs will always increase artistic output. Consequently, the estimates provide large enough well-behaved regions of the approximated underlying production technology. Furthermore, the returns to scale can also be reported and are calculated as the sum of the output elasticities. For the translog function they are again evaluated at the sample mean and hence they show a local measure of returns to scale (called also a total elasticity of scale) which measures a per cent increase in output due to a one per cent increase in all inputs, hence due to an increase in the scale of production.[7]

[Insert Table 2 about here]

In Table 2, the magnitude of the estimated output elasticities and returns to scale, estimated using the pooled model, differs significantly from those obtained using the true-random effects model. This confirms our earlier hypothesis that the first model is strongly affected by the heterogeneity bias in the production function coefficients as it ignores the firm-specific effects in the frontier function. Given the results obtained for the true-random effects model (columns 2 and 4 of Table 2), the output elasticity for capital (β_1) equals about 0.17, depending on the choice of the functional form of production function. Furthermore, as expected, the output elasticities for labour (β_2) vary between 0.20 for the Cobb-Douglas production function and 0.40 for the translog function respectively, and in each case are greater than those obtained for the capital. This confirms the fact that the labour is the most important factor in the artistic production process. With regard to the returns to scale coefficients obtained within the true-random effects model, they amount to 0.57 for the translog function, and to 0.40 for the Cobb-Douglas production function. Thus, at the sample mean, the decreasing returns to scale are prevalent in the performing arts sector, indicating that by doubling all inputs of productions, the output of performing arts companies would increase by

[6] All models were estimated using LIMDEP version 9.0 (Greene, 2007).
[7] The returns to scale are said to be increasing, constant or decreasing, when the obtained value (i.e. sum of the output elasticities) is greater than unity, equal to unity, or less than unity, respectively (see Coelli et al., 2005 and Varian, 1992 for details).

40 to 60 per cent only. The evidence of decreasing returns to scale in the performing arts sector was also confirmed in Zieba (2011) for German public theatres and in Gapinski (1980; 1984) for the performing arts firms in the UK and the US. These findings imply that the performing arts face potential barriers of output expansion. These barriers may be related not only to the capacity constraints but also to the geographical or time constraints. For example, the performing arts institutions might be restricted to stage only a few performances during a day. It should also be noted that for all specifications the yearly dummies, d_t, are not statistically significant. This would imply that the technological change is not a significant contributor to the productivity growth of performing arts sector in Italy, confirming the presence of Baumol's disease in this sector.

The summary statistics of estimated technical efficiency (TE_{it}) scores, the log-likelihoods and the variance parameters for the compound error are also presented in Table 1. In all cases, the λ- parameter is significantly greater than zero indicating that there exist inefficiency effects. Moreover, in order to test for the presence of u_{it} in the model, we apply a generalised likelihood ratio (LR) test for the null hypothesis of no one-sided error. The test is based on the log-likelihood values of the OLS (the restricted model given in Eq. (3)) and the stochastic frontier model (the unrestricted model given in Eq. (5) and Eq. (6)). We reject the null hypothesis in all cases confirming the existence of inefficiency effects and that applying the average response function with just v_{it} error term is not appropriate.[8] Furthermore, using the same LR tests, we test the Cobb-Douglas specification (restricted model) against the translog function (unrestricted model) and the null hypothesis of $\beta_{ll} = \beta_{kk} = \beta_{lk} = 0$ is always rejected at the 1 per cent level of significance (see Table 2), confirming that the translog function fits our data better. However, we consider using both functional forms in further analysis in order to check the robustness of our results.

The pooled model defined in Eq. (5) gives the efficiency scores between 50 and 54 per cent. Based on the true-random effects model, the technical efficiency scores are on average 68 per cent for the Cobb-Douglas function (last column of Table 2) and 62 per cent for the translog function (the second column of Table 2). As expected, the technical efficiency levels obtained from the pooled model are lower on average than those results obtained for the true-random effects model proposed in Greene (2004, 2005). This is because the latter method controls for time-invariant heterogeneity of the performing arts companies that is treated as random. Thus, the results confirm our hypothesis that the pooled model leads to a downward bias in the technical efficiency as it does not separate between the inefficiency and

[8] The LR test is equal to $-2[L(H_0) - L(H_1)]$ where $L(H_0)$ and L(H1) are the log-likelihoods of the restricted and unrestricted models respectively. The critical values are obtained from Kode and Palm tables. For more details see Kumbakhar et al. (2015).

heterogeneity. These findings also confirm the presence of unobserved heterogeneity of the performing arts sector and hence are compatible with earlier studies as discussed above.

Summing up, given the results in Table 2, the true-random effects model is considered as the most appropriate stochastic production frontier specification for our study as it controls for unobserved heterogeneity with regard to both the production function parameters and the technical efficiency scores. Furthermore, considering the translog production function as the right specification of technology, we conclude that output in the performing arts sector could increase by 38 per cent using the same amount of inputs. Overall, the findings demonstrate that the technical efficiency of performing arts companies in Italy is low and this finding is compatible with other efficiency studies for the performing arts sector (see e.g. Last and Wetzel, 2010; Zieba 2011, Zieba and Newman, 2013).

5.2 Technical Efficiency Factors

Given our findings in Table 2, we examine the impact of environmental factors on technical efficiency applying the true-random effects model. Accordingly, Tables 3 and 4 present the combined true-random effects model with heteroscedasticity in the inefficiency term, both for the translog and Cobb-Douglas production functions, respectively. Both tables report the estimated coefficients of efficiency factors (Z_k) which are included as heteroscedastic variables in the inefficiency function as defined in Eq. (2).

[Insert Tables 3 and 4 about here]

In all columns of Tables 3 and 4, we can find that the estimated coefficient of "*lnwage*" which is the proxy variable for quality, is negative and significant indicating that the higher labour unit cost tend to decrease variance and hence the mean of inefficiency (u_{it}) which leads to an increase in the technical efficiency scores (TE_{it}). This would suggest that the quality and reputation as measured by this proxy variable of quality will increase efficiency for the performing arts companies. Furthermore, our main variable of interest *lnCar_thefts*, representing the level of crimes and the reinforcement of law, increases the variance of inefficiency and hence the mean of inefficiency which leads to a decrease in TE for the region in which a performing arts institution is located. The finding is reinforced by another variable explaining the quality of life, measured by *IQL* index, which in turn negatively affects the inefficiency and hence positively affects technical efficiency in which the performing arts company is located. This may be due to the fact that companies that operate in a context where the rule of law is highly respected do not face negative externalities and operate according to market law[9].

Age and size of the arts company also do not contribute significantly to changes in inefficiency for the Italian arts companies as can be seen in Tables 3 and 4. Nevertheless, as regards the regional differences, we found that performing arts firms located in North East of Italy and in the South and Islands have significantly higher efficiency scores in contrast to the companies located in the Centre of Italy. This may be due to the fact that according to Castiglione and Infante (2016) firms located in the Central area of the country (where the Lazio region is located) receives the biggest amount of public funds. On the other side, firms located in the South of the country receive the smallest amount, consequently in order to stay in the market they should be more efficient compared with the performing arts firms located in Central area to survive in the local market.

In order to further confirm the impact of crimes (car thefts) and quality of life index on the estimated TE scores, the sample was split into values below, and values equal or above the median for both efficiency indicators. Table 5 presents the average technical efficiency scores calculated for the two groups of observations. The average TE scores are presented for the true random-effects model: both the basic model (presented in Table 2) and the combined model which includes the heteroscedastic variables (presented in Tables 3 and 4). The t-tests of the statistical significance of the difference in the technical efficiency means are reported. The mean efficiencies for low ln*Car_thefts* are higher than for the high crimes in the case of the translog production function although the difference is not statistically significant. Nevertheless, there is a strong support for our results found in Tables and 2 and 3 with regard to the quality of life index. The mean TE scores for high *IQF* are significantly higher than for the low *IQF*, for both the translog and the Cobb-Douglas production function estimates.

[Insert Table 5 about here]

Furthermore, to attempt to discriminate between the basic true-random effects model and the combined true random-effects model with heteroscedasticity, the log-likelihood ratio tests are applied in both Tables 3 and 4 by testing the restriction under H_0: $\delta_0 = \delta_1 = \ldots = \delta_8 = 0$ that the observed characteristics as efficiency determinants are jointly zero. In all cases, the null

[9] We have also added in our model dummy variables describing the legal form of performing arts firms but they were insignificant (with very high standard errors) for all specifications presented in Tables 3 and 4. This finding indicates that the differences in legal form do not have a statistically significant effect on technical efficiency score of performing arts companies. As a result these variables were excluded from the estimations to avoid unnecessary multicollinearity.

hypothesis that the variance of inefficiency is not a function of those factors is rejected at 1 per cent level. This implies that the model including the Z_k-variables as explanatory factors provides a better fit to the sample data. As a result, the presented combined true-random effects model is an important extension of our analysis of technical efficiency as it explains the possible sources of inefficiency and also incorporates both the observed and unobserved heterogeneity of performing arts companies. Interestingly, for the combined true-random effects model with the efficiency determinants in the variance of u_{it}, the average efficiency scores are very similar for the two alternative functional forms of production functions. The TE scores range between 65 and 66 per cent and the results are very consistent for all specifications in Tables 2 and 3. This implies that the performing arts firms should increase their output by 34 to 35 per cent using the same level of inputs. Furthermore, given the LR test, the translog function provides a better fit of the production frontier to our data than the Cobb-Douglas function as expected (see Table 2). Considering the translog production function, the decreasing returns are still apparent with the total output elasticity of scale equal to 0.58. Overall, the results suggest that despite controlling for heteroscedasticity which avoids the downward bias of technical efficiency scores, the TE levels for the performing arts firms are very low.

6. Conclusion

This work contributes to the literature on the determinants of technical efficiency in the cultural sector. It adds to that strand by investigating the determinants of technical efficiency in the Italian performing arts firms, using their balance sheet data for the period 2005-2012.

To this aim we estimate a translog and a Cobb-Douglas production frontier using different stochastic frontier approaches techniques (i.e. pooled model and true random-effects model). Whilst all inputs elasticities turn to be positive, decreasing returns to scale are prevalent in the Italian performing arts sector confirming that the performing arts face potential barriers of output expansion. Together with returns to scale, our findings also demonstrate that the technical efficiency of performing arts firms in Italy is low. These findings are compatible with other efficiency studies for the performing arts sector (Last and Wetzel, 2010; Zieba 2011, Zieba and Newman, 2013).

The main contribution of this paper, however, lies in investigating the impact of environmental factors on technical efficiency. To our knowledge this is the first article to look at such a broad range of efficiency determinants for the performing arts companies, some of which have not been used before in any study on cultural sector. Our finding confirms that quality and reputation increase efficiency for the performing arts institutions. On the other side, the institutions play a strong role. In fact, whilst the level of crime, as expected, increases the mean of inefficiency (i.e. decreases firm efficiency), the quality of life index negatively affects the inefficiency and hence positively affects technical efficiency. The mean efficiencies for *high* quality of life index are significantly higher than for the *low* quality of life index, for both the translog and the Cobb-Douglas production functions estimates. Whilst other scholars found regional differences in the demand and supply of theatre, we further demonstrate that these differences exist for the technical efficiency of performing arts firms.

More importantly, the TE levels for the performing arts companies are very low and equal to around 65 per cent, implying that the performing arts firms could increase their output by around 35 cent using the same level of inputs.

Turning to policy implications, our findings imply that policymakers should engage with performance measurement before allocating limited financial resources to the performing arts sector in Italy. This is a finding which corroborates results obtained for the performing arts sector in other countries. More importantly, the quality and regional factors are important in determining efficiency scores in the Italian performing arts sector. While factors such as quality of employed labour or the quality of life in a region increases technical efficiency, incidence of crime will decrease it. Henceforth, to stimulate the performing arts activities in many of the Italian regions policymakers, before deciding any financial support to the sector, should firstly work on the contextual factor, such as the enforcement of rule of law.

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Table 1: Summary statistics for output, inputs and efficiency determinants

	Mean/ Percent	Standard Deviation	Minimum	Maximum
Output and inputs Variables				
Output (total revenues in million EUR)	988.9	2000.389	1.39	13,275
Capital (total assets in million EUR)	2,405	13,976	0.098	111,686
Labour (number of employees)	25.2	59.1	1	405
Efficiency Determinants				
Continuous variables				
IQL index	9.3	5.8	1	30
lnCar_thefts	5.08	1.03	2.91	6.72
age	11.24	9.18	0	39
lnwages	4.39	1.92	-2.30	9.80
Indicator variables (%)				
small_size	92%			
cooperatives	52%			
corporations	43%			
other_legal forms	5%			
north_west	22.6%			
north_east	29.8%			
south_islands	21.4%			
centre	24.9%			

* 309 observations for 107 firms over the period 2005-2012.

Table 2: Stochastic Production Frontier Estimates

Dependent variable: $\ln Y_{it}$	(1) Pooled	(2) True RE	(3) Pooled	(4) True RE
	Translog function		*Cobb-Douglas function*	
Constant	0.566	0.265	4.830***	4.970***
	(0.513)	(0.243)	(0.543)	(0.301)
$\ln X_1$ (β_1)	0.054	0.166***	0.265***	0.175***
	(0.076)	(0.026)	(0.032)	(0.012)
$\ln X_2$ (β_2)	0.591***	0.408***	0.372***	0.226***
	(0.098)	(0.036)	(0.049)	(0.013)
$0.5\ln X_1 \ln X_1$ (β_{11})	-0.050**	-0.014*	-	-
	(0.021)	(0.007)		
$0.5\ln X_2 \ln X_2$ (β_{22})	0.189**	0.027	-	-
	(0.067)	(0.026)		
$\ln X_1 \ln X_2$ (β_{12})	-0.008	0.050***	-	-
	(0.025)	(0.008)		
Time dummies	yes	yes	yes	yes
	Technical Efficiency (TE_{it})			
Mean	0.471	0.619	0.396	0.683
Standard Deviation	0.124	0.154	0.156	0.102
Minimum	0.096	0.1	0.035	0.223
Maximum	0.746	0.931	0.754	0.927
No. observations	309	309	309	309
No. Firms	107	107	107	107
Returns to scale	0.65	0.57	0.64	0.4
Log-Likelihood	-494.22	-362.98	-500.34	-366.6
λ - parameter	0.965***	2.629***	1.606***	1.366***
	(0.152)	(0.494)	(0.004)	(0.310)
LR test under H0: $u_{it}=0$	10.36***	272.8***	13.37***	280.8***
LR test under H0: $\beta_{11} = \beta_{22} = \beta_{12}=0$ (Cobb-Douglas function)	12.24***	7.24**		

For the true-random effects model the simulation is based on 200 Halton draws. Standard errors are in parentheses. * significant at 10%; ** significant at 5%; significant at 1%. %. Estimations were conducted in Limdep 3.0.

Table 3: Efficiency determinants for the translog production function

Dependent variable: lnY_{it}	(1)	(2)	(3)	(4)
	Translog Production function coefficients			
Constant	0.173	0.005	0.134	-0.0013
	(0.27)4	(0.261)	(0.268)	(0.251)
lnX_1 (β_1)	0.282***	0.265***	0.270***	0.260***
	(0.028)	(0.028)	(0.027)	(0.028)
lnX_2 (β_2)	0.300***	0.321***	0.303***	0.320***
	(0.037)	(0.037)	(0.037)	(0.037)
0.5lnX_1lnX_1 (β_{11})	0.029***	0.026***	0.025***	0.024***
	(0.008)	(0.008)	(0.008)	(0.008)
0.5lnX_2lnX_2 (β_{22})	0.045*	0.076***	0.04	0.074***
	(0.026)	(0.025)	(0.025)	(0.009)
lnX_1lnX_2 (β_{12})	0.033***	0.033***	0.036***	0.033***
	(0.010)	(0.010)	(0.009)	(0.010)
Time dummies	no	yes	no	yes
	Environmental variables			
δ_0 (Constant)	0.626	1.863	3.265*	4.312**
	(1.908)	(1.856)	(1.922)	(1.903)
δ_1 (Age)	0.013	0.007	0.001	0.002
	(0.009)	(0.011)	(0.009)	(0.011)
δ_2 (Small)	0.565	-0.904	0.479	-0.951
	(1.761)	(0.868)	(1.810)	(0.832)
δ_3 (ln*Wage*)	-0.543***	-0.617***	-0.549***	-0.633***
	(0.101)	(0.133)	(0.097)	(0.128)
δ_4 (North_West)	0.126	-0.035	0.082	0.012
	(0.201)	(0.256)	(0.221)	(0.269)
δ_5 (North_East)	-0.281	-0.494	-0.721**	-0.877**
	(0.234)	(0.307)	(0.252)	(0.357)
δ_6 (South_Islands)	-0.082	-0.072	-0.659 *	-0.908**
	(0.201)	(0.230)	(0.361)	(0.461)
δ_7 (ln*Car_thefts*)	0.202**	0.107	-	-
	(0.099)	(0.116)		
δ_8 (IQL)	-	-	-1.688***	-2.287**
			(0.850)	(1.047)
Time dummies	no	yes	no	yes
	Technical Efficiency (TE_{it})			
Mean	0.658	0.661	0.66	0.663
Standard Deviation	0.211	0.211	0.211	0.211
Minimum	0.064	0.063	0.064	0.065
Maximum	0.96	0.961	0.959	0.961
No. observations	309	309	309	309
No. Firms	107	107	107	107
Log-Likelihood	-296.15	-292.07	-296.23	-290.89
LR test under H_0: $\beta_{11} = \beta_{22} = \beta_{12}=0$ (C-D function)	12.2***	416.54***	5.68*	21.56***
LR test under H_0: $\delta_0=\delta_1=\ldots=\delta_8 = 0$	133.66***	141.82***	133.5***	144.18***

For the true-random effects model the simulation is based on 200 Halton draws. Standard errors are in parentheses.
* significant at 10%; ** significant at 5%; significant at 1%. %. Estimations were conducted in Limdep 3.0.

Table 4: Efficiency determinants for the Cobb-Douglas production function

Dependent variable: $\ln Y_{it}$	(1)	(2)	(3)	(4)
		Cobb – Douglas Production function coefficients		
Constant	5.226	5.510***	5.221***	5.151***
	(0.294)	(0.299)	(0.288)	(0.309)
$\ln X_1$ (b_1)	0.163***	0.137***	0.164***	0.163***
	(0.012)	(0.012)	(0.012)	(0.012)
$\ln X_2$ (b_2)	0.178***	0.172***	0.176***	0.170***
	(0.019)	(0.020)	(0.018)	(0.019)
Time dummies	yes	yes	yes	yes
		Environmental variables		
δ_0 (Constant)	1.392	1.456	4.717	4.741**
	(1.089)	(2.172)	(1.187)	(2.255)
δ_1 (Age)	0.013	0.009	0.0009	0.002
	(0.009)	(0.011)	(0.009)	(0.011)
δ_2 (Small)	-0.248	-0.862	-0.332	-0.917
	(0.875)	(0.794)	(0.844)	(0.769)
δ_3 (ln*Wage*)	-0.523***	-0.562***	-0.517***	-0.581***
	(0.099)	(0.127)	(0.092)	(0.124)
δ_4 (North_West)	-0.196	-0.17	-0.258	-0.287
	(0.203)	(0.250)	(0.227)	(0.274)
δ_5 (North_East)	-0.500**	-0.446	-0.977***	-1.064***
	(0.243)	(0.290)	(0.269)	(0.373)
δ_6 (South_Islands)	-0.296	-0.156	-1.168***	-1.334***
	(0.203)	(0.224)	(0.400)	(0.507)
δ_7 (ln*Car_thefts*)	0.215**	0.132	-	-
	(0.096)	(0.112)		
δ_8 (IQL)	-	-	-2.508***	-3.002***
			(0.092)	(1.117)
Time dummies	no	yes	no	yes
		Technical Efficiency (TE_{it})		
Mean	0.644	0.661	0.645	0.646
Standard Deviation	0.204	0.207	0.205	0.206
Minimum	0.092	0.088	0.091	0.091
Maximum	0.953	0.957	0.954	0.955
No. observations	309	309	309	309
No. Firms	107	107	107	107
Log-Likelihood	-302.25	-299.07	-301.67	-297.45
LR test under H_0: $\delta_0=\delta_1=\ldots=\delta_8=0$	128.7***	135.06***	129.86***	138.3***

True-random effects model - the simulation is based on 200 Halton draws. Standard errors are in parentheses.
* significant at 10%; ** significant at 5%; significant at 1%. Estimations were conducted in Limdep 3.0.

Table 5: Mean Comparison Tests of Technical Efficiency Scores for the true-random effects model

Efficiency Determinant	Basic model	Combined model with no time dummies in efficiency determinants	Combined model with time dummies in efficiency determinants
	(1)	(2)	(3)
	Translog production function		
ln*Car_thefts* low	0.622	0.663	0.667
ln*Car_thefts* high	0.615	0.654	0.654
t-ratio	0.36	0.41	0.55
IQL_i low	0.608	0.594	0.598
IQL high	0.627	0.712	0.714
t-ratio	-1.12	-5.09***	-4.95***
	Cobb-Douglas production function		
ln*Car_thefts* low	0.684	0.637	0.655
ln*Car_thefts* high	0.683	0.651	0.666
t-ratio	0.08	-0.57	-0.47
IQL_i low	0.677	0.586	0.588
IQL high	0.688	0.691	0.692
t-ratio	-0.88	-4.60***	-4.52***

Low and high groups of observations (n=309) are split at the median of the efficiency determinant.
* significant at 10%; ** significant at 5%; *** significant at 1%. Estimations were conducted in Limdep 3.0.

Appendix 1

Table A1: Description of variables used

Variables	Description
Output	
Rev (Y_{it})	Total revenues of performing arts firm, adjusted for inflation using CPI index.
Inputs	
Capital (X_{1it})	Total assets of the performing arts firm. Total assets include tangible and intangible assets. They are adjusted for inflation using CPI index.
Labour (X_{2it})	The number of full-time and permanent employees of the performing arts firms.
Environmental variables	
ln*Car_thefts*	Log of the number of car thefts in the particular year and in particular province.
IQL	Index of quality of life at provincial level.
age	The age of the firm in years.
size	A dummy variable indicating the size of the company as measured by the number of employees. It equals 1 for 0-50 employees and 0 otherwise (51 and more employees).
lnwage	The log of the unit cost of the labour. A proxy measure for quality of personnel in the performing arts firm, and also a proxy for reputation of performing arts firm.
area	'North_West' = 1 and 0 otherwise, 'North_East' = 1 and 0 otherwise, 'Centre of Italy' (the reference category) = 1 and 0 otherwise (the reference category), 'South_East' = 1 and 0 otherwise.
legalform	The legal form of the firm: 'Cooperatives' = 1 and 0 otherwise, 'Corporations' (the reference category) = 1 and 0 otherwise, 'Other legal forms' =1 and 0 otherwise.
yearly dummies	Equals 1 for each successive year and 0 otherwise.