The Effect of Social Networks on Efficiency

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***Abstract* – The management of a firm needs a lot of information to achieve an efficient production process. This information can be gathered — amongst others — by social networks. We use stochastic frontier analysis to analyse the effect of farm managers' social networks on the technical efficiency of Polish and Slovakian farms. Preliminary results show that social relationships have a significantly positive effect on technical efficiency both in Poland and Slovakia, while long-term business connections do not have a significant impact in both countries. Personal contacts to relevant agricultural institutions have a positive effect on efficiency in Poland, but a negative effect in Slovakiá.**

INTRODUCTION

The management of a firm needs a lot of information to achieve an efficient production process. While some information is publicly available (e.g. in professional journals), other information (e.g. the effectiveness of a new production method adopted by a competitor) is private and hence, cannot be obtained from public sources. However, this does not mean that private information is not available at all. Managers might have friends or close business partners who have this private information and are willing to share it. Hence, the quantity and quality of relationships to other professionals and the relevance of these partners may have an important impact on the firm's efficiency. For instance, stochastic frontier analysis can be used to analyse the effect of managers' social networks on their firms' efficiency. To our knowledge, this kind of analysis has not been done (or at least not been published) before.

As an illustrative example, we analyse the effect of social networks on Polish and Slovakian farms' technical efficiency. Since farms generally have only a single manager, we avoid the problem of modelling multiple agents per per firm and intra-firm networks. In this empirical analysis, we want to check whether social networks have a noticeable impact on farms' efficiency and — if they have an impact — which types of social relations are most important for obtaining relevant information.

DATA

The data sets of Polish and Slovakian farms that are used in our analysis have been collected by Wiebusch (2005) in the years 2003 and 2004. The Polish data set includes 174 farms and the Slovakian data set includes 120 farms that can be used for this analysis. Both data sets provide not only production data, but also detailed information on the farm managers' social relations and long-term business connections. For instance, these data sets include variables that measure the quantity and relevance of long-term business connections to other farmers, agribusiness firms, and banks. Furthermore, the data provide information on the quantity and relevance of social relationships (e.g. friends, neighbours, or members of the same sports club) to other farmers and persons who work for agribusiness firms or banks. Finally, there are variables that measure the quantity and relevance of personal contacts to relevant institutions such as advisory services, farmers' unions, or the ministry of agriculture.

STOCHASTIC FRONTIER ANALYSIS

The above-mentioned data sets are used to estimate stochastic frontier production functions for Polish and Slovakian farms. The production data are aggregated to one aggregate output (y) and four inputs ($\boldsymbol{x}$): land, labour, capital, and intermediate inputs. We apply the "Technical Inefficiency Effects" model of Battese and Coelli (1995), because it can identify determinants of differences in predicted (in)efficiencies between farms. The unknown production frontier is approximated by the second-order flexible translog functional form.

As consistency with microeconomic theory is especially important for frontier functions (O'Donnell and Coelli, 2005; Sauer et al., 2006), we impose monotonicity in inputs at all data points by a new three-step procedure suggested by Henningsen and Henning (2008) that is based on the two-step method published by Koebel et al. (2003). In the first step, we estimate an unrestricted stochastic frontier production function of the translog form.

$$\ln y = \ln f(\boldsymbol{x}, \boldsymbol{\beta}) - u + v \tag{1}$$

$$E[u] = \boldsymbol{z}'\boldsymbol{\gamma}; \quad u \geq 0 \tag{2}$$

Here, $\ln f(.)$ is a translog function, $u \geq 0$ captures technical inefficiency, v captures statistical noise, $\boldsymbol{z}$ is a vector of variables explaining technical inefficiency, and $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are vectors of parameters to be estimated. From this estimation, we extract the unrestricted parameters of the production function $\hat{\boldsymbol{\beta}}$ and their covariance matrix $\hat{\boldsymbol{\Sigma}}_{\beta}$.

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In the second step, we obtain restricted parameters by a minimum distance estimation.

$$\hat{\boldsymbol{\beta}}^0 = \operatorname{argmin}\left[\left(\hat{\boldsymbol{\beta}} - \hat{\boldsymbol{\beta}}^0\right)\ \hat{\boldsymbol{\Sigma}}_\beta^{-1}\ \left(\hat{\boldsymbol{\beta}} - \hat{\boldsymbol{\beta}}^0\right)\right], \quad (3)$$

$$\text{s.t. } MP_i(\boldsymbol{x}, \hat{\boldsymbol{\beta}}^0) \geq 0\ \forall\ i, \boldsymbol{x}$$

Here, $MP_i(.)$ is the marginal product of the ith input. The restricted parameters ($\hat{\boldsymbol{\beta}}^0$) are asymptotically equivalent to a (successful) restricted one-step maximum likelihood estimation (Koebel et al., 2003).

In a third step, the efficiency measures of the firms based on the theoretical consistent frontier function are estimated by

$$\ln y = \alpha_0 + \alpha_1 \ln \hat{y}^{\max} - u^0 + v^0 \quad (4)$$

$$E[u^0] = \boldsymbol{z}'\boldsymbol{\gamma}^0; \quad u^0 \geq 0, \quad (5)$$

where α_0 and α_1 are (adjustment) parameters to be estimated and the only "input" is the "frontier" output of each firm $\hat{y}^{\max}$ calculated from the parameters of the restricted model:

$$\hat{y}^{\max} = f(\boldsymbol{x}, \hat{\boldsymbol{\beta}}^0). \quad (6)$$

The variables that may explain technical (in)efficiency ($\boldsymbol{z}$) include information on long-term business connections, social relationships, and personal contacts to relevant agricultural institutions, as well as the farm manager's education, the specialisation of the farm, and regional dummy variables.

RESULTS

The preliminary results of our stochastic frontier analysis show that the monotonicity and quasiconcavity conditions of the production frontier are generally violated at some some data points of our data sets. Due to the close relationship between monotonicity and quasiconcavity, imposing monotonicity by the three-step procedure described above resulted also in quasiconcavity at all data points.

Our preliminary estimation results indicate that social relationships generally have a significantly positive effect on technical efficiency both in Poland and Slovakia, while long-term business connections usually do not have a significant impact in both countries. These findings suggest that social relationships are much more important for exchanging information on production technology than long-term business connections. However, since we analyse technical efficiency only, we cannot say whether long-term business connections are relevant for exchanging market information and hence, have an impact on allocative efficiency.

Interestingly, personal contacts to relevant institutions seem to have a positive effect on efficiency in Poland, but a negative effect in Slovakia. Generally, one would expect a positive effect of these relationships, because information from advisory services and other institutions should increase technical efficiency. However, it seems that incompetent managers of Slovakian farms utilise their personal contacts to relevant institutions to stay in business in spite of low technical efficiency.

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