State Aid for Industrial Enterprises in Belarus: Remedy or Poison?

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Abstract

In this paper the impact of various types of state aid on aggregate productivity growth in Belarusian manufacturing is investigated by combining the data on government support with firm-level accounting data for period 1998-2007. Obtained results indicate that the state aid provided for restructuring truly leads to the modernization of the enterprises (capital-to-labor ratio grows), that this modernization leads to an increase in effectiveness (TFP grows, especially at large enterprises), and that this growth of TFP allows the newly restructured enterprises to raise their market share which results in the growth of the allocative efficiency. However, when the state aid is provided to support enterprises in financial distress, while it leads to an increase in employment (only for enterprises receiving aid, especially for large enterprises, but not for the total sample) and to an expansion in the market share of large enterprises (not small and medium size), this achievement comes at the expense of the decrease in TFP.

JEL Classification: C21, L2, L53, O47, P31.

Keywords: state aid, total factor productivity , allocative efficiency, Arellano-Bond method.

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Contents

1. Introduction

1.1. Policy Context of the Study

After deregulation of prices and dramatic changes in relative prices in the 1990s transition economies typically had only a limited share of firms that were competitive and could operate with profit. The rest of the firms were either doomed to fail or needed substantial restructuring. However, shortage of investment resources impeded instantaneous economic restructuring. That is why the aim of providing state aid to industrial enterprises was twofold.

Firstly, to absorb social shocks through maintaining employment at financially distressed enterprises. Supporting these enterprises for a limited period of time may be justified even if aid adversely affects resources allocation, provided that poorly performing enterprises (sectors) are eventually squeezed out.

Secondly, aid was aimed at increasing the investment potential of viable enterprises, which are expected to become the agents of future economic growth. In both cases state aid has externalities, which are rather difficult to measure directly. However, from economic point of view the second type of aid is justifiable if it positively influence TFP and aggregate productivity growth in the long run. If productivity of the enterprises that receive state aid decreases, there is little chance that they can create positive externalities for development of other sectors of manufacturing and for the economy as a whole.

Recent economic performance of Belarus was quite impressive (nearly 8% annual average growth of GDP in 2000-08), some even call it a new “Slavic tiger”, so the question that naturally arises is to what extent, if any, this successful performance is due to the state assistance to enterprises.

1.2. Statement of the Research Problem

The objective of this paper is to study impact of various types of state aid on aggregate productivity growth in Belarusian manufacturing. Aggregate productivity depends not only on average performance of enterprises, but also on the size of the market share held by efficiently performing enterprises. State aid may influence both components of the aggregate productivity: total factor productivity of a recipient enterprise, its market share and, hence, distribution of resources in the economy. To evaluate the impact of state aid on aggregate productivity, I use Olley and Pakes efficiency decomposition (1996) to measure the allocative efficiency.

There is of course the endogeneity problem in measuring the impact of different types of state aid on aggregate productivity because a counterfactual is lacking and because of selection bias. The latter is conditioned by the fact that firms receiving aid may differ from firms not receiving aid along other parameters. To overcome the problem, I use the Arellano-Bond (1991) and Arellano-Bover (1995)/Blundell-Bond (1998) methods that are specially designed for analysis of unbalanced panel data which is characterized with small T(time period) and large N (enterprises).

The study will contribute to the literature on evaluating the effectiveness of state aid to industry focusing on the experience of Belarus. The majority of empirical studies dealing with evaluation of effectiveness of state aid have been conducted either based on the analysis of specific programs within the framework of the industrial policy (R&D subsidies, export subsidies, etc.) (Girma et al., 2006 a, b, Kesner-akreb et al., 2003, J. Foreman-Peck, 2007), or based on the analysis of the impact of the state aid on financially distressed enterprises (London Economics, 2004, H. Schweiger, 2006, etc.). In addition, actually all studies have been conducted using the data on the countries where either unambiguous legislative constraints on providing such kind of aid (developed countries, specifically EU countries) exist, or such constraints are being introduced (WTO or EU accession countries and also the countries which have recently joined these organizations). Belarus, like some other FSU countries, is actually not bound by international commitments of such kind and, therefore, state aid to businesses is provided here at a large scale (within the time period in question – 1998-2005 – from 10 to 27% of industrial enterprises enjoyed the state aid in some or other form). It is noteworthy that the state aid has been provided both to viable businesses to expand investment opportunities (Program of State Support to Manufacturers-Exporters, Program of Stimulating Industrial Production, Program of Support to Specific Industrial Sectors) and financially distressed enterprises (Program of Financial Restructuring) to prevent their bankruptcy and maintain employment. Therefore, the case of Belarus is of specific interest because it provides an opportunity to comprehensively evaluate the effect of the state aid on the resources allocation in the economy. The results obtained would allow assessing the efficiency of the economic policy pursued and formulation of proposals to adjust it. The latter is extremely relevant at the time of the current financial crisis when the state has to support many enterprises: it is critical to indentify the directions and forms of aid that will be the most effective.

2. Literature Review

There exists a relatively large body of literature that focuses on the general impact of government assistance to enterprises and the effectiveness of such assistance. A number of theoretical models comprehensively evaluating the effect of the state aid on the economic welfare has been recently developed (Collie, 2000, Everaert, 2003, Mariniello, M., 2006 etc.). The empirical studies, however, are, as a rule, of a narrower character and evaluate the effect of the state aid on performance of specific enterprises and sectors without dealing with its impact on the aggregate productivity growth. As a result, empirical studies, which define 'effectiveness' of state aid in a number of different ways, provide ambiguous evidence. Harris, Robinson (2004) and Gual, Jodar (2006) find some evidence that firms receiving aid are able to improve their productivity. Girma, Gong, Gorg and Yu (2006) using Chinese firm-level data conclude that aid can foster export activity. In contrast, Bergstrom (2000) finds that firms which receive regional policy subsidies in Sweden are not able to boost their productivity. Similarly, Beason and Weinstein (1996) use industry-level data for evaluating the effect of assistance in Japan and no evidence of productivity enhancements as a result of the industrial policy measures is found. Foreman-Peck (2007) shows that government aid for innovation in UK supports growth, but returns from this aid are far from covering spending.

Using micro-level data, Wren and Storey(2002) and Girma et al. (2006 b) demonstrate that the receipt of financial assistance can improve the prospects of survival of the beneficiary firms.. However, a study conducted by London Economics (2004) to evaluate the impact of rescue and restructuring aid on international competitiveness reveals that most survivors remained well below average level of industry profitability. State aid the firms receive provides soft budget constraints, and soft budget constraints influence the life-cycle of firms and hence market selection, which, in its turn, affects aggregate productivity growth.

In compliance with this statement, Schweiger (2006) proves that state aid for rescue and restructuring hindered the efficient allocation of resources in Slovenian manufacturing. None of the firms that received aid exited the market; aid had a positive impact on the growth of market shares, but did not have a significant impact on the growth of TFP.

Inasmuch as the major portion of this study concerns the influence of policy and institutions on aggregate productivity growth, the referenced related literature would be useful. Aggregate productivity growth has been the topic of numerous studies, so our understanding of it and also its measurement have improved since Solow (1957). There is an increasing body of evidence implying that healthy market economies demonstrate both static and dynamic allocative efficiency, therefore more productive businesses possess a larger market share and reallocation of outputs and inputs within sectors shifts resources from less to more productive businesses (e.g. Bartelsman, Haltiwanger and Scarpetta (2004), Foster, Haltiwanger and Krizan (2006), Olley and Pakes (1996)). In terms of accounting, reallocation significantly contributes to overall productivity. However, the coexistence in narrowly-defined industries of firms with extremely different productivity performance conforms with the idea of substantial frictions preventing resources from being immediately allocated to the highest valued use. Among other factors, such frictions can be related to policy and institutions affecting market competition and adjustment costs (see e.g. World Bank, Doing Business, 2006). While these issues are hardly resolved for advanced economies, they assume an even greater role in emerging and transition economies (Bartelsman, E. et. al., 2006). Caballero and Hammour (2000) argue that the function of institutions is two-fold, one of efficiency and one of redistribution, and both are critical for macroeconomic outcomes. A poor institutional environment leads to technological "sclerosis" since it allows low-productivity units to survive for a longer period than they would in an efficient equilibrium and hence causes stagnation in the process of creative destruction. Haltiwanger and Schweiger (2005) find that an unfavorable business climate has a negative impact on allocative efficiency.

The above mentioned papers use quite broad measures of institutions, mostly at the country level. This study uses microlevel statistical data on the institute (state aid) characterized by potentially distortive effect, in particular, providing state aid for industrial enterprises.

3. Model and Estimation

3.1. Productivity Estimation

The problem of evaluation of TFP for specific firms has been extensively discussed in the economic literature (see Escribano and Guasch (2004), Arnold (2005) and Wooldridge (2005) for overview). Econometricians propose different estimation approaches: residuals from estimated Cobb-Douglas or translog production function, using instrumental variable techniques or employing panel data estimation (fixed effect estimations); stochastic frontier or data envelopment analysis. All these approaches have their advantages and disadvantages and have been analyzed in great detail in the literature. Even the currently most popular approach to the production function estimation proposed by Olley and Packes (1996) and extended by Levinsohn and Pertin (2003) has a number of limitations, since it requires a detailed sequential timing of the inputs decision which is not quite suitable for annual data.

It is obvious that choosing some or other approach to estimate TPF is based on the data available. Since comprehensive data neither on investment nor on intermediate input are available in the existing databases, the most simple way is to estimate TPF as residuals from an industry-specific Cobb-Douglas production function, which is, nevertheless, used in many productivity growth works (see, for example, Brown et al., 2006; Tytell et al., 2005).

Linear specification of Cobb-Douglas production function have the following form:

$$\ln Y_{it,j} = \ln TFP_{it,j} + \alpha_{lj} \ln L_{it,j} + \alpha_{kj} \ln K_{it,j} \qquad (1)$$

where

i- firm, t - time, j - 2-digit NACE[1] industry

$Y_{it,j}$ - annual gross value of output in constant 1998 prices

(deflated with PPP indices – specific for every enterprise)

$K_{it,j}$ - gross value of fixed capital stock in constant 1998 prices

(deflated with revaluation coefficients, computed for every enterprise)

[1] NACE - the General Industrial Classification of Economic Activities within the European Communities.

$L_{it,j}$ - average annual number of employees

Then TFP is calculated as follows:

$$\ln TFP_{it,j} = \ln Y_{it,j} - \alpha_{lj} \ln L_{it,j} - \alpha_{kj} \ln K_{it,j} \quad (2)$$

The TFP growth rates could be calculated by following way:

$$\Delta \ln TFP_{it,j} = \ln TFP_{it,j} - \ln TFP_{it-1,j} \quad (3)$$

In reality, residuals obtained from estimated Cobb-Douglas production function (Solow residual), is productivity P (or growth rate of productivity), which is highly correlated with TFP in level and TFP growth rate, though not equal to them[2]. To obtain more reliable results alternative Jorgenson (1995) method of estimation of TFP, is used. According this method translog specification of industry specific production functions is estimated separately for 24 sectors (2-digit NACE industries) using following equation:

$$\ln Y_{it} = \alpha_0 + \alpha_L \ln L_t + \alpha_K \ln K_t + \alpha_{KK} (\ln K_t)^2 + \alpha_{LL} (\ln L_t)^2 + \alpha_{LK} L_t \ln K_t \quad (4)$$

The TFP is obtained as residuals from estimated production function. One critical feature of this method is that TFP can be estimated without a presumption that factor prices are equal to marginal products. The TFP growth rate is obtained as the difference between the output growth rate and input growth rates multiplied by corresponding elasticities ($\bar{\eta}$).

$$\ln(A_t / A_{t-1}) = \ln(Y_t / Y_{t-1}) - \eta_K Ln(K_t / K_{t-1}) - \eta_L \ln(L_t / L_{t-1}) \quad (5)$$

where

$\bar{\eta}_K$ and $\bar{\eta}_L$ calculated as in (6)

$$\bar{\eta}_K = (\eta_{K,t} + \eta_{K,t-1})/2 \qquad \bar{\eta}_L = (\eta_{L,t} + \eta_{L,t-1})/2 \quad (6)$$

and

[2] See Escribano and Guasch (2004) for overview.

$$\eta_{K,t} = \frac{\partial \ln Y_t}{\partial \ln K_t} = \hat{\alpha}_K + 2\hat{\alpha}_{KK} \ln K_t + \hat{\alpha}_{LK} \ln L_t \quad (7)$$

$$\eta_{L,t} = \frac{\partial \ln Y_t}{\partial \ln L_t} = \hat{\alpha}_L + 2\hat{\alpha}_{LL} \ln L_t + \hat{\alpha}_{LK} \ln K_t \quad (8)$$

Another option to estimate Cobb-Douglas production functions using panel data covering a large sample of companies observed for a small number of time periods is an extended GMM estimator, proposed by Blundel and Bond (1999). According to them, the Cobb-Douglas production function is considered as:

$$\ln Y_{it} = \alpha_L \ln L_{it} + \alpha_K \ln K_{it} + \rho \ln Y_{i,t-1} + \gamma_t + (\eta_i + v_{it} + m_{it})$$

$$v_{it} = \rho v_{i,t-1} + e_{it} \quad (9)$$

Where $\ln Y_{it}$ is log sales of firm i in year t, $\ln L_{it}$ is log employment, $\ln K_{it}$ is log capital stock, γ_t is a year specific intercept. Of the error components, η_i - an unobserved firm-specific effect, v_{it} - a possibly autoregressive (productivity) shock and m_{it} denotes serially uncorrelated measurement errors.

It is presumed that both employment (L_{it}) and capital (K_{it}) are potentially correlated with the firm-specific effects (η_i), and with both productivity shocks (e_{it}) and measurement errors (m_{it}): The model has a dynamic presentation:

$$\ln Y_{it} = \alpha_L \ln L_{it} - \rho\alpha_L \ln L_{i,t-1} + \alpha_K \ln K_{it} - \rho\alpha_K \ln K_{it-1} + \rho \ln Y_{i,t-1} + (\gamma_t - \rho\gamma_{i,t-1}) + (\eta_i(1-\rho) + e_{it} + m_{it} - \rho m_{i,t-1}$$

(10)

or

$$\ln Y_{it} = \pi_1 \ln L_{it} - \pi_2 \ln L_{i,t-1} \pi_3 \ln K_{it} - \pi_4 \ln K_{it-1} + \pi_5 \ln Y_{i,t-1} + \gamma_t^* + (\eta_i^* + w_{it})$$

(11)

To obtain consistent estimation of the parameters ($\alpha_L ; \alpha_K ; \rho$), when the number of firms (N) is large and the number of years (T) is fixed, I use extended GMM estimator in which lagged first-differences of the series are used as tools for the levels equations in addition to lagged levels of dependent variable as tools for equations in first differences (system GMM). TFP is calculated as residuals from this form of production function and TFP growth as in (3).

Summing up, using data available TFP of individual firms are calculated by following way:

1) as a residual from a fixed effects estimation of the loglinear Cobb –Douglas production function;
2) using Jorgenson method (translog specification for estimating production function);
3) using GMM estimator for autoregressive model of Cobb –Douglas production function

In all approaches differences in factor shares by industrial sectors are allowed.

3.2. Measuring Allocative Efficiency

Aggregate productivity and its growth depend both on how productive businesses are on average and on whether more productive businesses have a higher market share.

Olley and Pakes [1996] demonstrate this formally by decomposing aggregate productivity as follows:

$$P_{tj} = \overline{p_{tj}} + \sum_{t=1}^{Hit} \Delta s_{it,j} \Delta p_{it,j} \qquad (12)$$

$$\Delta s_{it,j} = s_{it,j} - \bar{s}_{t,j} \qquad \Delta p_{it,j} = p_{it,j} - \bar{p}_{t,j} \quad (13)$$

where i denotes firm, t denotes time, j denotes 2-digit NACE industry, bar denotes unweighted average, H represents the number of firms, s is firm's domestic market share in industry j and p is a measure of productivity. In this study, TFP is used as a measure of productivity. The first term in (12) is unweighted average productivity in industry j at time t, while the second term is a covariance term measuring cross-sectional allocative efficiency and demonstrating whether activity is disproportionately located in high-productivity (in case the term is positive) or low-productivity (in case the term is negative) firms. In addition to providing a compact measure of allocative efficiency, one more advantage of covariance resides in the fact that it is more comparable across sectors than average productivity itself, since the first moment differences across sectors are differenced out. It is a cross-sectional measure.

The covariance term is defined as a cross product between the percentage deviation of the firm-held market share from the average market share in industry j and the deviation of the firm's log productivity from the average firm-level log productivity in industry j and might be interpreted as the contribution of a firm to aggregate allocative efficiency.

In comparison to decomposition methods proposed by Foster, Haltiwanger and Krizan (2001), this method of decomposition has two main advantages: differences in productivity cross-sectionally are more persistent and less prone to measurement error and transitory shocks, and in addition to continuing firms, entering and exiting firms could be included in sample.

A firm-level measure of allocative efficiency could be calculated as follows (see Schweiger (2006)).

$$\frac{\Delta s_{ti,j}}{\bar{s}_{t,j}} \Delta p_{it,j} \qquad (14)$$

This study considers measure (14) as indicator of allocative efficiency.

3.3. Empirical Model

Evaluation of impact of state aid on TFP of a firm and allocative efficiency is a typical problem of estimation of the so-called treatment effects. There are different methodologies of evaluation of treatment effects depending on data available (see Caliendo and Hujer, 2005 for overview). They have been developed due to the need to evaluate efficacy of different political (or medical) programs proposing nonrandom sampling of their participants. Conclusion on influence of such programs implies a presumption as to what could happen if an individual (firm), which was selected to be involved in the program, had not participated in the program. Difficulty of evaluation is that it is not possible to review it experimentally. In addition, in evaluating treatment effects, a problem of selection bias inevitably arises since in our case the firm which received the state aid (treated) usually differs in terms of other parameters from the firm which did not receive it. Depending on how they handle selection bias, it is possible to group non-experimental treatment effects estimators under two categories. The first category includes estimators which rely on selection of observable variables and the second category includes estimators which explicitly allow the selection of unobservable variables. OLS regression implicitly relies on the assumption of selection of observable variables. The equation of interest can have the following form:

$$y_{it} = \alpha_0 + \alpha_1 SA_{it-1} + X_{it-1}\eta + u_{it} \qquad (15)$$

where i denotes firms, t denotes time, y is the outcome variable of interest (covariance term, growth of market share or growth of productivity), SA is the ratio of state aid to sales (two types of state aid are defined depending on goals they pursued). X is a vector of control variables. The assumption needed for identification of the average treatment effect of aid is that conditioning linearly on X is sufficient to eliminate selection bias. This assumption might fail resulting in biased estimates. The bias may occur due to the reasons described hereinafter.

Firstly, many financially distressed enterprises prefer not to resort to state aid: subject to the legislation, an enterprise claiming the state aid has to make all current payments to the budget, which is a condition for eligibility for the state aid. In such situation, many enterprises prefer to further accrue the tax debt and other compulsory payments to the budget and not to apply for the state aid. In addition, small-sized enterprises being worse off financially are deprived of the aid. In this case, the OLS coefficients will be biased upwards.

Secondly, providing the state aid to enterprises under the Program of Stimulating the Industrial Production presumes selection of the most viable enterprises (to pick the winners). If it is the case, OLS coefficients will be biased upwards as well.

Thirdly, in case of providing the state aid to the known poorly performing enterprises in one -company-towns or operating in the declining industries (programs of support to the machine-building and metal working enterprises with a lengthy production cycle, radio electronic enterprises, agricultural machinery enterprises, peat-extraction enterprises, etc.), the OLS coefficients will be biased downwards.

This problem may be solved by using the instrumental variables method. Instrumental variables should comply with the following requirements: they should determine treatment participation (the probability of receiving aid), but do not influence the outcome equation, i.e. not correlated with error term in a regression of TFP on state aid with given control variables (X).

However, a good instrument is hard to come by in general, and in our case, in particular, because there are no obvious rules for granting state aid for industrial enterprises. Moreover, different kinds of state aid were provided in compliance with different rules. It means that the excluded instruments used in the IV regressions should be different for different types of state aid.

For enterprises that received state aid due to their financial distress the share of the region's population employed by the firm and credit liabilities as percent of debt receivables could be used as instruments. However, these instruments are not appropriate for enterprises that received state aid in order to expand their investment and export opportunities.
Besides, the dependent variables in estimation (TFP, market share and covariance term) are most likely autocorrelated.

That is why, alternatively, the Arellano-Bover (1995)/Blundell-Bond (1998) dynamic panel estimators is used (System GMM). The supple GMM framework fits unbalanced panel data and manifold endogenous variables. This estimator is particularly designed for analysis of panel data which is characterized by small T(time period) and large N (enterprises in our case), a dynamic dependent variable, fixed effects, and a lack of good external instruments(Roodman, 2006). This method estimates a system of equations in levels and first differences using as instruments, respectively, lagged first differences and lagged levels of endogenous variables (as well as lags and leads of exogenous variables). In a model with a dynamic dependent variable, this approach is superior to ordinary least squares, which causes an upward bias, and to the fixed effects estimator, which produces a downward bias in the estimated coefficients. This method also tends to perform better than the difference GMM approach of Arellano and Bond (1991) based on equations in first differences only, particularly in the case of persistent series, when lagged levels provide weak instruments for the subsequent first differences. However, use of System GMM requires additional assumption, that first differences of instrument variables are uncorrelated with the fixed effects. To test whether the Arellano-Bond GMM estimator is specified correctly, three diagnostic statistics are normally reported – the Sargan (Hansen in robust estimations) test for over-identifying restrictions and tests for first and second-order serial correlation. The GMM estimator is appropriately specified, if the over-identifying restrictions are not rejected[3], the test for first-order serial correlation cannot reject the null hypothesis on no correlation, but the test for second-order serial correlation does reject the null hypothesis of no correlation by any standard levels of significance. Since the equation is

[3] The null hypothesis of the Sargan test is that the instruments are jointly exogenous. Hence,
an increasingly high p-value of the Sargan statistic is preferential. It is worth noting, that instead of the Sargan statistic Stata uses the Hansen J statistic, which has the same null hypothesis.

estimated in first differenced form, the equation will show first-order serial correlation[4]. However, of importance is the absence of second-order serial correlation, if the error term in the levels equation is white noise[5]. Therefore, a test of second-order serial correlation is reported and is asymptotically N(0,1) distributed.

The equation for TFP have the following form:

$$TFP_{i,t} = \alpha_1 TFP_{i,t-1} + \alpha_2 SA_{i,t-1} + X_{it}\eta + \varepsilon_{it} \qquad (16)$$

where $SA_{i,t-1}$ is the ratio of state aid to sales (first type - for financially distressed firms, and second type – to expand investment opportunities; these ratios are used in different regressions), $X_{it}\eta$ - is a vector of control variables (share of the state in shareholders' equity, share of foreign investor in shareholders' equity, share of export in output and log employment as proxy to size of enterprises, year and sector dummies).The similar equations are estimated for market share deviation and for covariance term as dependent variables. Market share deviation is defined as percentage deviation of the firm-held market share from the average market share of the firm in industry, covariance term is defined as a cross product between market share deviation and the deviation of the firm's log productivity from the average firm-level log productivity in industry (13). The dynamic panel estimation that is used allows to analyze whether and how state aid affects the change in, rather than merely the level of productivity, market share and allocative efficiency of firms.

Another option to test dynamic effect of state aid on firms' productivity is to estimate log-linear production function at the firm level augmented with variable "state aid" using the system GMM method for following specification (see Aitken and Harrison (1999), Konning, 2000):

$$\ln Y_{it} = \alpha_0 + \alpha_1 \ln L_{it} - \alpha_2 \ln K_{it} + \alpha_3 SA_{it-1} + \varepsilon_{it} \quad (17)$$

The estimated coefficient on variable SA in (17) will show the influence of state aid on the change in total factor productivity.

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[4] In order to detect autocorrelation, one needs to apply the Arellano –Bond test to the differenced residuals. The null hypothesis of this test is that the model exhibits no autocorrelation. When testing for AR (1) process in the first-difference , the null hypothesis is usually rejected due to the fact that
$\Delta\varepsilon_{it} = \varepsilon_{it} - \varepsilon_{it-1}$ and $\Delta\varepsilon_{it-1} = \varepsilon_{it-1} - \varepsilon_{it-2}$ both have ε_{it-1}

[5] Autocorrelation in levels is frequently detected by the AR(2) test in first differences.

It could be hypothesized that the effect of state aid may manifest itself in the change of the production function of firms-recipients, rather than in higher/lower total factor productivity. To examine this issue in a dynamic setting, I look at the effects that state aid has on the capital/labor ratio of firms- recipients:

$$\ln(K/L)_{i,t} = \alpha_1 \ln(K/L)_{i,t-1} + \alpha_2 SA_{i,t-1} + X_{it}\eta + \varepsilon_{it} \quad (18)$$

The estimated coefficient of variable SA in (18) will show whether state aid affects the change in capital/labor ratio in the following year keeping in mind that higher capital/labor ratio is usually associated with more advanced technology and vice versa.

As was mentioned previously, the main goal of the state aid of the first type is to support employment. To see whether this goal is actually achieved I run additional regressions. The dependent variable is the deviation of the employment growth at particular enterprise from the average by industry, and the explanatory variables are the same as in (18).

$$DEV\_EMPGR_{i,t} = \alpha_1 DEV\_EMPGR_{i,t-1} + \alpha_2 SA_{i,t-1} + X_{it}\eta + \varepsilon_{it} \quad (19)$$

Even though in all regressions I control for the size of enterprises (via the logarithm of the number of employees variable), to examine the issue in greater detail (to reveal possible non-linearity), in addition I divided the sample into three groups and ran separate regressions for each of them:

- Less than 200 employees (considered as small enterprises according to the Law on Small Entrepreneurship) – 11802 observations
- 200-1000 employees (medium enterprises)– 5636 observations,
- Over 1000 employees (large enterprises) – 1780 observations.

To find out whether coefficients of state aid for enterprises of different sizes obtained from separate regressions are different, it would be necessary to perform specific significance test (Chow test [6]). For this purpose I test the null

[6] A Chow test is a test of whether the coefficients estimated over one group of the data are equal to the coefficients estimated over other.

hypothesis about equality of regression coefficients among three size groups .

Ho: $B_1 = B_2 = B_3$

where B_1 is the regressions coefficient for the small enterprises, B_2 is the regression coefficient for the middle enterprises, and B_3 is the regression coefficient for large enterprises. Since we are interested mainly in differences in meaning and statistical significance of the differences in the coefficients for state aid, to do this analysis, all specifications are supplemented with a dummy variables for size and their interactions with variable for aid [7] which were used as additional predictors. The equation for TFP has the following form:

$$TFP_{i,t} = a_1\ TFP_{i,t-1} + a_2\ SA_{i,t-1} + a_3STSH_{i,t} + a_4FDI_{i,t} + a_5EXPIi_{,t} + a_6SIZE1 + a_7SIZE2 + a_8SIZE1\ XSA_{i,t-1}$$

$$+ a_9SIZE2\ XSA_{i,t-1} + YR + IND + \eta_{i,t} \qquad (20)$$

where SA is ratio of state aid to sales(%),STSH is state share in shareholders' equity, FDI is share of foreign investor in shareholders' equity, EXP is share of export in sales (%); SIZE1 and SIZE2 are dummies for small and medium enterprises; SIZEXSA and SIZE2 XSA are interaction variables; YR and IND are year and sector dummies. The similar specifications are calculated for deviation from employment growth, market share, covariance term, indicating allocative efficiency, and capital/labor ratio as dependent variables with control variables like in (20) and for sales as dependent variable with controls for capital and labor inputs.

4. Data Sources and Dataset

In this study several data sets will be used. The first one is based on the reported company accounts of more than 2,000 incorporated firms in the manufacturing sector and are obtained from the National Statistical Committee of the Republic of Belarus (Belstat). Only the so-called "closed" enterprises (mostly in defense industry) are excluded from this data set. The

[7] I first made a dummy variable called size1 that is coded 1 if small enterprises 0 otherwise, and size2 that is coded 1 if middle sized, 0 otherwise. Besides, interactive variables size1_aid1 that is size1 times aid1, and size1_aid1 that is size2 times aid1 were created.

data cover the years of 1998-2007. Confidentiality of this data set has to be preserved. This sample covers more than 90% of total sales in manufacturing as reported by the Belstat. Therefore, the data can be considered as extremely representative of the population of firms in manufacturing. The data contains detailed information on employment, sales, fixed assets, export and finished-goods inventory in the warehouses. Each enterprise has an ownership code, but more detailed data on ownership structure were retrieved from the State Register of Economic Entities. It allows for measuring the fractions of shares in firms held by the state and by private investors, and distinguishing explicitly between private domestic investors and foreign investors. In addition, the data on the regional location of enterprises are available in the database. These data have been thoroughly treated to remove inconsistencies and improve missing longitudinal linkages due to change of firm identifier from one year to the next (for instance, related to reorganizations and changes of a legal form). The data from multiple sources were used to evaluate inconsistencies (including the previous year's data contained in the registries). Longitudinal linkages were improved based on the entire information available, including industry, region, size and some exact linking variables (e.g., names of a firm), to match the firms that exited from the data set in a given year with those that entered in the following year.

To deflate output I used PPI indices specific for every enterprise, computed using data on output in comparable and actual prices for every year.[8] Capital deflators were obtained in a different way. The value of a Belorussian firm's capital stock is subject to revaluation every year as of 1 January, so reported end-of-year and start-of-year capital stocks differ by the revaluation coefficient. I computed these revaluation coefficients for every enterprise and used them as deflators for capital stock.[9]

8 Sectoral PPI are calculated based on the producers' data on change in prices for essential products (representative products) manufactured by a particular sector (branch of industry). These data are used to compute average PPI for particular industries and are based on the structure of output that is typical for the industry as a whole (and which differs from structure of output at each individual enterprise). Therefore, PPI only approximately reflects changes in prices for the products manufactured by each individual enterprise. For this reason I used the data on output in comparable prices (i.e. prices of the previous year) based on actual price changes for particular products annually calculated at each enterprise. This allowed to calculate more precisely actual real annual output growth. Using price growth chain indices calculated in this way, I have computed output in the 1998 prices. The data obtained differ from those which were calculated using industry average PPI.

9 Due to high inflation rates over the period in question (over 20% a year), the Belarusian enterprises annually reappraised fixed assets using three methods: 1) index method (the technique applied to compute 35 sectoral PPIs depending on the fixed assets structure); 2) direct estimate method based on existing market prices; and 3) currency conversion method, if the equipment was imported. While the majority of enterprises reappraised fixed assets using the index method, there is no unified reappraisal index method, since the fixed assets structure of various enterprises differs considerably. Since our data contain the fixed assets value before and after reappraisal, the ratio of these values may be taken as the reappraisal index. It is also worth mentioning that the index method, as the experts state, most frequently leads to overestimation of the fixed assets, the fact that should be taken into account in interpreting the results.

I use 2-digit OKED classification, that groups firms by areas of major activity, which is equivalent to NACE (15-36, 94) classification. This classification allows for more precise estimations (24 industries instead of 9 according OKONH classification. See Appendix). A number of firms that listed a non-manufacturing occupation as their major NACE industry was excluded. Besides, firms in the top and bottom one percent of either the TFP distribution or the annual TFP growth distribution were dropped, so that outliers do not drive the results.

The data on the state subsidies and loans and tax allowances provided to the enterprises were obtained from the Ministry of Economy and Ministry of Finance. The enterprises that receive aid were divided into two groups depending on goal of state aid 1) to prevent their bankruptcy and maintain employment; 2) to expand their investment and export opportunities. This grouping was obtained through the analysis of the programs based on which the aid was provided to enterprises and for this purpose respective normative and legal framework has been analyzed (list of enterprises attached to Decrees of the President, Resolutions of the Council of Ministers and other ministries and also Regional Authorities).

Notwithstanding the efforts to clean the data, improve the links and make them as comparable as possible across firms and over time, measurement errors may still persist. Mismeasurement of productivity owing to errors in output, capital or labor could raise the variance of the estimated productivity effect and produce biased coefficients. The approach to analyzing an extensive range of alternative estimation methods is motivated to some degree by the possibility of such measurement problems and also by an intention to assess the robustness of findings. However, none of the methods is capable of improving the effects of measurement error entirely that should be considered when evaluating the results.

5. Estimation Results

5.1. Estimation Results for TFP

Table 1 summarizes the results of the TFP growth rate estimated separately for 2-digit NACE industries obtained from production function estimation with loglinear Cobb-Douglas production function (fixed effect technique), translog specification (Jorgenson method) and System GMM technique.

Table 1. TFP growth rates

	Loglinear specification			Translog specification			System GMM specification		
	Enterprises with state aid 1	Enterprises with state aid 2	Enterprises without aid	Enterprises with state aid 1	Enterprises with state aid 2	Enterprises without aid	Enterprises with state aid 1	Enterprises with state aid 2	Enterprises without aid
1999	.2075	.2112	.2021	.0352	. 1081	.1082	-	-	-
2000	.0732	.0812	.0668	.0112	.0122	.0138	.0041	.0081	.0098
2001	.0824	.0877	.0875	.0145	.0229	.0224	.0235	.0185	.0170
2002	.0271	.0325	.0576	.0054	.0060	.0091	.0021	.0102	.0104
2003	.0386	.0537	.0645	-.0091	-.0007	.0047	-.0156	-.0127	-.0022
2004	.0115	.0763	.0579	.0104	.0235	.0217	.0133	.0187	.0119
2005	.0366	.0606	.0732	.0308	.0256	.0307	.0199	.0214	.0205
2006	.0443	.0568	.0625	.0008	.0208	.0301	.0207	.0189	.0170
2007	.0434	.0545	.0594	.0017	.0199	.0286	-.0066	.0119	.0131
Mean	.0627	.0794	.0813	.0112	.0265	.0299	.0077	.0119	.0122

I found that the rank ordering and the quantitative variation in firm-level TFP and growth rate of TFP were not very susceptible of the estimation methodology used to calculate TFP, in spite of variation in the factor elasticities. The correlation coefficients between the various pairs of measures obtained from loglinear specification Cobb-Douglas production function (fixed effect technique) and translog specification are 0.91 or higher. This finding is similar in spirit to the finding of Van Biesebroeck (2004) who finds that the distributional properties of firm-level TFP are reasonably robust to a wide variety of estimation methods. However, correlation coefficients between firm-level TFP obtained from System GMM technique and loglinear or translog specifications are lower (0,66 and 0,61on average), probably because of dynamic essence of estimations. That is why I use different measures of productivity (TFP) to obtain consistent evaluation of effects of state aid on TFP growth rates.

As Table 1 shows, in all specifications firms without state aid have the highest TFP growth rates; enterprises, that received state aid 2 demonstrate on average higher TFP growth rates than enterprises that received state aid1. It remains to be seen of course, whether this results holds after controlling for other factors of TFP growth and for endogeneity.

5.2. Allocative Efficiency Estimation

In this Section I report allocative efficiency estimation results. Tables 2 and 3 below summarize these results. Market share growth rates during the period in question were negative, i.e. level of concentration decreased, but more so for firm-years with aid. In aggregate terms, the static allocative efficiency of Belarusian manufacturing, calculated as a weighted average of 2-digit industry aggregate covariance terms was positive in most calculations, except for some years, when using System GMM technique.

Table 2. Olley-Pakes Covariance and Growth Market Share in Manufacturing, 1999-2007

Year	Growth market share		Covariance term (mean)					
			Loglinear specification		Translog (Jorgenson) specification		System GMM specification	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
1999	-.0639	.0090	.1273	.0099	.1238	.0102		
2000	-.0075	.0074	.0372	.0035	.0241	.0028	.0014	.0084
2001	-.0420	.0072	.0311	.0050	.0203	.0037	.0131	.0040
2002	-.0503	.0074	.0350	.0052	.0218	.0042	.0149	.0038
2003	-.0499	.0082	.0633	.0080	.0484	.0066	.0425	.0078
2004	-.0076	.0019	.0018	.0001	.0010	.0002	-.0002	.0005
2005	-.0240	.0019	.0015	.0002	.0011	.0003	-.0003	.0005
2006	-.0305	.0017	.0023	.0099	.0025	.0102	.0012	.0065
2007	-.0024	.0027	.0034	.0032	.0028	.0022	.0009	.0031
Total	-.0350	.0053	.0337	.0053	.0273	.0034	.0103	.0036

Our main interest is the impact of state aid on TFP of individual firms and allocative efficiency, i.e. differences in market share changes for firms which receive different type of aid and do not receive aid at all. Table 3 shows that market share decreased faster in firms without state aid and with state aid of first type, i.e. for firms receiving aid due to financial distress.

Covariance terms are higher in firms which received state aid. The standard deviations of these variables indicate that there is a lot of heterogeneity among firms.

Table 3. Olley-Pakes Covariance and Growth Market Share in Manufacturing for firms with Different Types of State aid without it.

	Growth market share		Covariance term					
			Loglinear specification		Translog (Jorgenson) specification		System GMM specification	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Enterprises with aid1	-.0327	.0049	.5482	.0644	-.0160	.0098	.0240	.0195
Enterprises with aid2	-.0172	.0051	.6125	.1687	-.0124	.0307	.3545	.1108
Enterprises without aid	-.0370	.0033	.6983	.0215	-.0019	.0030	.0491	.0209

5.3. Impact of State Aid on Enterprises' Performance

Tables 4 and 6 present the results of regressions (coefficients on state aid) for state aid of first and second type respectively. In first column the samples are defined. The second column reports the coefficients on state aid obtained from the regression using equation (16) where TFP is used as dependent variable. In the right hand side of equation - lagged TFP, control variables (share of the state in shareholders' equity, share of foreign investor in shareholders' equity, share of export in output , log employment as proxy for size of enterprises) and year and sector dummies. Similar equations are estimated for employment growth deviation, market share deviation and covariance term as dependent variables. Regressions coefficients of variables "Staid Aid" obtained from these equations are reported respectively in columns 4-6. Employment growth deviation is defined as deviation of the firm's employment growth rate from average growth rate in industry. Market share deviation is defined as deviation of the firm-held market share from the average market share in industry. Covariance term is defined as a cross product between the percentage market share deviation and the deviation of the firm's log productivity from the average firm-level log productivity in industry (as in (14)).

In third column of both tables dependent variable is the log of sales and regression is calculated according to equation (17), i. e. log-linear production function at the firm level augmented with variable "state aid" is estimated.

All equations are calculated using the system GMM method (Arellano-Bond technique). In order to avoid second order serial correlation (AR(2)) and to obtain valid instruments for suspected to be endogenous variables, in all regressions different lags of these variables (third and deeper lags) are used. The variables 'share of the state', 'share of foreign direct investment', 'share of export ' and 'log employment' (and their interactions) are treated as endogenous. P-value of Arellano-Bond test for AR(2), Sargan and Hansen tests of over-identifying restrictions are not reported in tables, because all coefficients are obtained from different regressions. However, the P-values of these statistics in all regressions fall between 0.1 and 1 and are in support of the null hypothesis that the instruments are valid (the results available under request). I report results only for TFP obtained as residuals from loglinear specification of production function, because other measures of TFP gave similar results, but again, these results are available upon request.

5.3.1.State Aid of First Type

As it was mentioned previously, the state aid of the first type is provided to financially troubled enterprises. The main goal of state aid of this type is to avoid bankruptcy and to support employment. Table 4 displays the results. Regressing the total factor productivity on state aid for the whole sample of enterprises (19, 47 observations) reveals negative and significant impact of aid of the first type: state aid is negatively associated with productivity of recipient firms in the same sector next year. In other words, the higher the relative amount of state aid of the first type, the less productively the firm performs next year. The increase in aid/sales ratio by 1 percentage point was associated with decrease in total factor productivity by 3.8 percentage points. This result could be explained by the fact that the mean value of the ratio of state aid1 to sales is relatively small (3.9%) which is considerably less than tax burden on a average industrial enterprise (according to my own calculations, total tax rate as % of sale in Belarusian industry during the period in question was about 16% [10]). In this case, this type of aid is frequently provided in the form of tax debt relief. It is obvious that state aid of this type is most frequently inadequate for comprehensive restructuring of enterprises and increasing TFP and only prolong their existence.

The same regression for the smaller sample – only for enterprises receiving state aid (3,934 observations for 1,683 enterprises) – gives different results: no significant impact of state aid on TFP growth. The interpretation is straightforward: the corrupting effect of state aid on TFP does not depend on the amount of given aid; the mere fact that the enterprise is

[10] According to World Bank Report "Doing Business" and own calculations, the mean value of total taxes to profits ratio in Belarus in 1998 – 2007 was 134.7%. As to the tax burden degree, the World Bank ranks Belarus the last out of 183 countries.

included in the list of the government grantees (even when the actual amount of aid is very small) is considered as a guarantee of future survival without bankruptcy, so the management stops caring about efficiency. It is consistent with the fact that in recent 10 years not a single enterprise with over 50 employees went bankrupt in the Belarusian industry.

Table. 4. Impact of First Type State Aid on Growth of TFP, Employment, Market Share and Allocative Efficiency

Sample	Impact on TFP		Impact on employment	Impact on market share	Impact on allocative efficiency
	TFP as dependent variable	Log of sales as dependent variable			
1	2	3	4	5	6
Whole sample (19,218 observations; 2,335 firms)	-.0377** (.0184)	-.0199* (.0117)	-.0439 (.0981)	.2505 (.3427)	.0165 (.0112)
Only for firms with aid of first type (3,934 observations, 1,690 firms)	-.0009 (.0009)	-.0007 (.0011)	.0319** (.0161)	.0269 (.0204)	.0011 (0009**)**
Firms with less than 200 employees (11,802 observations I,628 firms)	-.0291** (.0148)	-.0190* (.0112)	-.0946 (.0588)	-.0496 (.0755)	.0015* (.0008)
Firms with employees with more than 200, but less than 1,000 (5,636 observations, 717 firms)	.0009 (.0114)	.0107 (.0142)	-.0386 (.0710)	.0389 (.0283)	.0019 (.0021)
Firms with more than 1,000 employees (1,780 observations, 201 firms).	-.0193** (.0103)	-.0040* (.0024)	.0699** (.0311)	.0153* (.0093)	-.0098 * (.0061)

Note: * - significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in brackets.
Year and sector dummies are included.

To check the robustness, I also regressed sales on state aid with controls for capital and labor inputs.. The results are very similar: negative relationship for the whole sample and no relationship for the reduced sample (only enterprises receiving state aid). According to results obtained from regression for the whole sample, increase in aid/sales ratio by 1 percentage point was associated with decrease in the firm's sales by 1.99 p.p [11] holding all other independent variables constant at their

[11] When the outcome variable (sale) is log transformed, there is natural interpretation of the exponentiated regression coefficients (exp(X)-1)*100). These values correspond to changes in the ratio of the expected geometric means of the original outcome variable. However, for small values of coefficients a change in independent variable by one unit is approximately associated with a* 100% change in dependent variable (Stock and Watson, 2003).

mean values.

For both specifications (for TFP and sales as dependent variables), the regressions for three groups of enterprises of different size were run. The results are similar – negative impact of state aid on TFP in the following year for all groups of small and large enterprises, but insignificant for medium enterprises. There are certain non-linearities, though: the coefficients at the state aid variable for small enterprises are -.029 (-.019 in second specification) and for large enterprises – -.019 (-.004 in second specification) - see Table 4. It looks like the negative impact of the state aid 1 is especially ruinous for small enterprises: with probability of 90%, increase in aid/sales ratio by 1 percentage point leads to decrease in the small firm's TFP by 2.9 p.p. and sales - by 1.9 p.p. at mean value of state aid.

However, to be able to make claims about differences among the regression coefficients on state aid for enterprises of different sizes, there would be needed to perform specific significance test (Chow test) for specification with interaction variables estimated for full sample (20). The results of estimations are presented in Table 5.

The analysis showed that the null hypothesis about equality of coefficients could be rejected (F= 2.58 Prob > F = 0.0757) (column 2, Table 5). It means that the regression coefficients between aid1 and TFP do indeed significantly differ across the 3 size groups. Significance of overall interaction indicates that the effect of state aid1 on the TFP is conditional upon the size of enterprises.[12] However, comparing slope of aid 1 at each size category it appears that slopes between size1 (small enterprises) and size 3 (large enterprises) do not differ significantly, but slopes between combined groups of small and large enterprises vs. group of medium enterprises differ (as shown in Table 5, coefficients for interactions between aid 1 and size 1 is negative and insignificant, but between aid 1 and size 2 is positive and significant at 10% level). In other words, despite the results, obtained from separate regressions, small and large enterprises perform in approximately similar way: increase in aid/sales ratio at mean value is associated with statistically significant decrease in the firm's TFP next year [13], i.e. they generally fail to use state aid of first type effectively. However, medium-size enterprises did not experience negative influence of state aid on their TFP, i.e. they perform relatively better in terms of effectiveness probably because they are more stable than small enterprises and more flexible than large ones.

[12]A significant categorical by continuous interaction means that the slope of the continuous variable is different for one or more levels of the categorical variable.

[13] These results did not change significantly at median value of aid/sales ratio.

Similar results were obtained from specification with sales as dependent variable (with controls for capital and labor inputs). However, they suggest that small enterprises with state aid of first type perform significantly worse than large ones: coefficients for interactions between aid1 and size1 are negative and significant. It means that an increase in aid/sales ratio by 1 p. p leads to a more significant decrease in the small firm's sales by approximately 1.5 p.p. as compared to large firms.

Table 5. Results of Tests on Equality of Coefficients of State Aid of First Type Between Enterprises of Different Size Groups

	Dependent variable in models with interaction terms				
	TFP	Sale	Deviation from employment growth	Market share deviation	Covariance term
1	2	3	4	5	6
Difference in slope between small and large enterprises (coefficient on aid1xsize1)[14]	-.0339 (.0372)	-.0486* (.0256)	-.0337 * (.0482)	-.1215 * (.715)	.0015** (.007)
Difference in slope between medium and large enterprises (coefficient aid1xsize2)	.1771* (.0092)	.0151* .(0085)	-.07452** (.03203)	.2322 (.1678)	.0002 (.0034)
P-value of test for significance of overall interaction (Chow test)	0.0757	0.0696	0.0624	0.0726	0.0549

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in brackets.

With regards to the effect of first type aid on employment, it was found that for the whole sample aid1 does not have a significant impact, but for the sample of enterprises that receive aid1 its impact on employment is significantly positive (the increase in aid/sales ratio by 1 p.p. raises deviation from annual employment growth rate in the sector by 3.2 p.p.). In other words, the more relative amount of state aid of the first type, the more employment growth compared to the average over industry in the following year. The effect is stronger for large enterprises (the increase in aid/sales ratio by 1 p.p. raises the deviation from average employment growth rate in industry by 6.9 p.p.). So, it looks like state aid of the first type provided to large enterprises really helps to increase employment, but at the expense of TFP growth. For small- and medium-size enterprises, the increase in employment due to state aid1 is insignificant, although the slowdown of TFP for small firms is pronounced (it is confirmed by statistical significance of overall interaction in both regressions). So, if first type state aid is a

[14] The magnitude of coefficients does not appropriately reflect difference in marginal effect between size group in case of Arellano—Bond estimation, but the sign and significance of these coefficients do matter.

game that is worth a candle (increase in employment at the expense of slowdown of TFP growth), it is the case only for large enterprises, but not so for small and medium size firms. Or, to put it differently, if the efficiency of state aid is measured as the sum of the generated increase in employment and decrease in TFP growth, then this efficiency is rather high for large-scale enterprises.

The impact of state aid of the fist type on the increase in the market share is again significant only for large firms: the increase in aid/sales ratio by 1 p.p. raises market share by 1.5 p.p. Chow test for significance of overall interaction (reported in column 5, Table 5) rejects the null hypothesis about equality of coefficients and confirms results obtained from separate regressions.

Despite significance of impact of state aid of the fist type on TFP in regression for whole sample, there is no relationship between allocative efficiency and aid for the whole sample and for the reduced ones (only enterprises receiving state aid). However, the value of coefficients changes in specific regressions for enterprises of different sizes: being insignificant for the medium-sized enterprises , they become positive and significant for small firms (increase in aid/sales ratio by 1 p.p. raises small firm's allocative efficiency by approximately 0.15 p.p) and negative and significant for large firms (increase in aid/sales ratio by 1 p.p. leads to a decrease in allocative efficiency by approximately 0.1 p.p). The Chow test (Prob > F = 0.0549, column 6, Table 5) confirms statistical significance of difference of coefficients across the size groups . Interpretation of obtained results is obvious: despite the state aid received, the small-sized enterprises reduce their relative share in the market faster than the fall in their TFP, and, as a result, the first type state aid does not lead to the reduction in allocative efficiency of small-sized enterprises. However, the first type state aid for the large-sized enterprises ultimately lead to inefficient allocation of resources in the economy, since this allows them to increase their market share at the cost of extensive factors (increase in employment using outdated equipment) against the background of the reduced efficiency in term of TFP.

5.3.2. State Aid of Second Type

As it follows from Table 6, second type of state aid has both positive and statistically significant impact on TFP growth: with probability of 90%, increase in aid/sales ratio by 1 percentage point leads to an increase in the firm's TFP by 0.15 p.p. and sales - by 0.6 p.p. at mean value of state aid to sales ratio. It should be noted that the size of state matters: in the sample of only those enterprises which received the state aid, increase in aid/sales ratio by 1 p. p. results in the TFP growth by 1,85 p.p next year, and sales – by 0.25 p.p. But as before, this trend is more pronounced for large firms[15]: increase in aid/sales ratio by 1 p.p. raises the large firm's TFP by 3.2 p.p. and sales - by 0.3 p.p. at mean value of state aid to sales ratio. Due to state aid2, large firms significantly increased their TFP, market shares and, as a result, allocative efficiency increased by 0.5 p.p. for every 1 p.p. increase in aid/sales ratio. Furthermore, the growth of the market share was significant only for large firms, i.e., ceteris paribus, they grew faster than other enterprises of the sector. Nevertheless, state aid has promoted the growth of allocative efficiency in manufacturing as a whole, even though mostly it occurred through the large firms.

Table. 6. Impact of Second Type State Aid on Growth of TFP, Employment, Market Share and Allocative Efficiency

Sample	Impact on TFP growth rates		Impact on employment	Impact on market share	Impact on allocative efficiency
	TFP as dependent variable	Log of sales as dependent variable			
1	2	3	4	5	6
Whole sample (19, 218 observations. 2,335 firms)	0.0015* (.0008)	.0058* (.0034)	.0009 (.0022)	.0003 (.0003)	.0039* (.0023)
Only for firms with aid of second type (2605 observations, 352 firms)	.0183*** (.0046)	.0028 ** (.0014)	.0023** (.0010)	.0007 (.0005)	.0052 (.0049)
Firms with less than 200 employees (11,802 observations I,628 firms)	No observation	No observations	No observations	No observations	No observations
Firms with more than 200 employees, but less than 1000 (5,636 observations, 717 firms)	.0115 (.0156)	.0040 (.0027)	.0045 (.0028)	.0002 (.0003)	-.0006 (.0005)
Firms with more than 1,000 employees (1,780 observations, 201 firms).	.0319*** (.0085)	.0031** (.0016)	.0004 (.0008)	.0013** (.0006)	.0054* (.0020)

* - significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in brackets

Notes: 1) Control variables: share of the state in shareholders' equity, share of foreign investor in shareholders' equity, share of export in sales and log employment as proxy to size of enterprises.

2) Year and sector dummies are included.

[15] The Chow test results presented in Table 7.

Table 7. Results of Tests on Equality of Coefficients of Second Type of State Aid Between Enterprises of Different Size Groups

	Dependent variable in models with interaction terms				
	TFP	Sale	Deviation from employment growth	Market share deviation	Covariance term
1	2	3	4	5	6
P-value of test for significance of difference in coefficients between medium and large enterprises (Chow test)	0.0056	0.009	0.236	0.052	0.032

5.3.3. Impact of State Aid on Capital/Labor Ratios

As mentioned earlier, the effect of state aid may manifest itself in the change of the production function of recipient firms rather than in higher/lower total factor productivity. To examine this issue, the effects of state aid on the capital/labor ratio of recipients firms were examined using the equation (18). Table 8 displays the regression results.

The estimated coefficients on variable State aid1 show that state aid of first type did not have any significant effect on capital/labor ratios. Besides, in the majority of cases, the coefficients have negative sign. On the contrary, obtained regression coefficients for state aid2 in all samples confirms that state aid of second type positively and significantly affects change in capital/labor ratio. Increase in aid/sales ratio of state aid of second type by 1 p.p. at mean value raises firm's capital/labor ratio by approximately 0.24 p.p. But again, large firms outperform medium ones: they increase their capital/labor ratio by 0.38 p.p. on increasing aid/sales ratio by 1 p.p, while medium firms increase their capital/labor ratio only by 0.24 p.p., with all other things being equal. Chow test confirms statistical significance of the difference in obtained coefficients.

Table 8. Impact of State Aid on Capital/Labor Ratios

Dependent variable: Log K/L	Enterprises with State Aid1				Enterprises with State Aid2		
	Whole sample	Enterprises with less than 200 employees	Enterprises with more than 200 employees, but less than 1,000	Enterprises with more than 1,000 employees	Whole sample	Enterprises with more than 200 employees, but less than 1,000	Enterprises with more than 1,000 employees
Lagged Log K/L	1.0332*** (.0416)	.9864*** (.0133)	1.0039*** (.0312)	1.0264*** (.0834)	.9930*** (.0262)	1.006*** (.0227)	.9991*** (.0217)
Aid1	-.0001 (.0017)	.0002 (.0016)	-.0007 (.0026)	-.0005 (.0031)			
Aid2					.0032** (.0014)	.0024* (.0012)	.0038*** (.0014)
Control variables	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes	yes	yes	yes
N groups	1690	1089	511	149	352	190	201
N observations	3934	2408	1161	361	2605	1118	1488
P-value of Arellano-Bond AR(2) Test	0.309	0.443	0.896	0.179	0.939	0.320	0.555
P-value of Hansen Chi2 Overid Test	0.774	0.254	0.425	0.606	0.404	0.842	0.282
P-value of Chow test	0.363				0.092		

* - significant at 10%; ** significant at 5%; *** significant at 1%; standard errors in brackets; p-values in parentheses

Notes: 1) Control variables: share of the state in shareholders' equity, share of foreign investor in shareholders' equity, share of export in sales and log employment as proxy to size of enterprises.

2) Log K/L, State aid and control variables are assumed endogenous and instrumented by lags (starting from the third lag).

Due to the fact that higher capital/labor ratio is usually associated with more advanced technology, it could be expected that state aid 2 leads to the increase in TFP, which is indeed the case, according to our previous calculations. It should be noted that its is quite an expected result, since the first type of state aid (provided to enterprises being in financial distress), both due to its specifics, and relatively insignificant size (mean value of first type state aid in relative terms is only 45% of the second type of state aid) as a rule is not used to finance restructuring, but for replenishment of the working capital and for wage payments for employees.[16] In addition, this result was the consequence of the pursued industrial policy: the second type of state aid has been provided to the large-size and largest enterprises which are the leaders of the Belarusian industry. It should be noted that the directions of spending of aid funds were strictly specified and controlled. Although civil servants are not the best managers and that is why not all projects became success stories[17], on the average, the pursued policy for provision of the second type of state aid has yielded positive results.

6. Conclusions

Table 9 summarizes the results of my findings. It appears that there is a good deal of difference between state aid 1 and state aid 2.

Table. 9. Summary. Impact of State Aid 1 and 2 on TFP, K/L Ratio, Employment, Market Share and Allocative Efficiency

Impact of state aid on performance indicators	Impact of state aid 1	Impact of state aid 2
TFP		
-Whole sample	Negative	Positive
-Enterprises, receiving aid	Insignificant	Strongly positive
-Small	Negative	No observations
-Medium	Insignificant	Positive
-Large	Negative	Strongly positive

[16] Until December 2008, indicators for the average wage growth for the future year were set in Belarus irrespective of the form of ownership of the enterprises, and they were mandatory.
[17] So, despite the significant size of state aid, the State-Owned company “Horizont” producing television sets failed to compete in the market successfully.

K/L ratio		
-Enterprises, receiving aid	Insignificant	Positive
-Medium	Insignificant	Mildly positive
-Large	Insignificant	Strongly positive
Employment		
-Whole sample	Insignificant	Insignificant
-Enterprises, receiving aid	Positive	Positive
-Small	Insignificant	No observations
-Medium	Insignificant	Insignificant
-Large	Positive	Insignificant
Market share		
-Whole sample	Insignificant	Insignificant
- Enterprises, receiving aid	Insignificant	Insignificant
-Small	Insignificant	No observations
-Medium	Insignificant	Insignificant
-Large	Mildly positive	Positive
Allocative efficiency		
-Whole sample	Insignificant	Positive
- Enterprises, receiving aid	Insignificant	Insignificant
-Small	Positive	No observations
-Medium	Insignificant	Insignificant
-Large	Mildly negative	Positive

The state aid of the second type (that is provided for restructuring) is quite efficient in a sense that it affects positively the growth of K/L ratio in the following year, TFP growth, employment (only for large firms), market share (again for large enterprises only) and allocative efficiency. The story consistent with the data is that state aid 2 really leads to the modernization of the enterprises (K/L ratio grows) and that this modernization leads to the increase in efficiency (TFP grows especially at large enterprises), and that this growth of TFP allows these newly restructured enterprises to increase their market share which results in the growth of the allocative efficiency.

On the contrary, state aid of the first type (that is provided to support enterprises in financial distress) cannot be considered efficient. It leads to the increase in employment (only for enterprises receiving aid, especially for large enterprises, but not for the total sample) and to the increase in the market share of large enterprises (not small and medium size), but this achievement comes at the expense of the decrease in TFP.

Appendices

Table1. State Aid for Industrial Enterprises in Belarus as Percent of Total Output

	Total aid	Aid 1	Aid 2
1998	4.10	1.72	2.38
1999	5.03	2.01	3.02
2000	4.84	1.84	3.00
2001	4.94	2.32	2.62
2002	5.15	2.27	2.89
2003	5.76	2.13	3.63
2004	5.01	2.11	2.91
2005	4.39	1.76	2.63
2006	3.57	1.61	1.96
2007	3.71	1.45	2.26
Weighted average over period	5.01	2.07	2.94
Old EU members on average (excluding agriculture and transport)	0.4		
New EU members on average	1.2		

Table 2 . Summary Statistics on Aid for Enterprises receiving Aid

.

Variable	Obs	Mean	Std. Dev.	Min	Max
Aid to sale ratio (percent)					
aid 1	3,934	3.90	2.09	0.51	14.88
aid 2	2,605	8.65	5.21	1.17	24.01
Amount of aid in rubles (1998)					
aid 1	3,934	98,477.83	314,444.50	1.20	11,035,100
aid 2	2,605	201,092.60	781,525.20	39.38	142,000,456

Table 3 . Structure of sample by ownership type, %

	1998	2007
State enterprises	49.15	47.11
Mainly state	4.58	14.45
Mainly private	20.40	15.94
private	13.15	15.96
Joint Venture	10.15	5.40
Foreign enterprises	1.95	1.66
Total number of enterprises	2,358	2,112

Table 4. **Firm-level summary statistics, billion BYR 1998, labor in units**

.

Employment						
Industrial Sector	NACE 1.1	Obs	Mean	Std. Dev.	Min	Max
Mining of coal and lignite	10	272	183,94	97,90	4	450
Other mining (stone, sand, etc.	14	137	1 322,77	3 965,29	10	18 131
Foods and beverages	15	4 247	216,58	266,79	2	2 903
Tobacco products	17	862	568,50	1 062,33	7	7 287
Textiles	18	1 020	312,65	413,90	5	2 332
Apparel	19	330	519,52	488,37	4	2 434
Leather	20	1 683	192,48	330,74	2	3 810
Wood and wood products	21	139	595,12	675,27	18	2 888
Paper	22	502	114,91	202,40	3	1 312
Publishing	23	32	2 497,06	1 769,04	58	5 716
Coke, petroleum products	24	352	1 203,92	2 614,40	5	17 750
Chemicals	25	299	570,60	1 876,29	2	13 392
Rubber and plastics	26	1 077	405,97	684,19	7	4 530
Other non-metals	27	128	1 223,16	2 689,69	6	12 195
Basic metals	28	640	281,00	343,29	2	1 935
Metal products	29	969	989,85	2 047,67	5	19 762
Machinery	30	43	1 079,53	1 374,63	10	5 044
Office equipment	31	408	625,32	849,19	6	4 676
Electrical equipment	32	232	954,28	1 132,40	6	5 950
TV and Radio Sets, and	33	222	600,31	854,80	2	4 853

equipment						
Precision instruments	34	286	1 624,44	3 587,94	3	23 410
Motor vehicles	35	76	611,07	1 084,14	36	3 975
Other transport equipment	36	903	393,30	775,55	2	6 651
Furniture	37	77	221,26	136,60	29	531
Repair of computers and others	94	438	274,27	496,15	3	3 134
Total		19 218	433,36	1 142,29	2	23 410

Capital

Industrial Sector	NACE 1.1	Obs	Mean	Std. Dev.	Min	Max
Mining of coal and lignite	10	272	1 491 909	6 235 045,40	1 749,38	47 200 000
Other mining (stone, sand, etc.	14	137	4 440 854	16 210 935,00	2 176,47	78 700 000
Foods and beverages	15	4 237	454 332	5 337 702,50	0,00	1 134 000
Tobacco products	17	862	324 261	764 071,31	59,84	5 902 470
Textiles	18	1 020	67 845	131 853,90	15,13	1 169 743
Apparel	19	327	637 729	1 097 556,00	30,30	5 887 358
Leather	20	1 680	370 760	4 851 936,80	20,08	182 000
Wood and wood products	21	138	341 826	373 457,38	144,56	1 456 163
Paper	22	502	68 488	195 846,57	192,29	1 676 383
Publishing	23	32	14 000 000	9 950 558,70	33 003,40	29 300 000
Coke, Petroleum Products	24	352	3 542 530	9 327 958,20	508,24	55 900 000
Chemicals	25	299	1 472 436	6 520 206,40	179,20	43 200 000
Rubber and plastics	26	1 075	731 552	2 880 607,40	60,05	36 200 000
Other non-metals	27	128	5 369 664	15 791 489,00	52,00	75 900 000
Basic metals	28	640	225 143	304 841,42	28,88	1 817 160
Metal products	29	969	1 059 276	2 264 831,00	57,75	21 800 000
Machinery	30	43	1 472 586	2 425 493,70	450,00	7 201 592
Office equipment	31	408	575 658	804 697,18	1 017,40	3 666 155
Electrical equipment	32	232	966 727	1 318 166,70	984,00	6 630 846
TV and Radio Sets,	33	222	410 796	639 301,00	746,65	2 790 752

and equipment						
Precision instruments	34	286	1 345 535	3 459 375,10	38,08	31 900 000
Motor vehicles	35	76	624 195	979 978,36	12 419,46	3 778 677
Other transport equipment	36	903	253 512	671 575,57	20,08	5 423 623
Furniture	37	77	531 869	486 895,79	1 400,00	1 972 306
Repair of computers and others	94	438	131 822	303 291,00	44,11	1 825 928
Total		19 218	673 778	4 562 270,40	2.89	78 700 000

Output

Industrial Sector	NACE 1.1	Obs	Mean	Std. Dev.	Min	Max
Mining of coal and lignite	10	264	78 783,63	101 640	725,22	797 780
Other mining (stone, sand, etc.	14	134	1 821 580,00	6 881 109	77,33	36 800 000
Foods and beverages	15	4 237	401 605,90	1 489 964	0,00	33 100 000
Tobacco products	17	862	312 378,50	764 897	119,30	14 100 000
Textiles	18	1 020	559 497,30	2 067 579	0,00	31 400 000
Apparel	19	330	1 008 485,00	3 912 712	2 052,77	32 800 000
Leather	20	1 682	303 711,20	2 329 213	0,00	80 600 000
Wood and wood products	21	138	603 002,30	917 010	708,53	3 585 746
Paper	22	502	1 193 696,00	7 658 540	179,49	71 200 000
Publishing	23	32	1 092 987,00	1 552 343	937,68	3 830 773
Coke, Petroleum Products	24	352	1 180 175,00	3 314 826	0,00	22 500 000
Chemicals	25	299	335 053,10	664 136	0,00	4 278 521
Rubber and plastics	26	1 067	960 665,00	7 985 629	302,92	106 323 000
Other non-metals	27	121	715 367,30	1 702 816	1 770,25	8 615 702
Basic metals	28	640	380 058,40	948 361	2,90	11 700 000
Metal products	29	969	1 693 273,00	6 527 747	0,00	67 800 000
Machinery	30	43	1 000 135,00	1 646 866	307,85	5 950 872
Office equipment	31	408	430 593,70	842 735	359,87	6 211 555
Electrical equipment	32	232	488 319,10	909 827	822,47	5 330 894

TV and Radio Sets, and equipment	33	222	300 391,70	402 475	789,85	1 850 804
Precision instruments	34	286	1 467 674,00	4 699 154	1 002,00	34 100 000
Motor vehicles	35	76	462 357,40	1 186 710	2 527,07	4 727 916
Other transport equipment	36	900	279 358,50	778 901	0,00	7 946 856
Furniture	37	77	380 424,60	426 107	3 911,75	1 433 927
Repair of computers and others	94	432	287 150,00	594 898	461,63	4 995 288
Total		19 218	596 218,82	3 511 353	2.9	106 323 000

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