RESOURCE MISALLOCATION AND MANUFACTURING PRODUCTIVITY: THE CASE OF UKRAINE

by

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Abstract

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This thesis investigates the effect of resource misallocation on Ukrainian manufacturing productivity using the dataset of 56574 unique establishments over the period of 2002-2010. In order to perform this analysis, I apply Hsieh and Klenow (2009) framework, which consists of the monopolistic competition model with heterogeneous goods. Individual plants are subject to output and capital distortions, which influence revenue productivity; thus, the variance of TFPR in this framework is the main measure of resource misallocation. The principal aim of this paper is to estimate the potential gains for manufacturing TFP in case of distortions elimination and TFPR equalization within industries.

Empirical results shows that there is a significant resource misallocation in Ukrainian manufacture as dispersion of the revenue productivity is almost twice higher than in the benchmark economy. In case of full liberalization, when all the distortions are eliminated, potential gains are expected to be equal to 97.1-135.2%. However, if we apply for Ukraine the benchmark distribution of resources, which is believed to be close to the optimal one, gains shrink to 34.1-60.0%, which satisfies the initial hypothesis. Empirical results also provide us with conclusion that most of Ukrainian enterprises underperform their optimal size by more than twice. Decomposition of the basic results shows that total distortion is

mainly driven by revenue productivity variance, which is determined, on the one hand, by output distortions, and on the other hand, by between-group components. The most reallocations of resources, which influence the whole distribution, occur among the most and the least productive enterprises.

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LIST OF ABBREVATIONS

TFP – Total factor productivity

TFPQ – output-based total factor productivity

TFPR – revenue-based total factor productivity

MPPL – marginal revenue product of labor

MPPK – marginal revenue product of capital

Chapter 1

INTRODUCTION

Why do some countries that were poor decades ago are now getting richer, while some remain poor with the per capita income not growing or even decreasing? One of the seminal papers in economic growth theory, Solow (1957), shows that country's output dynamics mainly depends on marginal productivities of inputs (i.e., capital and labor) and technical change index (Solow residual), which in the following research was formalized as the total factor productivity (TFP). It is believed that TFP is the main source of cross-country variations in per capita output as Klenow and Rodriguez-Claire (1997), and Hall and Jones (1999) prove it. Thus, it is of significant interest to evaluate the extent to which a country can increase its output due to higher total factor productivity.

However, because of idiosyncratic distortions, it is not sufficient to evaluate TFP at the macro level, so during recent decades a significant number of studies emerge, which consider aggregate productivity from the micro-level perspective (Haltiwanger, 1997, and Foster et al., 2001, clearly describe the logic why we should use micro-data). For example, in Hsieh and Klenow (2009), which presents a popular recent view on this issue, micro-distortions prevent the optimal allocation of resources across firms within industries and significantly contribute to cross-country differences in TFP. Moreover, recent calculations show that resource misallocation has a significant impact on countries' TFP and, hence, lowers total output. To be more specific, different empirical applications allows us to conclude that, on average, while resource misallocation is eliminated, the country is able to produce its output by 30-60% more productive. So, higher TFP allows a country to increase its output per capita and grow faster.

According to the different estimations, in 2011 Ukraine occupied 109-114 rank in the world by GDP per capita with average value of $3600[1]. Thus, production efficiency, which implies optimal resource allocation, can allow firms to operate in more liberalized markets producing close to the potential level of output, which in total will increase manufacture pruduction and gross domestic product, hence, increasing the well-being of Ukrainian population.

This thesis studies the role of resource misallocation in the dynamics of Ukrainian manufacturing TFP and output during 2002-2010, thus, dealing with the period of WTO accession (in 2008) and recent financial crisis (2008-2009). Answering the global research question about the role of allocative efficiency in Ukrainian manufacturing productivity, I intend to answer the following sub-questions: (i) What are the potential gains of optimal resources allocation? (ii) What are the key factors, which determine the misallocation of resources in Ukrainian manufacturing?

To reach these goals, I would like to employ the methodology proposed by Hsieh and Klenow (2009), which allows accounting for firm-level distortions on TFP in the framework of monopolistic competition model with heterogeneous firms. Aggregating firm-level productivity to industry and aggregate levels, and comparing with the case of full allocative efficiency allows evaluating of the potential gains in terms of TFP growth, when distortions are eliminated. Additionally, I perform decomposition of distortions variation as it is done in Hsieh and Klenow (2011), and Chen and Irarrazabal (2013) in order to account for the sources of resource misallocation.

[1]Here I use the data for 2011 from World Economic Outlook Database-October 2012, IMF (http://www.imf.org/external/pubs/ft/weo/2012/02/weodata/index.aspx), World Development Indicators database, World Bank (http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2) and National Accounts Main Aggregates Database, December 2012, UN Statistics Division (http://unstats.un.org/unsd/snaama/selbasicFast.asp).

To be able to perform these calculations and to answer the questions of interest, I use a micro-level dataset on Ukrainian manufacturing firms, which contains information on balances (here I get the book value of fixed capital stock), financial results (here I get turnover, net sales, material cost and wage bill), employment and information on characteristic features of the firms (ownership, exporting status and region).

As the main outcomes of this thesis, I expect to obtain the potential gains of resources misallocation elimination, to find the empirical evidence on the key drivers of misallocation, and to provide a policy toolkit for manufacture liberalization. Analysis of the analogous studies using the applied in this research methodology for the other countries allows me to set the initial hypothesis of potential gains equal to 30-80% of TFP growth comparatively to the benchmark economy.

Empirical results shows that there is a significant resource misallocation in Ukrainian manufacture as dispersion of the revenue productivity is almost twice higher than in the benchmark economy. In case of full liberalization, when all the distortions are eliminated, potential gains are expected to be equal to 97.1-135.2%. However, if we apply for Ukraine the benchmark distribution of resources, which is believed to be close to the optimal one, gains shrink to 34.1-60.0%, which satisfies the initial hypothesis. Empirical results also provide us with conclusion that most of Ukrainian enterprises underperform their optimal size by more than twice. Decomposition of the basic results shows that total distortion is mainly driven by revenue productivity variance, which, on the one hand, determines by output distortions, and on the other hand, by between-group components. The most reallocations of resources, which influence the whole distribution, occur among the most and the least productive enterprises.

The rest of the paper proceed as follows: chapter 2 contains literature review, chapter 3 describes the employed methodology, chapter 4 describes the data, chapter 5 presents empirical results, chapter 6 discuss possible liberalization toolkit, chapter 7 concludes.

Chapter 2

LITERATURE REVIEW

This section is organized as follows. Firstly, I overview the results of studies, which applied Hsieh and Klenow (2009) methodology. Secondly, I present literature, which is closely related to the given study. Finally, I briefly overview what was done for Ukraine in the given area.

This thesis is a part of rapidly expanding recent literature on the importance of micro-distortions and firm-level resource misallocation for aggregate productivity and output. One of the most discussed areas here is the effect of micro-level resource allocation efficiency on the aggregate productivity and the potential gains of distortions elimination. This literature emerges after Hsieh and Klenow (2009) paper publication, where they initially provide their analysis and compute potential gains of 30-50% for China and 40-60% for India. Applying this methodology, a number of calculations are made, mainly for Latin America countries, which are presented in Table 1. For example, Machicado and Birbuet (2009) apply this methodology for Bolivian data covering the period of market liberalization period of 1988-2001 and obtain the result of 60% gains. Camacho and Conover (2010) perform analysis for Colombia covering 1982-1998 and obtain results of 47-55%.

Thus, Hsieh and Klenow (2009) and further studies show that resource misallocation is responsible for underproduction by approximately 30-60% of the current production level. Almost all results fit this interval, but the only outlier here is Mexico, where the potential gains are expected to be equal to 127%. My research mainly contributes to this literature, as I will perform these estimations for Ukraine, which was never done previously.

Table 1. Summary of Hsieh-Klenow methodology applications

Study	**Results**	
	Country	**Possible TFP growth**
Hsieh and Klenow (2009)	China	30-50%
	India	40-60%
Machicado and Birbuet (2009)	Bolivia	60%
Casacuberta and Gandelman (2009)	Uruguay	50-60%
Camacho and Conover (2010)	Colombia	47-55%
Neumeyer and Sandleris (2010)	Argentina	50-80%
Oberfield (2011)	Chile	60-80%
Busso, Madrigal and Pages (2012)	Venezuela	55.2%
	Bolivia	52.5%
	Uruguay	61.8%
	Argentina	52.2%
	Ecuador	52.7%
	Chile	45%
	Colombia	48.9%
	Brazil	49.1%
	Mexico	127%

It also should be mentioned that some studies on expanding Hsieh and Klenow (2009) methodology are currently in progress. Thus, Yang (2012) introduces firm stay-exit decision as micro-frictions can result in extensive-margin misallocation. This type of misallocation means that non-productive firms can continue operating, whereas highly productive firms exit the market because of some reasons. So, this situation makes misallocation differ as net flow of resources from more to less productive firms occurs. Also, Chen and Irarrazabal (2013) provide further derivations of original Hsieh and Klenow (2009) model in order to perform decomposition analysis (this study will be discussed more in details later in this literature review and in methodology part). One of the perspective directions is including input-output tables into analysis. In this area there is are the seminal papers Jones (2011a), where the Hsieh and Klenow (2009) methodology is partially employed, and Jones(2011b). Both of them prove that input-output structure of the economy can aggravate misallocation of resources and its negative impact on TFP: while some sector experience significant misallocation of resources and, thus, distorted TFP, use of its output by another sector as intermediate goods will worsen misallocation by introducing the additional distortion.

This thesis is also related to few parts of literature on manufacturing productivity and resource misallocation.

On the one hand, my research is closely connected with a number of studies considering decompositions of aggregate TFP (Baily, Hulten, Campbell, Bresnahan and Caves, 1992; Griliches and Regev, 1995; Olley and Pakes, 1996; Foster, Haltiwanger and Krizan, 2001; Melitz and Polanec, 2012) and a huge stream of further literature, which applied these techniques for industry-level estimations in different countries. In general, these studies mainly propose to decompose aggregate productivity into contributions of five terms: within-firm component (productivity improvements of surviving firms), between-firm component (market share reallocations among surviving firms), cross-firm component (the covariance between changes in market shares and changes in productivity), contribution of entrants and contribution of exiters. Chen and Irarrazabal (2013) developed a decomposition technique within the framework of Hsieh and Klenow (2009), so I will be able to decompose productivity variations into within-group and between-group components.

Also, this thesis actively uses the concept of output- and revenue-based total factor productivity (TFPQ and TFPR) respectively, which is presented in Foster, Haltiwanger and Syverson (2008). Differences in output and revenue base for TFP calculation allows to account for different factors. Thus, TFPQ mainly reflects plants' idiosyncratic cost components, both technological fundaments and factor prices, whereas TFPR confounds idiosyncratic demand and factor price effects efficiency differences. As a result, this paper provide a framework for TFP computation as a combination of TFPQ and TFPR, which is used in Hsieh and Klenow (2009) and in this thesis.

Another area of related literature consider the differences in the resources allocation across firms that differ in productivity to be an important factor in accounting for cross-country differences in output per capita (Restuccia and Rogerson, 2008; Guner, Ventura and Xu, 2008; Midrigan and Xu, 2010; Buera and Shin, 2010; Moll, 2012; Buera, Moll and Shin, 2013). Research in this area evaluate the effect of distortions on firm-level prices and size, subsidies and financial constraints on productivity and resource misallocation.

Also, this thesis is connected to the stream of literature, which consider the impact of different liberalization practices on TFP. For example, Arnold, Javorcik and Mattoo (2011) study the impact of services liberalization on Czech manufacturing firms. They found a significant positive productivity effect of services liberalization fir those firms, which use services as inputs in the production. Moreover, the international openness of services sectors amplify the positive effect on manufacturing TFP. Amity and Konings (2007) study the effect of trade liberalization on manufacturing productivity. Their results show that 10 percent import tariffs elimination leads to 12 percent productivity increase in case of input tariffs reduction (on those goods, which are used as intermediate) and 6 percent productivity increase in case of output tariffs reduction (on final goods).

Speaking about studies concerning Ukraine, we should mention that research on TFP is usually conducted to evaluate the impact of trade liberalization (Shevtsova, 2010, and Kravchuk, 2012) and services liberalization (Shepotylo and Vakhitov, 2012a, and Shepotylo and Vakhitov, 2012b), or only agricultural sector TFP is considered using another techniques (Nivyevs'kiy, 2004, Lissitsa and Odening, 2005, Gagalyuk, 2006, applied Data Envelopment Analysis and Stochastic Frontier Analysis for this single sector). Goncharuk (2006) studies aggregate TFP based on macro statistics for transition period of Ukrainian economy.

As a concluding remark for this section, I would like to mention that given research is the first attempt to apply Hsieh-Klenow methodology and its extensions for Ukraine. However, some liberalization influence assessments are done previously, but they use the earlier time interval, thus, this thesis complements these studies.

C h a p t e r   2

METHODOLOGY

This section is consists of two main parts. In the first part, I present the theoretical Hsieh and Klenow (2009) model, which is the theoretical baseline of my research. In the second part, I describe an extension of this methodology, which arises from Hsieh and Klenow (2011) and Chen and Irarrazabal (2013), in order to perform the decomposition of the obtained in the first part results.

1. Theoretical model

The theoretical framework of this thesis is Hsieh and Klenow (2009) model of monopolistic competition with heterogeneous firms based on Melitz (2003) closed economy model. Hsieh-Klenow framework is developed in order to estimate the extent to which distortions affect wedges between marginal products of inputs (both capital and labor) across the firms within industries, thus, lowering the aggregate total factor productivity. In the absence of distortions, the revenue productivity of firms within industries should be equated as allocative efficiency concept predicts, so its variation is considered as a measure of distortions-driven resource misallocation among establishments.

The basic setup of Hsieh and Klenow (2009) model is the following. The economy consists of a number of heterogeneous manufacturing firms, which operate at the monopolistic competition market. All of these firms differ not only by productivity, but also by output and capital distortions they face. A single final good is produced by a representative firm and combines the output of S manufacturing industries using a Cobb-Douglas production technology. Each firm face a profit maximization problem, which yield an output price as a fixed markup over the marginal cost. Industry output is a CES aggregate of M differentiated goods with corresponding Cobb-Douglass production functions of TFP, capital and labor, where the inputs shares differ across industries, but are equal for the firms within a single industry.

The first part of my methodology, which directly arises from Hsieh and Klenow (2009) framework, aims to answer the first sub-question about the potential gains of allocative efficiency achievement in Ukrainian economy. It consists of the TFP calculation, aggregation and potential gains evaluation procedure derived from the Hsieh-Klenow model.

The process of TFP calculation and aggregation follows the three main steps, which are presented in the Figure 1.

Figure 1. Steps in TFP calculation

The first step of this framework starts with computation of output and capital distortions. Output distortions are defined as those, which moves capital-labor ratio in the same direction and computed as a ratio of actual wage bill relative to optimal one (as a share of labor in value added predicts):

$$1 - \tau_{Ysi} = \frac{\sigma}{\sigma - 1}\frac{wL_{si}}{(1-\alpha_s)P_{si}Y_{si}}, \quad (1)$$

where σ – is elasticity of substitution between plants' value added, wL_{si} – wage bill (wage rate w is normalized to equal 1), α_s – share of capital in value added, $P_{si}Y_{si}$ – plant's value added.

On the other hand, capital distortions are defined as those, which change capital-labor ratio and computed as a deviation of actual capital-labor ratio from predicted by factor elasticities optimal ratio:

$$1 + \tau_{Ksi} = \frac{\alpha_s}{1-\alpha_s}\frac{wL_{si}}{RK_{si}}, \tag{2}$$

where R – is a rental price of capital, K_{si} – book value of fixed capital.

Having output and capital distortions computed, it is possible to calculate marginal revenue products of labor (MRPL) and capital (MRPK), which are defined as:

$$MRPL_{si} = w\frac{1}{1-\tau_{Ysi}} \tag{3}$$

$$MRPK_{si} = R\frac{1+\tau_{Ksi}}{1-\tau_{Ysi}} \tag{4}$$

At the firm level, following Foster, Haltiwanger and Syverson (2008), Hsieh and Klenow (2009) distinguish between product productivity (TFPQ, which measures productivity in terms of real output) and revenue productivity (TFPR, which accounts for revenue of a firm).

Physical productivity in this thesis is measured as the ratio of actual production over inputs:

$$TFPQ_{si} = A_{si} = \kappa_s\frac{(P_{si}Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s}L_{si}^{1-\alpha_s}} \tag{5}$$

where κ_s=1.

Revenue productivity, thus, is measured as a geometric mean of capital and labor revenue productivity:

$$TFPR_{si} = \frac{\sigma}{\sigma-1}\left(\frac{MRPK_{si}}{\alpha_s}\right)^{\alpha_s}\left(\frac{MRPL_{si}}{w(1-\alpha_s)}\right)^{1-\alpha_s} \quad (6)$$

While I obtain both physical and revenue productivity for firms in the sample, I can move to the second step and obtain industry level TFP. As TFPR is considered as the main source of distortions and TFPQ reveal the actual productivity, sectoral TFP is calculated as a harmonic average of firms' TFPQ weighted by individual deviations of TFPR from sector mean:

$$TFP_s = \{\sum_{i=1}^{M_s} A_{si}\frac{\overline{TFPR_s}}{TFPR_{si}}\}^{\frac{1}{\sigma-1}}, \quad (7)$$

where M_s is a number of firms in the industry.

Average sectoral TFPR in (7) is computed by the following formula:

$$\overline{TFPR_s} = \frac{\sigma}{\sigma-1}\left[\frac{R}{\alpha_s\sum_{i=1}^{M_s}\frac{1-\tau_{Ysi}}{1+\tau_{Ksi}}\frac{P_{si}Y_{si}}{P_sY_s}}\right]^{\alpha_s}\left[\frac{1}{(1-\alpha_s)\sum_{i=1}^{M_s}1-\tau_{Ysi}\frac{P_{si}Y_{si}}{P_sY_s}}\right]^{1-\alpha_s}, \quad (8)$$

or,

$$\overline{TFPR_s} = \frac{\sigma}{\sigma-1}\left(\frac{\overline{MRPK_{si}}}{\alpha_s}\right)^{\alpha_s}\left(\frac{\overline{MRPL_{si}}}{w(1-\alpha_s)}\right)^{1-\alpha_s} \quad (9)$$

Thus, following the same logic as for firm-specific revenue productivities, average TFPR is defined as weighted average of average sectoral marginal products of inputs.

In case of distortions elimination, all TFPRs are equalized, so there no more deviations from the mean. In this situation sectoral TFP is considered as effective one and equals to the average product productivity:

$$TFP_s^e = \overline{A_s} = \left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}} \quad (10)$$

The third step implies calculation of the aggregate TFP and manufacturing output using the Cobb-Douglas production technology in the following way:

$$TFP = \prod_{s=1}^{S} TFP_s^{\theta_s} = \prod_{s=1}^{S} (\sum_{i=1}^{M_s} \{A_{si} \frac{\overline{TFPR_s}}{TFPS_{si}}\}^{\sigma-1})^{\frac{\theta_s}{\sigma-1}} \tag{11}$$

$$Y = \prod_{s=1}^{S} (TFP_s * K_s^{\alpha_s} * L_s^{1-\alpha_s})^{\theta_s} \tag{12}$$

where Y is aggregate manufacturing output, S is a number of analyzed manufacturing sectors and θ_s shows a share of specific sector in aggregate manufacturing output.

Finally, when all the required steps of TFP calculation are performed, I am able to evaluate potential gains of the optimal allocation of resources. Plugging sector-specific results of (7) into (11) gives me aggregate actual TFP, whereas using sector-specific results of (10) in equation (11) gives me optimal manufacturing TFP.

Thus, the relative gains from liberalization within sectors can be expressed as the ratio of actual and effective aggregate manufacturing productivity

$$\frac{TFP}{TFP_e} = \prod_{s=1}^{S} [\sum_{i=1}^{M_s} (\frac{A_{si}}{A_s} \frac{\overline{TFPR_s}}{TFPR_{si}})^{\sigma-1}]^{\theta_s/(\sigma-1)} \tag{13}$$

Thus, gains of liberalization, which implies elimination of resource misallocation are obtained in the following way:

$$Gain = \left(\frac{TFP_e}{TFP} - 1\right) * 100\% \tag{14}$$

Besides total liberalization, Hsieh and Klenow (2009) also propose to calculate gains in case of similarity of distribution with the benchmark economy, which is proposed to be the US one. Thus, dividing potential gains for Ukrainian economy by American ones will give us gains for Ukraine in case if resource allocation within sectors to be the same as in USA.

2. Decomposition analysis

The second part of this methodology presents a technique, which allows to answer the second sub-question about the key factors, which determine the misallocation of resources in Ukrainian economy.

For this part, I intend to combine Hsieh and Klenow (2011) and Chen and Irarrazabal (2013) findings, where they expand the basic Hsieh and Klenow (2009) methodology by decomposing the potential gains of liberalization in order to account for the main misallocation driver factors.

The below described decompositions are performed using the assumption by Hsieh and Klenow (2009), Hsieh and Klenow (2011) and Chen and Irarrazabal (2013) of joint log-normal distribution of revenue productivity $TFPQ_{si}=A_{si}$, output distortions $(1-\tau_{ysi})$, factor distortions $(1+\tau_{ksi})$, which also implies joint log-normal distribution of TFPQ anf TFPR.

Using Central Limit Theorem over (13), the potential gains of optimal resource allocation can be approximated by the following decomposition:

$$logTFP_e - logTFP = \frac{\sigma}{2} var[\log(TFPR_{si})] + \frac{\alpha(1-\alpha)}{2} var[\log(1+\tau_{Ksi})] \quad , (15)$$

where the LHS represents the gains computed in (13) and the RHS consists of two terms: the variation of TFPR, $var[log(TFPR_{si})]$, which captures resource allocation distortions across firms, and the variation of capital distortions, $var[\log(1+\tau_{ksi})]$, captures the distortions on capital-labor ratio, deviating it from the ideal one.

Next, it is also possible to account for the sources, which lead to variation of TFPR, thus, causing resource misallocation. Here I also follow the logic of Hsieh and Klenow (2011) and Chen and Irarrazabal (2013) and present their findings in the following decomposition:

$$var(\log(TFPR_{si})) = var[\log(1-\tau_{Ysi})] + \alpha_s^2 var[\log(1+\tau_{Ksi})] - \\ -2\alpha cov[\log(1-\tau_{Ysi}), \log(1+\tau_{Ksi})], \quad (16)$$

where the first term captures the resource misallocation due to output distortion, the second term – due to factor distortion and the third term presents their covariance.

Following Chen and Irarrazabal (2013), the third type of analysis consists of decomposition by between- and within-group components, which allows us to account for reallocation of resources between groups of establishments with different productivities. This type of decomposition can be presented in the following way:

$$var[\log(TFPR_{si})] = \frac{1}{M_s}\sum_q^Q \sum_i^{N_q} (logTFPR_{sqi} - \overline{logTFPR_s})^2 = \\ = \frac{1}{M_s}\sum_q^Q N_q var[\log(TFPR_{si})]_q + \frac{1}{M_s}\sum_q^Q N_q (\overline{logTFPR_{sq}} - \overline{logTFPR_s})^2, \quad (17)$$

where the first term of RHS is within-group component and the second one is between-group component. In (17) *log(TFPR$_{si}$)* is log TFPR of firm i, which belongs to quintile q within industry s; $\overline{logTFPR_s}$ – if the average logTFPR in industry s; $\overline{logTFPR_{sq}}$ – average logTFPR for quintile q within industry s; N_q – number of firms within each quintile. Chen and Irarrazabal (2013) claims that between group component, which accounts for the variance of TFPR among groups with different levels of product productivity, allows to rule out idiosyncratic shocks, which influence resource misallocation and, thus, allows to estimate the level of distortions within every quintile of productivity distribution. Between-group's component contribution to the total TFPR variance is proposed to be computed using the following equation:

$$\frac{\Delta \frac{1}{N}\sum_q^Q N_q(\overline{log\,TFPR_q} - \overline{logTFPR})^2}{\Delta var(logTFPR)}, \quad (18)$$

where Δ presents difference between the last and the first years of the analyzed period.

The contribution of each quintile to between-group components is evaluated using:

$$\frac{\Delta\frac{N_q}{N}(\overline{\log TFPR_q}-\overline{\log TFPR})^2}{\Delta between-group\ component} \tag{19}$$

By analogy to TFPR, also I would like to decompose output and capital distortions.

Concluding, the methodology of this thesis, firstly, I employ the Hsieh and Klenow (2009) approach in order to estimate the potential gains of resource misallocation elimination. Secondly, I use the Hsieh and Klenow (2009) framework extension by Hsieh and Klenow (2011) and Chen and Irarrazabal (2013) in order to compute main factors, which influence allocation improvement.

Chapter 4

DATA DESCRIPTION

The data for this research come from a database of Ukrainian firms, which is provided by Institute for Economic Research and Policy Consulting. I am using balances and financial statements of all manufacturing companies for the period of 2002-2010 year, where I get such variables as total turnover, net sales, wage bill, employment, book value of fixed capital stock, material costs, industry (type of economic activity code according to NACE Rev. 1.1.), organizational form, region, exporting and importing indicators.

One of the main analysied variables is value added, which is constructed from the obtained data. In order to get value added, I substract material costs from the total turnover. Also, I use average book value of fixed capital, which is computed as a simple average of current period and previous period values. Additionally, I construct exit and enter dummy variables, which correspondingly indicate last or first appearance in the database. Age variable is computed only for 2010 as a difference between 2010 and the year of the first appearance in the database.

As Ukrainian statistics reports classification for the type of economic activity using NACE Rev. 1.1., but the preceding research uses ISIC rev. 3.1. classification for distinguishing the industries, I apply the concordance table and convert the industry code into ISIC framework.

Here I would like to mention that all monetary values are transformed to the real terms using the following deflators:

- Total turnover is adjusted by sector-specific output deflator;

- Book value of fixed capital and material costs are adjusted by producer price index;
- Wage bill is adjusted by consumer price index.

The initial data cleaning occurred for each year's data separately. The main criteria for firm's presence in the raw sample were the following:

- A firm should belong to the section D of ISIC classification (divisions 15-37);
- Positive total turnover and net sales;
- Positive values for labor and material costs, and stock of fixed capital;
- Positive number of employment with the only exception for 2003 as the data for this year is not present in the dataset;
- Non-missing observations for the rest of the variables;
- Computed value added should be positive.

As a result, I obtain a raw dataset, which satisfies the above-mentioned criteria and consists of 234,444 observations for 56504 unique firms. In further, the data cleaning process consists of two main procedures: (i) trimming of those firms, for which the computed shares of labor in value added exceed 1; (ii) trimming of firms, which belong to 1% tails of outliers by share of labor in value added; (iii) trimming of 1% tails of outliers by the computed productivity and distortions. The results of the data cleaning process are presented in the Table 2.

Thus, after additional cleaning I obtain a dataset of 217,755 observations for 52,795 unique firms, which finally enter the analysis. It should be mentioned that application of the described procedures makes me lose 22.61-32.24% of the initial annual total value added, but this is the price of making the results stable to the outliers.

Table 2. Data cleaning steps

Step	# of trimmed values	Resulting # of values	Share of the initial annual VA,%
Initial raw dataset	-	234,444 for 56504 unique firms	100
Trim if share of labor exceeds unity	554	233,890 for 56,395 unique firms	93.50-96.51
Trim 1% tails of labor share distribution	5000	228,890 for 55,211 unique firms	88.23-92,60
Trim 1% tails of productivity and distortions	11,1350	217,755 for 52,795 unique firms	67,76-77,39

Table 3 presents the descriptive statistics of the key monetary variables. As we have data over 9 years, simple means over the whole periods are not representative. However, we can see than nominal values on average are adjusted by 1.81 in order to get the real data. Also, during 2002-2010, the average Ukrainian establishment hired 89 employees. Table 4 shows trends in inflation-adjusted data over 2002-2010, thus presenting statistics for previously deflated nominal values. During 2002-2010 real value added of manufacturing increases by 38.2% with average annual growth rate equal to 3.66%. However, in 2009 value added decreased by 17.51% comparatively to the previous year.

Speaking about total manufacturing production, I would like to mention that during 2002-2010 the real output increases by 21.39% with average annual growth rate of 2.18%. The crisis-driven drop in 2009 is estimated to be -29.62% within the analyzed sample. However, State Statistics Service of Ukraine reports a drop by 21.9%. This difference between the official statistics and computed one can be explained by the fact that during data cleaning I trimmed the most productive and the least distorted enterprises, thus, I expect that those establishments, which are less resistant to economy volatility, are left in the sample, so they declined in more by more extent that the whole manufacturing on average. Another important tendency is the shrink of typical manufacturing establishment during 2002-2010: average number of employees decreased from 116.2 to 71.5.

Table 3. Descriptive statistics of key monetary variables

Variable	N	Mean	S.D.
Turnover, real	217755	83705.45	1046853
Turnover, nominal	217755	155093.3	2395670
Value added, real	217755	38187.1	356991.1
Value added, nominal	217755	66333.65	913060.8
Fixed capital, real	217755	23054.06	296126.7
Fixed capital, nominal	217755	43282.53	614533.7
Wage bill, real	217755	7170.568	85883.24
Wage bill, nominal	217755	11673	143948.8
Material cost, real	217755	45518.35	742079.3
Material cost, nominal	217755	88759.69	1555305
Employment, # of employees	192721	89.16799	715.0362

Note: in hundred UAH, or other where specifies

Table 4. Inflation-adjusted data over 2002-2010

Year	Turnover	Value added	Fixed capital	Wage bill	Material cost	Employment, # of workers
2002	68554.9	30078.2	32176.1	5676.6	38476.7	116.2
2003	73335.1	32029	25417.5	5619.5	41306.1	-
2004	76473.6	35565.4	19968.2	6109.1	40908.1	89.81
2005	84826.7	37394	20522.6	7089.6	47432.6	91.16
2006	88294.8	39855.7	22873.3	8243.2	48439.1	92.88
2007	90435.2	42050.5	21056.3	8750.5	48384.7	87.17
2008	109344.6	46353.6	24148.2	9038.1	62990.9	91.08
2009	76948.8	38236.3	22261.2	6704.5	38712.6	74.88
2010	83222.6	41568.3	20223.2	7140.5	41654.2	71.47

Note: in hundred UAH, or other where specifies

Table 5 shows the tendencies of enter and exit of the Ukrainian manufacturing firms. Thus, one can see that during pre-crisis years a positive net enter is observed, whereas during 2008-2009, when the recession occurs, net enter becomes negative. This important conclusion I use in my further analysis of the resource misallocation influence on the total productivity.

Table 5. Firms' dynamics during 2002-2010

	Enter		Exit		Net enter	
Year	# of firms	Share, %	# of firms	Share, %	# of firms	Share, %
2002	n/a	n/a	2531	11.9	n/a	n/a
2003	7471	29.8	3488	13.9	3983	15.9
2004	4758	18.5	3408	13.3	1350	5.2
2005	3749	14.7	3746	14.6	3	0.1
2006	3943	15.7	3651	14.6	292	1.1
2007	2930	11.9	2038	8.25	892	3.65
2008	1891	7.73	2993	12.2	-1102	-4.47
2009	2016	8.63	4136	17.7	-2120	-9.07
2010	2464	10.9	n/a	n/a	n/a	n/a

Table 6 allows me to analyze the size structure of Ukrainian manufacturing enterprises. The conclusion, which I would like to make while analyzing this data, is the revealed fact that approximately 1% of the biggest enterprises (in terms of employment) produce approximately 40% of total manufacturing value added, whereas approximately 70% of the smallest establishments produce less than 10%. Thus, in Ukrainian manufacturing a strong misbalance is present, which imply a crucial role of the biggest producers, whereas the smallest establishments are limited in their development possibilities.

Table 6. Size structure of Ukrainian manufacturing establishments in selected years

		<10	10-19	20-49	50-99	100-249	250-499	500-999	>=1000
2002	Share in total number,%	27.81	20.95	20.14	9.72	10.03	4.33	2.16	1.79
	Share in value added,%	2.31	2.23	4.97	5.42	11.83	11.03	12.77	49.22
	Share in employment,%	1.12	2.46	5.55	5.97	13.59	13.07	12.76	45.24
2007	Share in total number,%	33.19	19.85	20.86	8.69	8.57	3.33	1.64	1.15
	Share in value added,%	1.24	2.46	5.82	6.44	15.32	13.52	14.13	40.85
	Share in employment,%	1.76	3.16	7.47	7.04	15.49	13.3	13.07	38.42
2010	Share in total number,%	41.47	18.05	17.39	8.21	7.31	2.81	1.33	0.94
	Share in value added,%	2.02	2.71	6.38	7.05	14.91	14.43	14.95	37.29
	Share in employment,%	2.44	3.48	7.55	8.03	15.87	13.66	12.77	35.88

Analysis of a geographical structure of manufacturing firms sample, which I perform using Figure 2, shows that most of manufacturing value added is produced in the north and east of the country. This result seems to be logic, as eastern regions are usually considered as industrial ones, whereas a big share of the northern regions is implied by the fact that Kyiv, where huge manufacturing facilities are situated, is included in this group.

Finally, additional calculations on industry structure of the analyzed plants, shows that, while computed as a share in total annual value added, the most sizeable industries are 15 – Manufacture of food products and beverages, 27 – Manufacture of basic metals, 29 – Manufacture of machinery and equipment n.e.c.

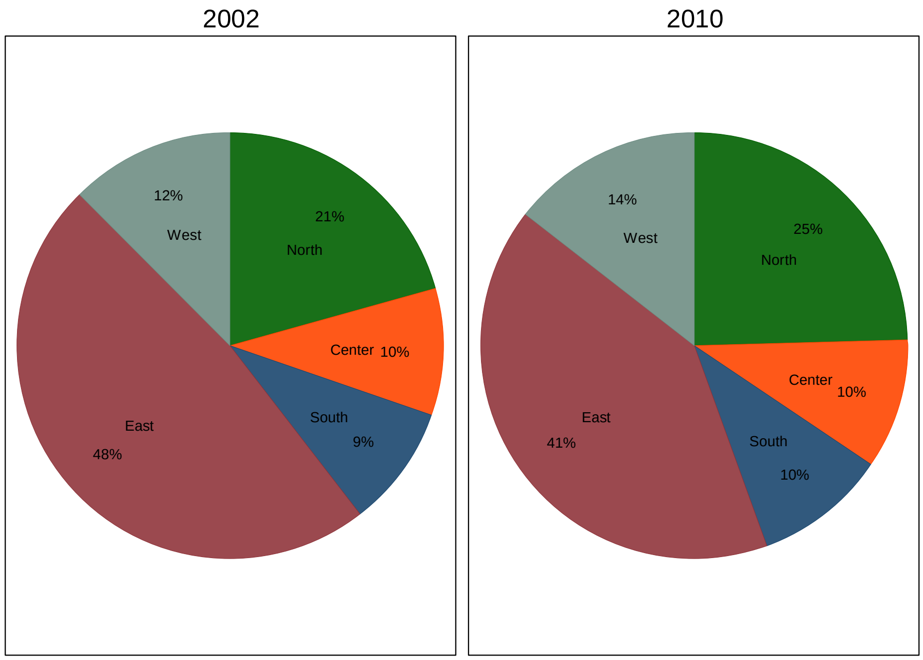

Figure 2. Geographical structure of the sample (shares of value added)

C h a p t e r 5

EMPIRICAL RESULTS

This section is organized as follows: at first, I describe the calibration of the specific non- or distortedly observable from the data variables; secondly, I present the results obtained from Hsieh and Klenow (2009) framework; thirdly, I perform the decomposition of obtained previously results; fourthly, I perform robustness checks; finally, I discuss the possible measurement error.

1. Calibration of parameters

The calibration section I would like to start with the discussion of the rental price of capital. In the original Hsieh and Klenow (2009) paper and in the following research, which is presented in Table 1 and discussed in literature review section, the rental price of capital is set at the level of 10%, or, R=0.10, which includes the real interest rate equals to 5% and depreciation of 5%. This value is set by default for all the analyzed countries, but I, in order to capture peculiarities of the Ukrainian economy more precisely, will use depreciation rate of 10%, which is approximately average depreciation rate for the Ukrainian economy if we analyze the Tax Code of Ukraine. On the other hand, if we consider the real interest rate in Ukraine, it is hardly to set it equal to 5%. Figure 3 shows that during 2002-2010 real interest rate in Ukraine varied from -8.63 to 19.24% with its mean equals to 1.72 and median of 0.74. Hence, I would like to use interest rate for this model equal to 1% as outlier of 19.24% in 2002 has a significant upward effect on the mean value, thus, I will use the approximation of the median value. In the end, including of all these assumptions gives me the calibrated value of the rental rate equal to 11%, or, R=0.11.

Speaking about the elasticity of substitution between plants value-added, in all research, which belong to the same stream of research where given thesis does, it is set to be equal to σ=3. The motivation is Hsieh and Klenow (2009) conclusion that the literature on this very issue provide the estimates ranging from 3 to 10, so 3 is assumed to be a conservative value for elasticity. As Hsieh and Klenow (2009) and all the following research use σ=3 for their basic estimations and σ=5 for robustness check, I intend to do the same in this thesis.

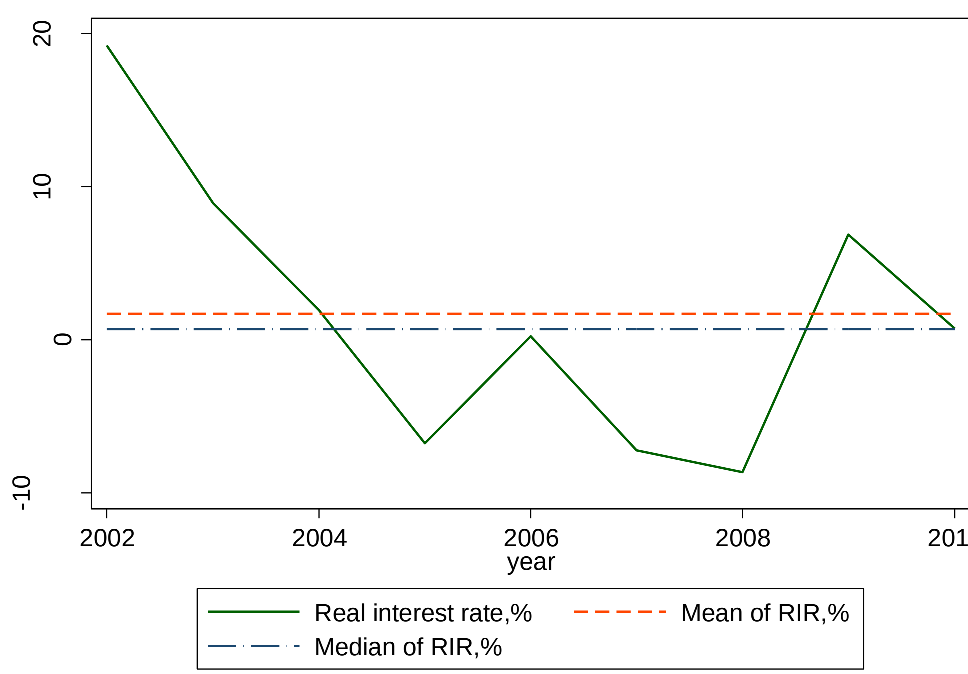

Figure 3. Real interest rate in Ukraine during 2002-2010[2]
Source: Index Mundi

[2] Index Mundi (http://www.indexmundi.com/facts/ukraine/real-interest-rate)

The elasticity of output with respect to capital (α_s) is equal to unity minus labor (wage bill) share in the corresponding industry's value added as it is defined in Hsieh and Klenow (2009). Within this framework, US shares are mainly used as it is assumed that US economy is less subject to different distortions. However, in this thesis I intend use shares computed for the Ukrainian data as I believe that US shares cannot appropriately reflect the structure and peculiarities of the Ukrainian economy. At the same time, using actual reported wage bills can distort our estimates of factor elasticity as quite high level of the shadow economy is reported for Ukraine, which implies underreporting of actually paid wage bills.[3] In order to deal with this potential problem, I estimate elasticity from the production function regression using the logarithms of the corresponding inflation-adjusted data. Thus, the model for shares estimation is fixed effect regression with included year effects:

$$\log(value\ added_{sti}) = \beta_0 + \beta_1 * \log(capital_{sti}) + \beta_2 * \log(employment_{sti}) + year\ effects + \varepsilon_{sti} \quad (14)$$

where *s* presents sector index, *t* indicates the year and *i* stands for a specific firm. Using fixed effects regression allows capturing firm-specific effects. Production function regression is run for each industry according to 4-digit ISIC classification separately. Resulting average share of labor while we compute elasticity as a simple share of wage bill in value added is 0.21, whereas regression evaluation gives 0.6. If we compare obtained average labor share with US shares presented in Camacho and Conover (2010), we can see that share of 0.6 for Ukraine is almost equal for average US share, which is equal to 0.61. Thus, I will use for analysis share of labor obtained as a coefficient from production function regression and a share of capital obtained as unity minus share of labor in the corresponding industry.

[3] Some Ukrainian language studies can be found using the following links: http://www.niss.gov.ua/content/articles/files/TEN.indd-532d7.pdf
http://www.ier.com.ua/files/publications/Policy_papers/German_advisory_group/2011/PP_04_2011_ukr.pdf

2. Potential gains of resource misallocation elimination

While the calibration of basic parameters is over, I would like to describe the obtained results of Hsieh and Klenow (2009) framework application for Ukraine.

The analysis starts with the consideration of product and revenue productivities. For each type of productivity I am interested in the relative to the mean distribution, so, at first, using (5) and (10), I compute $\log(\frac{TFPQ_{si} * M_s^{\frac{1}{\sigma-1}}}{A_s})$ and, using (6) and (8), I compute $\log(\frac{TFPR_{si}}{TFPR_s})$, and trim 1% tails of outliers in the obtained distributions. After this procedure completed, I recompute total industries' value added P_sY_s, industries' fixed capital stock K_s, industries' wage bill L_s, shares of industries in the total value added for each year θ_s, average industry revenue-based productivity $\overline{TFPR_s}$ and average industry output productivity $\overline{TFPQ_s}$. Finally, I obtain new values for TFPQ and TFPR distributions.

Figure 4 presents $\log(\frac{TFPQ_{si} * M_s^{\frac{1}{\sigma-1}}}{A_s})$ for selected years, while Figure B1 shows output distributions for all the years from the analyzed period. Distributions are weighted by the shares of industries in total manufacturing output.

One can notice that the distribution has the following properties: the whole distribution is skewed to the left relatively to zero and the left tail is thicker. If we consider descriptive statistics of TFPQ, which is presented in Table A1, during all the analyzed years mean actual TFPQ was higher than its median, which implies that most enterprises are significanltly less productive than the average productivity – calculations shows that approximately 84.3-88.2% of manufacturing establishments, which on average produce 30.5-34.6% of the industrial output, usually underperform the average value of TFPQ, which supports my above mentioned conclusion regarding Table 6, that industrial production in Ukraine is driven by a number of the biggest establishments, whereas the rest of small and medium ones significantly underperform.

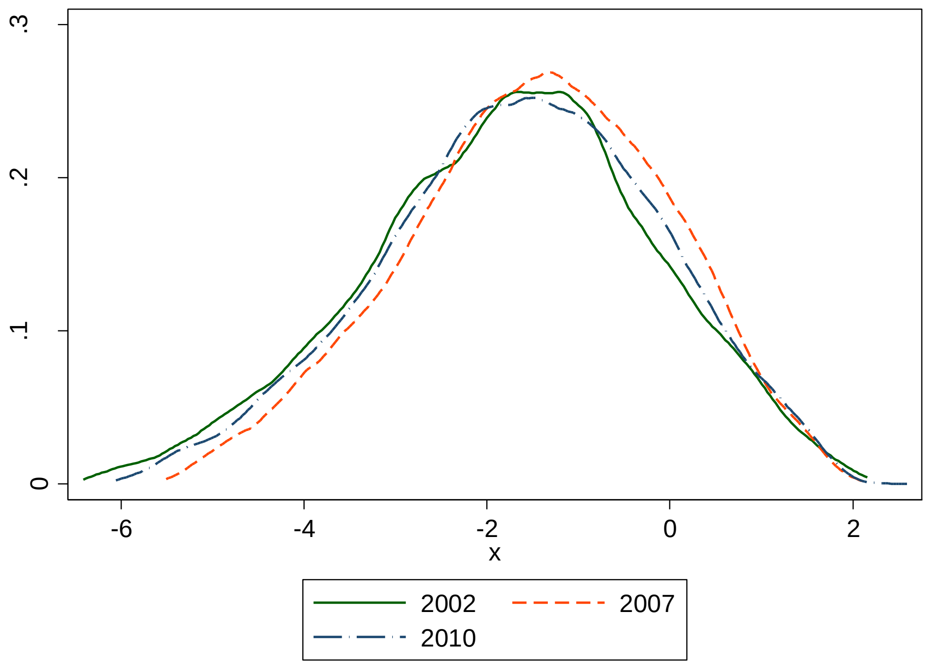

Figure 4. TFPQ distribution for selected years

Weighted least square regression of $\log(\frac{TFPQ_{si} * M_s^{\frac{1}{\sigma-1}}}{A_s})$ over ownership dummies (Table A2) indicates that the least productive units are pure private enterprises, which are less productive than governmnent enterprises by 32,3% and than mixed enterprises - by 47.9%, whereas , on average, private units underperform the average productivity by 85.4%. WLS of TFPQ distribution over size quartiles (Table A3, group variable is employment) indicates that the bottom quartile of establishments underperform the average productivity by 89.1%; moreover 2nd quartile is more productive by 39%, 3rd – by 112.8%, whereas the top size quartile is more productive by 300.2%. Thus, I would like to conclude the discussion of

TFPQ distribution by the fact that small private enterprises significantly underperform the average productivity as it is hard for them to compete by TFPQ with the biggest ones (regressing TFPQ on employment indicate a significant and positive conncetion among productivity and firm's size).

Speaking about the prevailing tendencies for the whole TFPQ distribution, Figure 2 and Figure B1 shows that till 2007, reflecting the results of market liberalization policies, distribution of productivities becomes less dispersed with median closer to 0, so less enterprises underperform the mean productivity, while after the beginning of the crisis the dispersion widen and the share of underperformers increses.

Additional results concerning TFPQ are presented in Table A4. Using fixed effects regressions of logTFPQ over ISIC-2 digit industries indiacators, I come to conclusion that, on average, the most productive industries in Ukraine are Manufacture of paper and paper products; Tearing and dressing of leather; Publishing, printing and reproduction of recorded media; Manufacture of wearing apparel and Manufacture of textiles. However, the least productive industries are Manufacture of fabricated metal products; Manufacture of basic metals and Manufacture of coke refined petroleum products and nuclear fuel.

Figure 5 presents $\log(\frac{TFPR_{si}}{TFPR_s})$ for selected years, while Figure B2 shows output distributions for all the years from analyzed period. Distributions are weighted by the shares of industries in total manufacturing output.

The properties of TFPR distribution includes variation around zero, thus, approximately half of the enterprises have close to the mean TFPR, and thicker right tail. As, according to the theoretical prediction of Hsieh and Klenow (2009), TFPR is directly proportional to the capital distortions and inversely proportional to the output distortions, this can imply that enterprises to the left of the mean face more output distortions, whereas those to the right – capital distortions. The tendency shows that before 2008 the dispersion decreases, which means that less enterprises become subject to distortions or the effect of the existed distortions becomes less. After the crisis begins, the dispersion starts to increase.

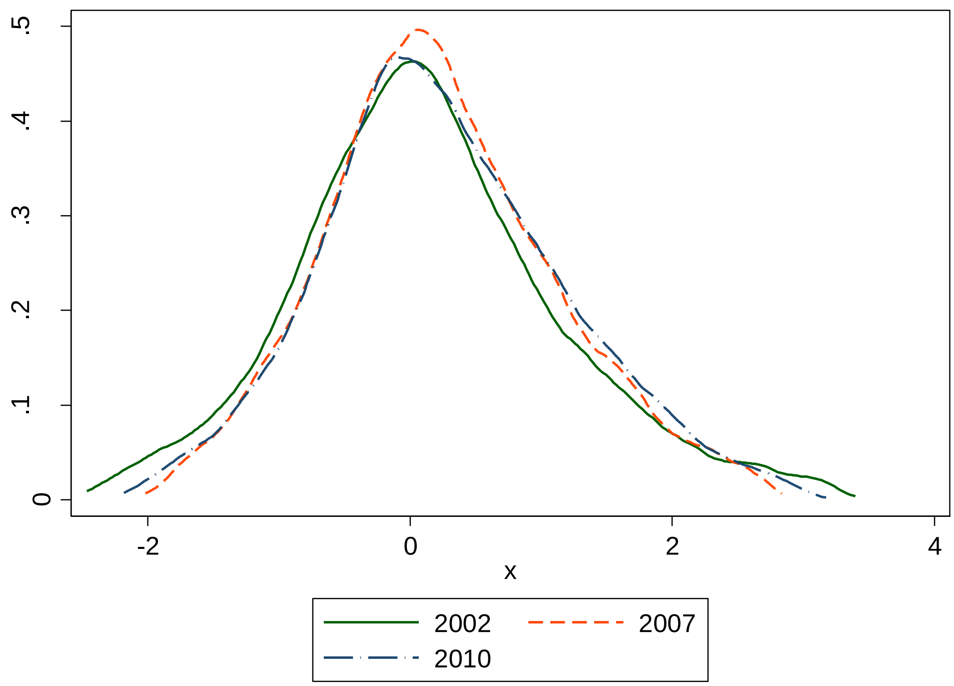

Figure 5. TFPR distribution for selected years

Table A2 shows that private enterprises on average have higher TFPR than the rest – TFPR of state-owned enterprises is lower by 53%, whereas mixed ownership imply 1.8% lower productivity. Speaking about size distribution, the smallest firms are associated with the highest TFPR (Table A3): 2nd quartile exhibits lower TFPR by -1.2%, 3rd – by -8.3%, top quartile – by -31.2%.

Table A4 also presents additional results for TFPR, but contrary to TFPQ, I run fixed effects regression of TFPQ variance on ISIC-2 digit industries indicators in order to see which industries are on average the most distorted. Thus, the most distorted industries are Manufacture of radio, television and communication equipment and apparatus; Manufacture of coke, refined petroleum products and nuclear fuel and Manufacture of office, accounting and computing machinery. On the other hand, the best performers in terms of being the less distorted are Manufacture of food products and beverages; Manufacture of rubber and plastics products and Manufacture of other non-metallic mineral products.

At this very point, I would like to consider the nature of relations between productivity and distortions in Ukraine. Figure B3 confirms predicted by the model nature of relationship between revenue-based productivity: capital distortions are positively correlated with TFPR, whereas output distortions has a negative effect on TFPR. Figure B4 demonstrates a positive relation between TFPQ and TFPR. In case of full liberalization, when TFPRs are totally equalized within industries, it is assumed that more productive establishments with higher TFPQ will be able to attract more resources, which implies higher output and, hence, ability to impose lower prices. However, positive regression coefficient shows that this ideal situation does not hold for Ukraine: as plants with higher TFPQ are usually subject to higher capital distortions and lower output distortions, a positive relation with TFPR holds.

Table 7 numerically shows how during the analyzed period dispersion of TFPQ and TFPR changes. We can see that during 2003-2007 a strong downward trend of resource misallocation elimination is observed, which can be seen from lowering of TFPR dispersion. Moreover, the dispersion of output productivity also shrinks, which implies that more establishments become less skewed to the left tail of the distribution. During the financial crisis, situation worsen, which can be seen from variation widening of both TFPQ and TFPR. Thus, more establishments become again significantly less productive than the average mean and more of them are subject to more severe distortions.

Table 7. Dispersion of TFPQ and TFPR in Ukrainian manufacturing

	2002	2003	2004	2005	2006	2007	2008	2009	2010
# of firms	20647	24245	24851	24752	24222	23879	23676	22615	21894
				TFPQ					
S.D.	1.57	1.63	1.55	1.45	1.44	1.43	1.46	1.55	1.52
75-10	2.11	2.27	2.18	2.03	2.05	2.02	2.05	2.14	2.10
90-10	4.12	4.31	4.11	3.82	3.81	3.81	3.84	4.09	4.00
				TFPR					
S.D.	1.01	1.02	0.97	0.90	0.88	0.88	0.90	0.95	0.94
75-10	1.24	1.29	1.23	1.14	1.13	1.15	1.18	1.23	1.22
90-10	2.54	2.65	2.51	2.29	2.27	2.31	2.34	2.47	2.43

Note: distributions are weighted by the industry shares

If we compare the obtained results with those, which was computed by Hsieh and Klenow (2009) for the US economy as a benchmark, we can see the following situation. I would like to stick to 2005 year as a last year of Hsieh and Klenow analysis; moreover, this year is also included in the analysis in my thesis. So, in 2005 standard deviation of TFPQ is 0.84, which is approximately twice less than in Ukraine in 2007, the most successful year for Ukraine in terms of productivity variation shrink. US distribution is also skewed to the left relatively to the mean with bigger left tail, but less dispersion tells that the amount of support to the lest productive or depressing of some establishments' activities is significantly lower than it is in Ukraine, so most of enterprises are relatively equally productive. Speaking about TFPR, US dispersion of revenue productivity is 0.49, which is much less than the best result for Ukraine (0.88 in 2006-2007). Thus, resource misallocation has a much huge nature in Ukraine than in USA. However, due to a positive correlation of product and revenue productivity, higher TFPQ dispersion imply higher TFPR dispersion, so the productivity structure of the economy is also partially responsible for higher TFPR variance in Ukraine than in US.

Finally, for this part, I would like to consider potential gains for Ukrainian manufacture in case of resource misallocation elimination. Table 8 shows that potential gains of full liberalization are expected to be at the level of 97.1-135.2%. However, while we apply distribution of the benchmark economy (I apply the conservative value of US gains from Hsieh and Klenow, 2009, which is equal to 1.47, or 47%), the potential gains are 34.1-60.0%, which satisfies my initial hypothesis of 30-60% of gains.

Table 8. Potential gains of resource misallocation elimination

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gains of full liberalization,%	133.8	126.7	122.1	97.1	97.1	96.9	110.0	135.2	122.9
Gains of benchmark distribution,%	59.0	54.3	51.1	34.1	34.1	33.9	42.8	60.0	51.6

During the period of 2002-2010 potential gains decrease from 133.8 to 122.9%, so allocative efficiency improves by 4.8% (2.338/2.229) with average annual improvement by 0.53%. However, the analyzed period can be divided by two parts: in 2002-2007 allocative efficiency improved by 18.75% (2.338/1.969), but because of recession it worsened by 11.67%. Aggregate manufacturing TFP at the same period increased by 71.78% with average annual growth by 6.2%. Thus, better allocation of resources is responsible for 8.55% of aggregate manufacturing TFP growth (0.53/6.2).

Here I would like to recall the conclusion from the discussion of Table 5. While we combine conclusions about enter-exit, extent of resource misallocation and gains of liberalization, the following conclusion can be made: positive net enter signals about positive selection on productivity as new more productive firms enter, whereas the existing ones are enough productive not to exit the industry, thus, the total productivity increase and dispersion shrinks, which result in lower

TFPR variation and lower potential gains. This result support conclusions of Hopenhayn and Rogerson (1993), Hopenhayn (1992), Melitz (2003).

Figure B5 shows how the probability of exit is associated with different productivity measures and how this relation changes over time. Thus, the general conclusion is that lower TFPQ is associated with a higher probability of exit – 1-log-point decrease in TFPQ leads to 6.1% higher probability of exit in 2007 (probability declines from 7.7% in 2003 to 6.1% in 2007 with further increase to 8.4% in 2009); however, results shows that firms with higher TFPR are more disposable to exit (in 2003 1-log-point increase in TFPR leads to 9.7% higher probability of exit, in 2007 this probability drops to 7.1%, but till 2009 it increases to 11.5%). However, during the years with favorable conditions this connection weaken: the cutoff TFPQ drops, so less firms exit, however, those, which exit, are more profitable. Thus, I can conclude that a number of firms are significantly subsidized in order to left them in the market, even if they exhibit low profitability. Table A5 shows that exit is usually associated with the lower output productivity by -42.1%; however, there is no exact relation between exit and TFPR observed. Speaking about enter, on average firms with higher both TFPQ and TFPR enter manufacture as we predicted before.

As actual size distribution of enterprises cannot produce the optimal output, I would like to compute the efficient one and to compare both of them.

Following Camacho and Conover (2010), the actual production is computed as

$$Y_{si} = (P_{si} Y_{si})^{\frac{\sigma}{\sigma-1}}, \tag{20}$$

whereas the effective firms' output is defined as

$$Y_{si,eff} = \frac{\overline{A_s}}{M_s^{\frac{\sigma}{\sigma-1}}} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \tag{21}$$

Figure 6 shows that efficient distribution is less dispersed than the actual one and less skewed to the left from the mean manufacturing value added (mean value is also higher). While analyzing both of these distributions, I can make a conclusion that, in order to come closer to the optimal production, establishments with the lowest value added should significantly increase their production and generate higher value added. However, some of the biggest enterprises are already even overperform the efficient output, thus, these establishments can be scaled down in order to make available more resources to the smallest firms.

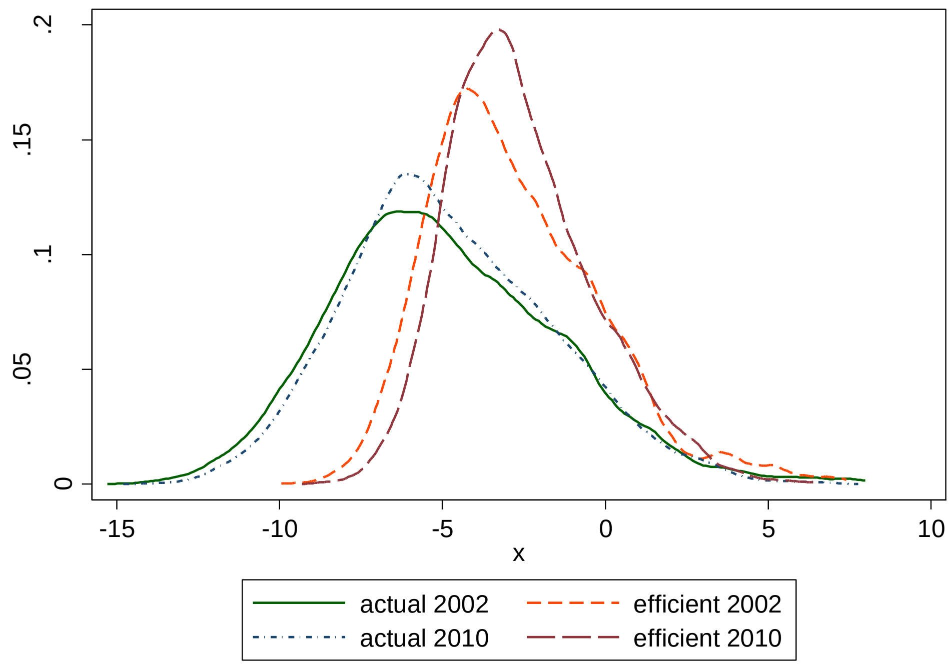

Figure 6. Actual vs. Efficient size distribution of plants

Table 9 shows that most of the Ukrainian manufacturing establishments underperform the optimal level of production by more than twice; moreover, the less the enterprise, the more widespread underperformance is. While we consider underperformance by less than twice, the least value added generating firms here are the most numerous. The opposite tendency holds for overperformance –

usually the firms with the highest value added firms overperform the efficient level of production. In general, 87.14% of firms underperform the efficient level of production, whereas 12.86% overperforms it. Comparing this distribution with the results of Hsieh and Klenow (2009) for US economy, which is considered as a benchmark within this framework, shows that in less distorted economy shares quartiles should be approximately equal within four groups of performance results. Moreover, total number of under- and overperformers should approximately equalize. This means that the whole distribution of Ukrainian firms' production should be moved to the right with more emphasis on the smallest establishments.

Table 9. Actual vs. Efficient size: share of different levels of deviations (value added quartiles)

2002	0-50	50-100	100-200	>200
Bottom quartile	24.75	0.23	0.02	0.00
2nd quartile	22.82	1.55	0.54	0.09
3rd quartile	17.57	4.15	2.20	1.08
Top quartile	10.43	5.64	4.60	4.33
# of firms	15603	2388	1520	1136
2010	0-50	50-100	100-200	>200
Bottom quartile	24.71	0.25	0.05	0.005
2nd quartile	22.60	1.80	0.51	0.08
3rd quartile	17.18	4.40	2.34	1.08
Top quartile	8.54	6.49	5.35	4.62
# of firms	15988	2833	1806	1267

Considering employment as a measure of firms' size in Table 10 shows that the smallest enterprises usually significantly underperforms the efficient level, whereas the biggest ones overperform by more than 2 times. However, the shares of under and overperformers are approximately equal. Thus, again I conclude that the smallest enterprises should be stimulated in order to increase their production.

Table 10. Actual vs. Efficient size: share of different levels of deviations (employment quartiles)

2002	0-50	50-100	100-200	>200
Bottom quartile	15.51	6.73	2.55	0.23
2nd quartile	7.16	9.34	7.06	1.44
3rd quartile	3.77	5.43	10.37	5.42
Top quartile	1.00	1.28	4.90	17.82
# of firms	5664	4703	5136	5144
2010	**0-50**	**50-100**	**100-200**	**>200**
Bottom quartile	17.41	6.18	1.36	0.05
2nd quartile	7.45	9.65	7.25	0.64
3rd quartile	2.74	6.18	10.96	5.12
Top quartile	0.26	1.08	4.89	18.78
# of firms	6098	5056	5355	5385

3. Decomposition of potential gains

This section presents the decomposition analysis of the obtained in previous part gains and distortions.

Figure 7 shows decomposition of the total distortion, which is the potential gain in our notation, according to expression (15). Using the figure, it is easy to see that the main source of total distortion is TFPR variation, which determines the its level and development over time. Capital distortion has comparatively small and constant effect on potential gains; however, during 2008-2010 the impact of these distortions increases, which can be explained by crisis-driven limited access to the credit.

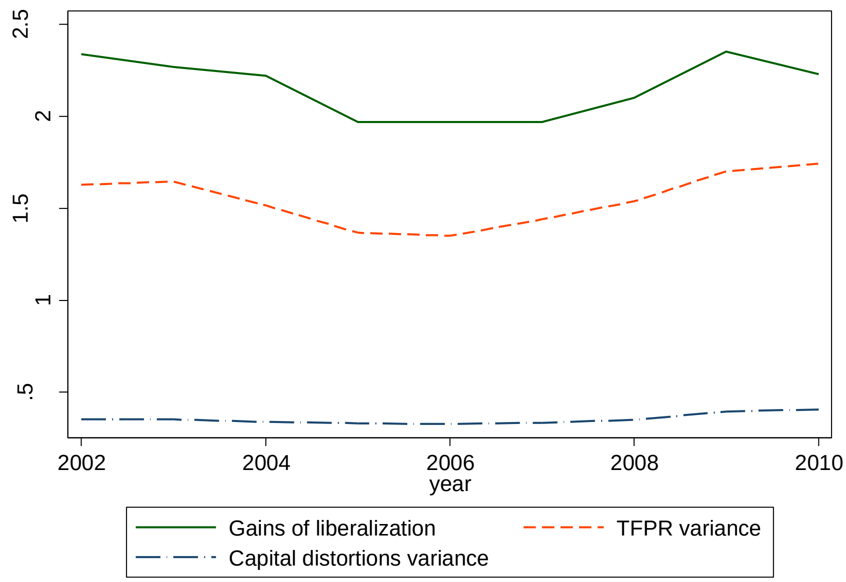

Figure 7. Decomposition of total distortion by components

While TFPR has the key role in total distortion, I would like to perform further decomposition of this variable. The next decomposition is done according to (16) and depicted in Figure 8. The main source of TFPR variation, thus, is output distortions, which determines the dynamics of TFPR. However, as in case with total distortion, capital distortions has a positive and stable influence on TFPR with a slight increase of its impact in 2008-2010. Thus, shrink of output distortions during 2003-2007 is mainly responsible for TFPR variance decrease, which implies lower resource misallocation, whereas the increase of resource misallocation in 2008-2010 is caused not only because of output distortions variance increase, but also because of the variance of capital distortions also increase. Figure 8 also shows that during 2008-2010, when both types of distortions has impact on the resource allocation, the covariance of distortions increase, which implies synergetic effect on TFPR.

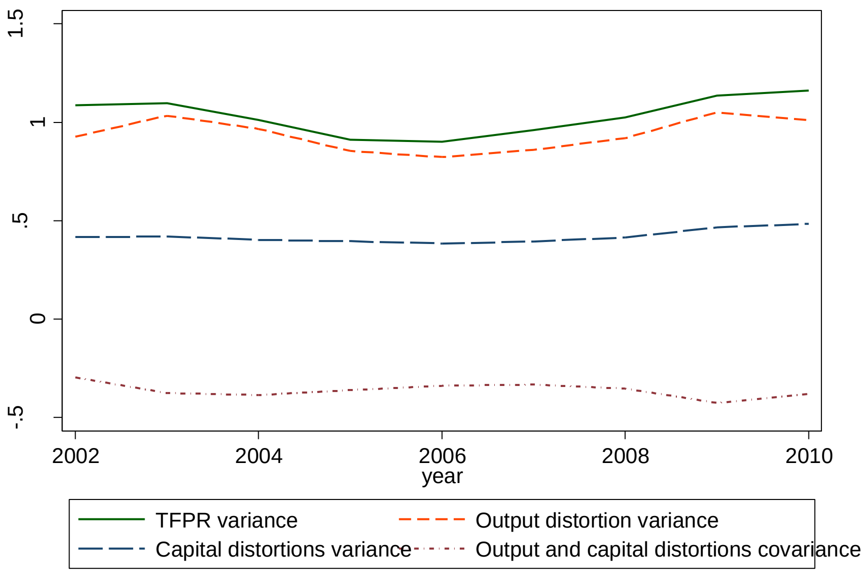

Figure 8. Decomposition of TFPR variance by components

Figure 9 follows (17) by decomposing TFPR variance by between- and within group components. One can see that the main source of TFPR variance in this framework is between-group component, which implies that different level of distortions across productivity quintiles plays a crucial role in the total effect of resource misallocation. However, within-group components has quite high impact and slightly approximate thy dynamics of TFPR, thus, I would like to conclude that idiosyncratic factors, which are captured by within-group component also influence the allocation of resources in Ukrainian manufacture. Using (18), I obtain that in 2002-2010, when the variance of TFPR increases by 6.99%, between-group component is responsible for 128.67% of its dynamics. However, this result seems to be distorted, as during 2008-2009 a huge volatility of idiosyncratic shocks emerges, thus I apply (18) for the period of 2003-2007, when a strong trend of distortions lowering is observed, which gives me a contribution of between-group component to total TFPR variance decrease by 72.94%.

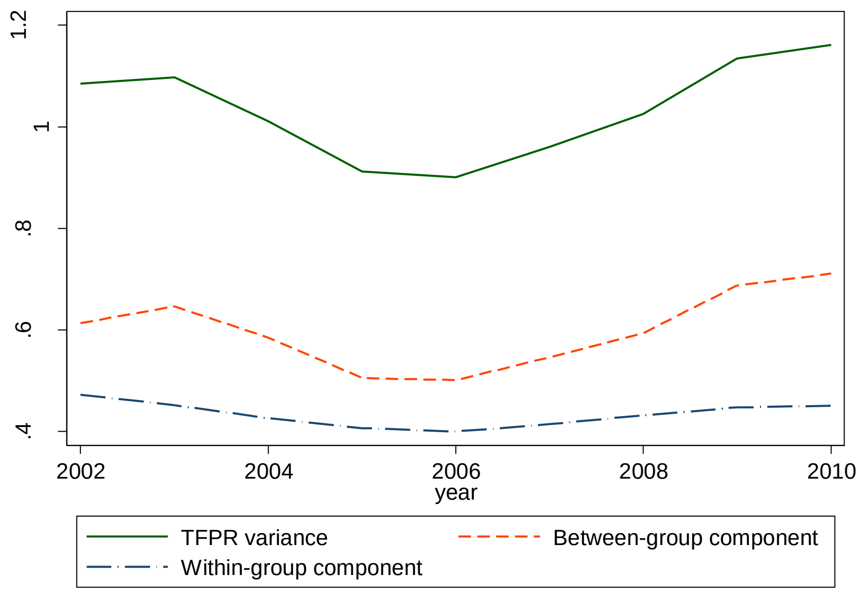

Figure 9. Decomposition of TFPR variance by between- and within-group components

Figure 10 presents further decomposition of the between-group component in order to study the effect across different quintiles of productivity. Results shows that the most significant reallocations are observed for the most and the least productive enterprises. Moreover convergence/divergence within the least productive establishments are responsible for 34.5% of between-group component variance, whereas the contribution of the most productive firms is estimated as the level of 30.1%. Such results makes me to conclude, that shrink or widen of between-group component dispersion, which in the following influence TFPR dispersion, is mainly driven by convergence or divergence of TFPR within top and bottom productivity quartiles. Thus, combining this conclusion and above mentioned result of positive correlation between TFPQ and TFPR, I can make the same conclusion as Chen and Irarrazabal (2013), that within these groups, while converging to the mean, TFPR of the most productive establishments decrease, whereas TFPR of the least productive within quartile firms increase, implying TFPR variance decline.

The same analysis is performed for output and capital distortions. Figure B6 and B7 shows that between-group component is crucial for output distortions variation – it is responsible for 80.2% of output distortions dynamics. The influence of top and bottom groups is even stronger in this case, but, comparatively to TFPR, convergence within the least productive quintile plays more significant role (47.2% of distortion dynamics) that the convergence within the most productive quintile (40.5%).

Figure B8 and B9 shows decomposition of the capital distortion. Between-group component plays here the most crucial role: while I compute for 2003-2007, it is responsible for 96.4% of capital distortion variance decrease in the corresponding period. The effect of reallocations is the most significant for the top quintile, whereas for bottom quintile it is still high, but the contribution to the variance is lower. Thus, reallocations within top productivity group contributes 59.6% of capital distortion variance change, whereas bottom productivity group contributes 32.0%

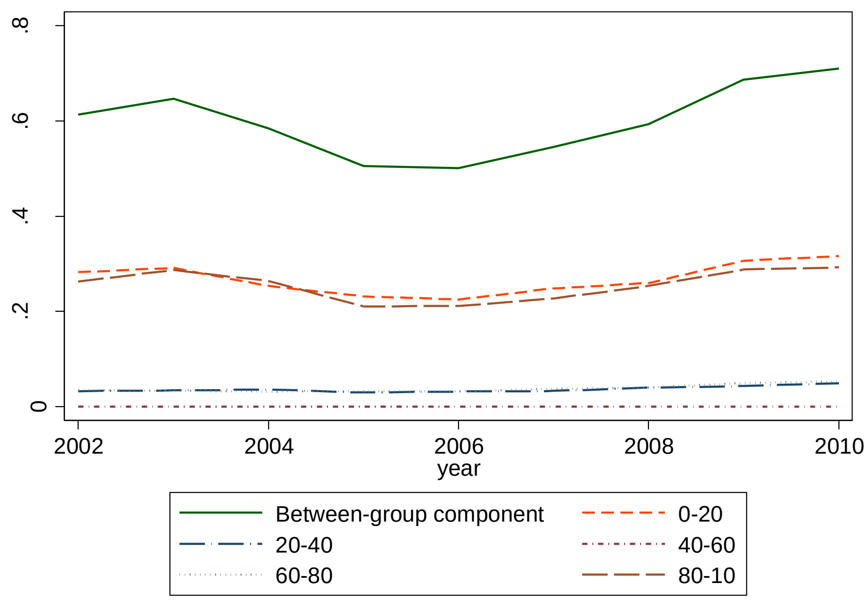

Figure 10. Decomposition of between-group component by quintiles

4. Robustness check

For robustness check of the obtained results, at first, I would like to perform potential gains computations using the nominal data. As original results are obtained using the real data, we I can check whether inflation adjustment plays a crucial role for potential gains computations, as nominal value can contain year-specific effects, which distort the basic results.

Table 11. Robustness check using real and nominal data

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gains using real data,%	133.8	126.7	122.1	97.1	97.1	96.9	110.0	135.2	122.9
Gains using nominal data,%	133.8	121.9	127.7	90.6	87.2	86.8	92.7	126.6	117.7

Recomputing gains of full liberalization, I obtain results, which shows the same trends as the basic estimations. However, potential bias is -5.6-17.3, so it is possible that these difference capture the price changes. Figure B10 shows that this can be a reasonable conclusion as differences in estimations to some extent correlate with price indeces.

Additionally, to perform the robustness check by changing the value of elasticity of substitution between plants' value added and change the composition of the panel – I would like to restrict the panel to be balanced.

Table 12 shows that the results are increasing with respect to the value of elasticity. Hsieh and Klenow (2009) explain this property of their model by slower reallocations among firms with different productivities, so in this case gains are higher. As I initially take the conservative value for elasticity, and use this value for their basic results, I would like to stick to this very variable in order to make Ukrainian results comparable with the US ones. On the other hand, balancing a panel significantly reduce the gains, as I believe that only the most productive firms are able to survive during the whole period, so these results presents total distortion only for the sample of the most well-performing firms, thus underestimating the gains for the whole manufacture.

Table 12. Robustness check by balancing the panel or changing elasticity

Year	Baseline results (unbalanced panel, sigma=3)	Balanced panel, sigma = 3	Unbalanced panel, sugma = 5
2002	133.8	53.61002	281.2213
2003	126.7	57.17603	288.0335
2004	122.1	44.86009	229.3441
2005	97.1	41.35795	194.1549
2006	97.1	40.25447	210.105
2007	96.9	39.01684	188.0134
2008	110.0	41.21706	216.6208
2009	135.2	49.59391	256.0018
2010	122.9	53.39671	260.5657

C h a p t e r 6

DISCUSSION AND POLICY IMPLICATIONS

I would like to start this chapter by a brief discussion of the key empirical findings, which can be useful for policy implications. So, the whole manufacture dynamics is mainly driven by a little number of the biggest enterprises, whereas the share of the smallest ones is negligible. I also conclude that small enterprises usually underperform their potential level of production, whereas the biggest ones tend to overperform it. Such imbalances cause a significant left-sided shift of the output productivity relatively to the mean, which imply that most of manufacturing enterprises are less productive that the average for the industry level. Moreover, the least enterprises are the least productive, but has the highest TFPR. The same tendency for correlations with productivity also holds for ownership, thus, small private enterprises can be considered as the least productive in the manufacture and the most distorted ones, so liberalization policy should be targeted mainly on this group. Results also shows that the least productive enterprises are mainly subject to output distortions and the most productive ones are mainly subject to capital distortions, so liberalization policy should be more targeted at these specific distortion-productivity clusters in order to get faster and more substantial feedback.

Analyzing literature on policy effects on productivity of different policy tools, allows me to highlight the following main patterns in the potential manufacture liberalization toolkit.

I would like to start with trade policy liberalization. A number of studies indicate that tariffs reduction of external trade penetration increase has a positive impact on the overall productivity (Amiti and Konings, 2010; Melitz, 2003; Melitz and Ottawiano, 2008; Gustafsson and Segerstrom, 2010; Fernandes 2007; Bond, Crucini. Potter, and Rodrigue, 2012; Topalova and Khandelwal, 2011). Moreover, one of the recent studies on Ukraine, which is Kravchuk (2012), provides the result of productivity dispersion shrunk by 1-5% during 2001-2009, which is caused by external tariff reductions. Additionally, results in Table A7 shows that sectors with higher share of exporters are more distorted, so more resource misallocation is present among them; however, I obtain the result that for importers the pattern is opposite: the more there are importers in the industry, the less distorted it is. Also on average both exporters and importers are expected to be more productive and less distorted. This findings allow me to conclude that it order to eliminate a part of resource misallocation it is a good idea to continue external trade liberalization by further both output and input tariffs cuts, lowering the level of non-tariff barriers and easing market access.

Additional source of resource misallocation elimination is services liberalization. Thus, Arnold, Javorcik and Mattoo (2011), and Shepotylo and Vakhitov (2012a) provide an evidence that liberalization of services, which are intensively used by manufacture, allows to improve the situation. For example, Shepotylo and Vakhitov (2012a) estimate that liberalization of services in Ukraine during 2001-2007 boosted the manufacture productivity by 5.5-9%. The process of liberalization can include free entry of foreign services companies and liberalization of FDI, which mainly invested in services.

Another important direction of manufacture liberalization is elimination of capital distortions, which mainly takes the form of restrictions on bank loans. Moll (2012), and Midrygany, Yi Xuz (2012) shows that financial frictions lead to capital misallocation, which lowers TFP and add to the total level of resource misallocation.

Guner, Ventura, and Xu, (2008) shows that size restrictions lower TFP, so, as we have a situation of prevailing number of small enterprises, no policy actions should be taken in order to limit some of them. Our estimations shows that, vice versa, small enterprises should be provided with all necessary conditions in order to boost their level of production.

Eslava, Haltiwanger, Kugler and Kugler (2005) highlight the role of factor market liberalization, so both financial and labor markets should be liberalized in order to boost manufacturing productivity. As I have already considered financial market, I would like to add regarding the labor market, that it should become more flexible with more employees rights and stronger contract enforcement.

To my opinion, procedures of enter and exit should be eased. As I discovered that the period of net enter in my sample corresponds to better resource allocation, eased asses to market enter can bring additional productivity to the aggregate manufacture. On the other hand, easier procedures of exit will not left the least successive establishments at the market, so aggregate productivity will also increase.

Input-output structure of economy, which can amplify basic results of resource misallocation extent, should be also taken into account, as improvements in specific sectors will contribute to the overall improvement, so liberalization can be started from few industries with further expansion.

Finally, Table A6 shows that lower market concentration is directly connected with the extent of resource misallocation, so precise competition policy can have a positive influence on allocation of resources improvement. However, increase of Hirschman-Herfindahl index by 1 standard deviation increase variance of TFPR by 0.007, which on average widen if by 0.8%. However, as the connection does not seem economically significant, it still exists.

To conclude this chapter, I would like to recall in glance possible policy measures: external trade liberalization, services liberalization, financial frictions elimination, labor market flexibility, precise competitive policy, easier enter and exit, and absence of size restrictions, domestic markets liberalization, which due to input-output structure of the economy will facilitate the whole scope of improvement Subsidies to favorable firms elimination should be also included in this list as they leave the least productive firms at the market decreasing the aggregate manufacture productivity.

C h a p t e r   7

CONCLUSIONS

This paper investigates the impact of resource misallocation on manufacturing productivity in Ukraine during 2002-2010. The study is based on the data containing information from balances and financial statements for 52,795 unique firms, which enter the final cleaned dataset. In order to perform the analysis, I apply a model of monopolistic competition with heterogeneous firms developed by Hsieh and Klenow (2009) and decompose the obtained gains from liberalization.

Empirical results show a presence of significant resource misallocation in Ukraine as variation of TFPR, which is the main indicator of allocation non-optimality, noticeably exceeds the one of the benchmark economy. Due to positive correlation between TFPQ and TFPR, higher variation of revenue productivity can be explained by wider distribution of output productivity; moreover, TFPQ productivity is shifted to the left relative to 0, which indicates that more than 84% of firms underperform the average industry productivity, supporting the previously made conclusion that more than 40% of manufacturing output within the sample is produced by 1% of the biggest firms. Also, higher TFPQ corresponds to state-owned and mixed enterprises, on the one hand, and to the bigger ones, on the other hand. For private and small establishments the tendency is the opposite – they are expected to be less productive and have higher revenue productivity. Dynamics of the variances of TFPQ and TFPR indicates that during 2002-2007 a significant improvement is observed, which corresponds also to the period of huge firms' net enter. However, during the crisis years the situation worsened.

In case of full liberalization, when all output and capital distortions are eliminated, potential gains in terms of TFP growth are expected to be equal 97.1-135.2%. At the same time, while comparing to the benchmark economy, US distribution of TFPR allows Ukraine to have potential gains equal to 34.1-60%. Efficient size distribution, which allows producing optimal output is shifted to the right comparatively to the actual one and has less dispersion. This imply that most Ukrainian manufacturing establishments underperform the optimal level of production by more than twice with the higher level of underproduction among the smallest firms.

Decomposition of obtained results shows that the total distortion is mainly driven by TFPR variation. At the same time, the dynamics of TFPR variation is determined mainly by output distortions with quite high and stable influence of capital distortions. Reallocations, which occur within productivity clusters mainly occur among the least and the most productive establishments. Moreover, as decomposition of distortions show, the least productive establishments are mainly subject to output distortions, whereas the most productive ones – subject to capital distortions.

The proposed set of policy tools, which can potentially decrease the level of resource misallocation, include external trade liberalization, services liberalization, financial frictions elimination, labor market flexibility, precise competitive policy, easier enter and exit, absence of size restrictions, domestic markets liberalization, subsidies to favorable firms elimination

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APPENDIX A: Tables

Table A1. Descriptive statistics for TFPQ distribution

	TFPQ		A_s/adj		log(TFPQsi*adj/As)	
Year	Mean	Median	Mean	Median	Mean	Median
2002	572.8	163.8	1169.1	985.9	-1.8	-1.7
2003	665.1	170.8	1446.6	1216.7	-1.9	-1.9
2004	814.3	220.1	1675.3	1261.2	-1.8	-1.8
2005	742.0	233.3	1407.0	1187.5	-1.6	-1.6
2006	776.8	251.3	1395.6	1156.5	-1.5	-1.4
2007	900.7	300.3	1597.0	1502.1	-1.5	-1.4
2008	1021.3	317.8	1869.5	1872.6	-1.5	-1.5
2009	1016.6	286.7	1949.1	1831.5	-1.7	-1.6
2010	1164.7	338.8	2199.5	2192.7	-1.7	-1.6

Table A2. Regressions of productivity on ownership dummies

	TFPQ	TFPR
State-owned	0.280***	-0.759***
	(0.097)	(0.063)
Mixed	0.304***	-0.168***
	(0.029)	(0.019)
Intercept	-1.928***	0.473***
	(0.026)	(0.017)
N	16052	16052
R^2	0.007	0.011

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

Note: dependent variables are logs of TFPQ and TFPR relative to the industry mean. Regressions are weighted least squares with industry shares in total value added as weights. Omitted group is private

Table A3. Regressions of productivity on size dummies

	TFPQ	TFPR
2nd quartlile	0.329***	-0.012*
	(0.010)	(0.007)
3rd quartile	0.755***	-0.087***
	(0.010)	(0.007)
Top quartile	1.387***	-0.374***
	(0.010)	(0.007)
Intercept	-2.214***	0.400***
	(0.006)	(0.004)
N	151346	151346
R^2	0.124	0.022

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

Note: dependent variables are logs of TFPQ and TFPR relative to the industry mean. Regressions are weighted least squares with industry shares in total value added as weights. Omitted group is the bottom employment quartile. Data are pooled for all years

Table A4. Fixed effects regressions of TFPQ and the variance of TFPR on ISIC-2 digit industries

Industry	logTFPQ	varTFPR
Manufacture of textiles	0.201***	0.251***
	(0.071)	(0.009)
Manufacture of wearing apparel; dressing and dyeing of fur	0.234***	0.147***
	(0.069)	(0.009)
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.544***	0.054***
	(0.098)	(0.013)
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-0.252***	0.041***
	(0.056)	(0.007)
Manufacture of paper and paper products	0.573***	0.028***
	(0.076)	(0.010)
Publishing, printing and reproduction of recorded media	0.366***	0.144***
	(0.070)	(0.009)
Manufacture of coke, refined petroleum products and nuclear fuel	-1.170***	0.405***
	(0.160)	(0.021)
Manufacture of chemicals and chemical products	-0.416***	0.146***
	(0.060)	(0.008)
Manufacture of rubber and plastics products	0.108*	-0.014**
	(0.055)	(0.007)
Manufacture of other non-metallic mineral products	-0.511***	-0.032***
	(0.059)	(0.008)
Manufacture of basic metals	-0.868***	0.358***
	(0.065)	(0.008)

Table A4 (continued). Fixed effects regressions of TFPQ and the variance of TFPR on ISIC-2 digit industries

Industry	logTFPQ	varTFPR
Manufacture of fabricated metal products, except machinery and equipment	-0.789***	0.122***
	(0.052)	(0.007)
Manufacture of machinery and equipment n.e.c.	0.109**	0.253***
	(0.053)	(0.007)
Manufacture of office, accounting and computing machinery	0.153*	0.363***
	(0.090)	(0.012)
Manufacture of electrical machinery and apparatus n.e.c.	0.124**	0.259***
	(0.059)	(0.008)
Manufacture of radio, television and communication equipment and apparatus	-0.144*	0.544***
	(0.075)	(0.010)
Manufacture of medical, precision and optical instruments, watches and clocks	0.106	0.189***
	(0.065)	(0.008)
Manufacture of motor vehicles, trailers and semi-trailers	0.102	0.065***
	(0.082)	(0.011)
Manufacture of other transport equipment	0.197**	0.199***
	(0.086)	(0.011)
Manufacture of furniture; manufacturing n.e.c.	-0.453***	0.049***
	(0.057)	(0.007)
Recycling	-0.101	0.302***
	(0.074)	(0.010)
Intercept	5.484***	0.850***
	(0.041)	(0.005)
N	210781	210781
R^2	0.025	0.458

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Note: Omitted group is Manufacture of food products and beverages. Intercept term shows the average value of dependent value for the control group. Year effects are included. Regression are fixed effects regressions

Table A5. Regressions of productivity on exit and enter dummies

	TFPQ	TFPR
exit	-0.547***	0.003
	(0.012)	(0.008)
enter	0.136***	0.360***
	(0.011)	(0.007)
Intercept	-1.646***	0.252***
	(0.004)	(0.003)
N	151346	151346
R^2	0.014	0.016

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

Note: dependent variables are logs of TFPQ and TFPR relative to the industry mean. Regressions are weighted least squares with industry shares in total value added as weights. Independent variables are dummies of enter and exit. Data are pooled for all years.

Table A6. Regressions of TFPR variance on Standardized Hirschman-Herfindahl index

	(1) Var(TFPR)
Standardized Hirschman-Herfindahl index	0.007***
	(0.000)
_cons	0.875***
	(0.000)
N	151346
R^2	0.002

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

Note: dependent variable is variance of log TFPR. Regressions are weighted least squares with industry shares in total value added as weights. Independent variable is standardized value of Hirschman-Herfindahl index. Data are pooled for all years.

Table A7. Regressions of TFPQ and TFPR on export and import status

	(1) Var(TFPR)	(2) TFPQ	(3) TFPR
Exporters share,%	0.061***		
	(0.008)		
Importers share, %	-0.207***		
	(0.006)		
Exporter (1 if yes)		0.152***	-0.441***
		(0.017)	(0.013)
Importer (1 if yes)		0.658***	-0.040***
		(0.016)	(0.012)
Intercept	0.967***	-1.297***	0.695***
	(0.009)	(0.021)	(0.016)
N	32704	32704	32704
R^2	0.043	0.053	0.038

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

Note: dependent variable in the 1st regression is variance of TFPR, which is regressed on exporters and importers shares in the corresponding industry; dependent variables in the 2nd and the 3rd regressions are log of TFPQ and TFPR relative to the industry mean, which are regressed on export and import dummies Regressions are weighted least squares with industry shares in total value added as weights. Data are pooled for all years.

APPENDIX B: Figures

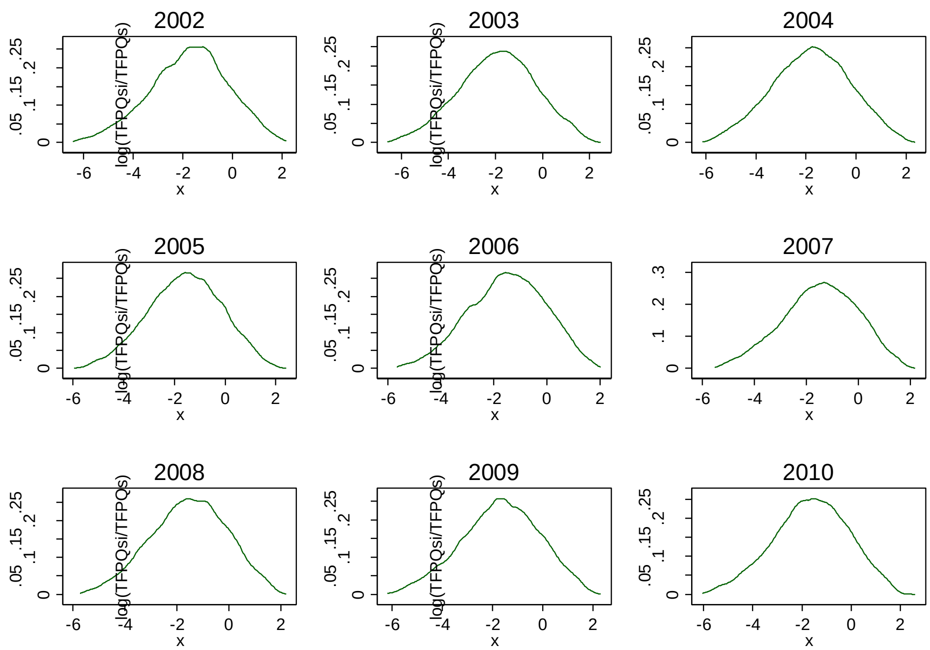

Figure B1. TFPQ distributions during 2002-2010

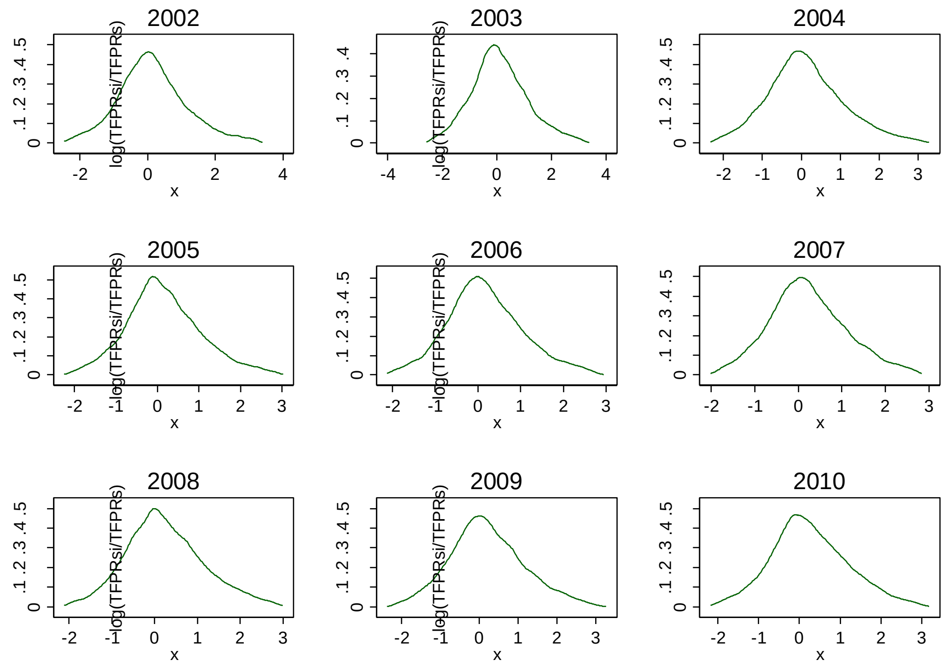

Figure B2. TFPR distributions during 2002-2010

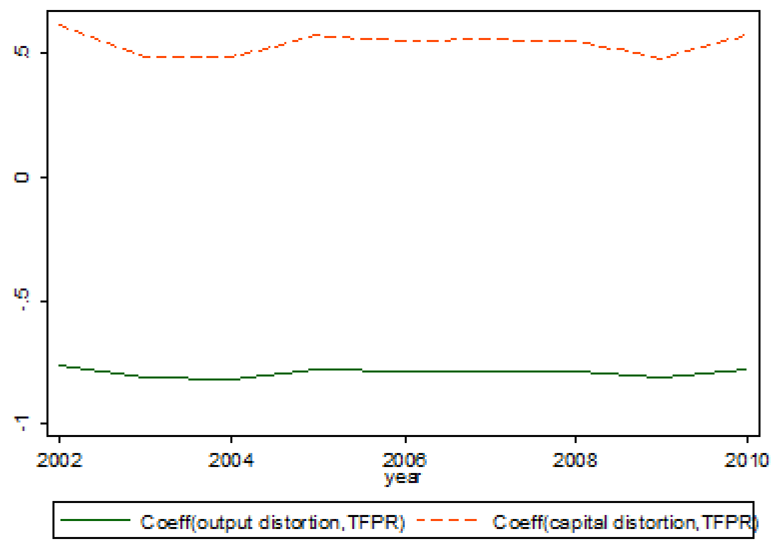

Figure B3. Regression coefficients of distortions on TFPR

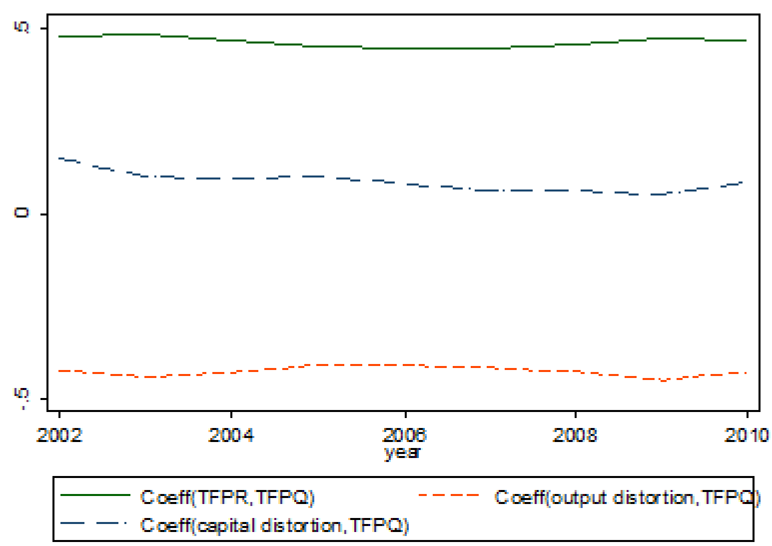

Figure B4. Regression coefficients of distortions and TFPR on TFPQ

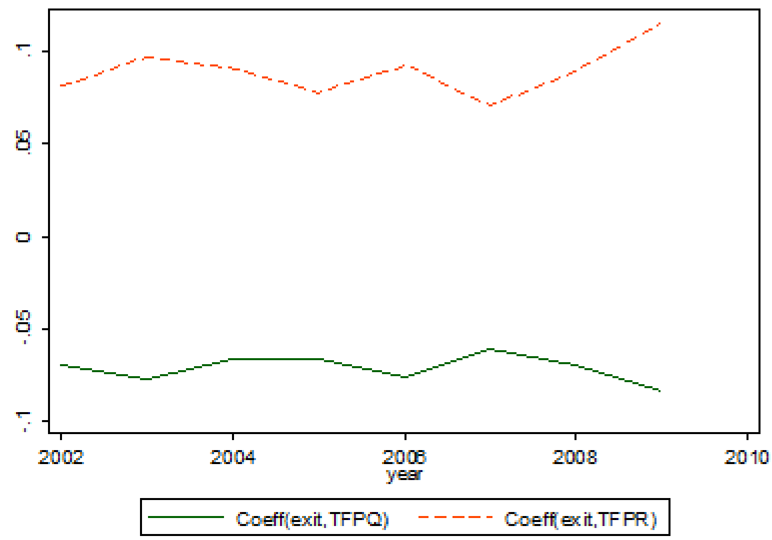

Figure B5. TFPR, TFPQ and probability of exit
Note: calculated as coefficient form WLS regression of exit dummy on logs of TFPQ and TFPR relative to the industry mean. Weights are industry shares

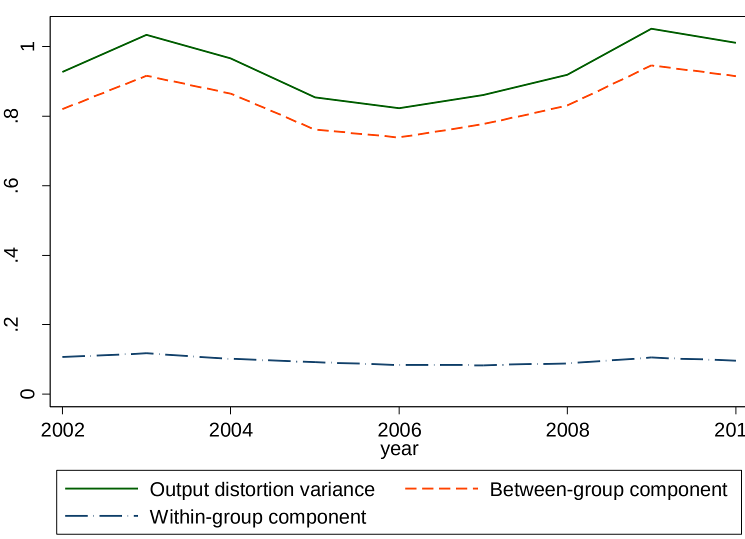

Figure B6. Decomposition of output distortion

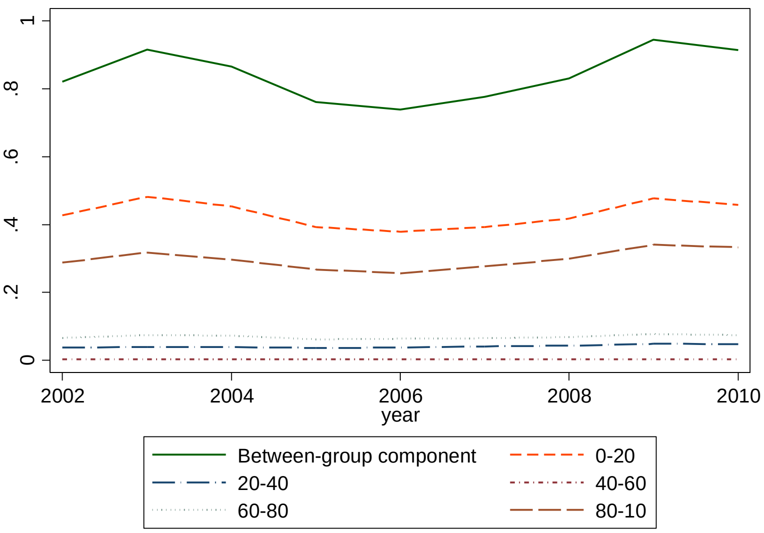

Figure B7. Quintile effects of output distortion

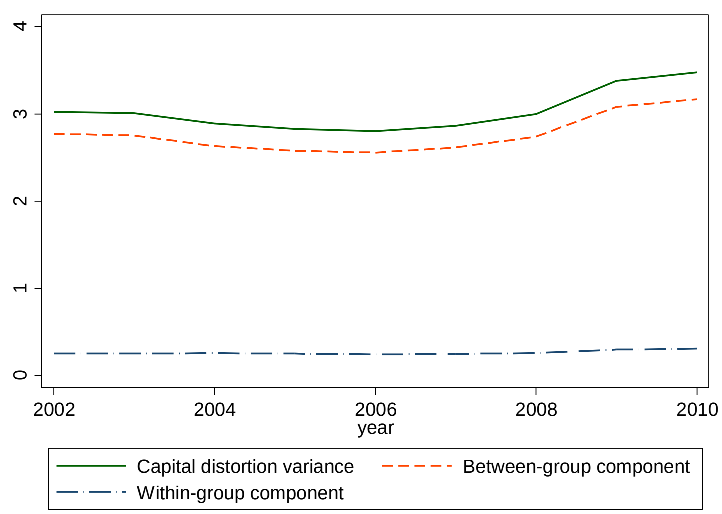

Figure B8. Decomposition of output distortion

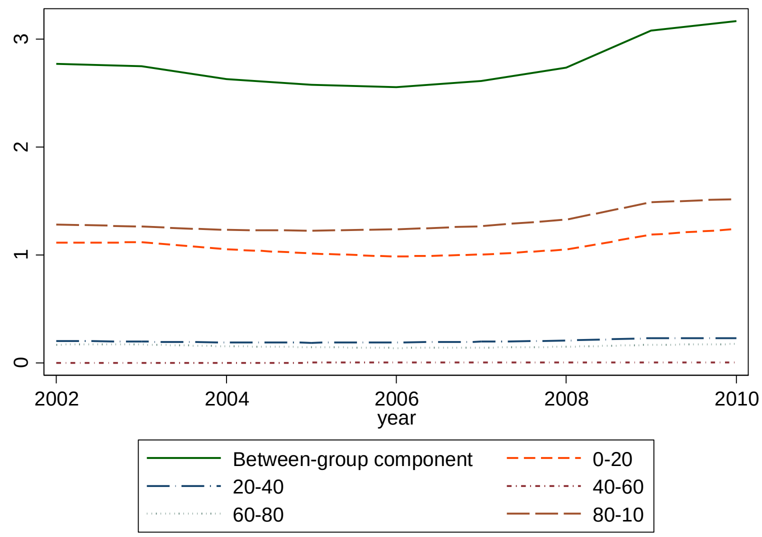

Figure B9. Quintile effects of capital distortion

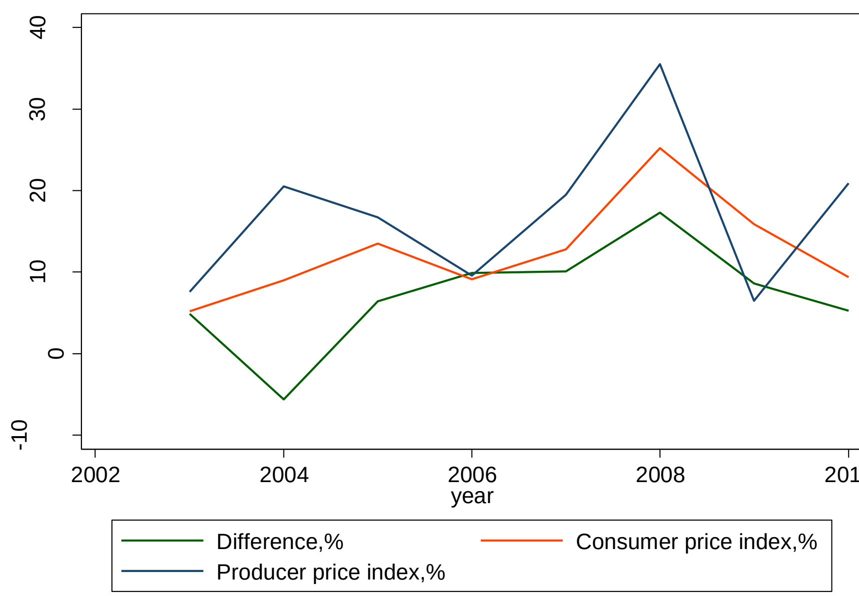

Figure B10. Nominal vs. Real data results difference and price indices
Source: DSSU