# Exporting and Productivity under Endogenous Trade Policy:

# Theory and Evidence from Ukraine

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## Abstract

Recent theoretical models postulate that only the most productive firms become exporters due to the existence of costs of exporting. Empirical evidence does suggest that exporters are on average more productive than their domestic counterparts. Using a Ukrainian manufacturing dataset I find that performance of exporters in Ukraine is heterogeneous across sectors and that the productivity distribution for exporters and non-exporters overlaps. Motivated by this empirical finding, I extend an existing model of heterogeneous firms by adding endogenous trade policy based on a political economy argument. I identify firms that receive explicit government support in the form of preferential tax policy, subsidies and other exclusive benefits. I find that explicit political support is positively associated with firms size and state ownership. I also find that in the presence of government interventions, conventionally estimated TFP may not be an appropriate measure of firms' efficiency.

# 1   Introduction

A growing number of studies have been looking into how globalization has affected economic agents at the micro level. Earlier theoretical work related to so-called "new trade theory" treated all firms within a sector as homogenous. Globalization then would affect all firms in the same way. However, empirical research at the firm level has shown that firms are very different even within narrowly defined 4-digit NACE industries. Differences in performance are often driven by whether firms serve only the domestic market or also export their products. Challenged by this empirical evidence on diversity among firms,[1] a number of theoretical models featuring heterogeneous firms have been developed. Melitz (2003) introduces heterogeneity among producing agents by assuming that firms differ by their productivity drawn randomly from a given distribution. Prior to the revelation of their productivity, firms have to incur fixed costs of entry. Once the productivity draws are realized, firms make a decision on whether to stay in the market given the estimated present value of the profit stream. Since all firms face the same fixed costs of entry, only firms with productivity above a certain threshold will stay in the market. The Melitz model allows to study the implications of trade policy on firm performance. If there are no trade costs, trade is equivalent to an increase in the size of the closed economy, which does not affect firm-level outcomes. However, if entry into a foreign market is associated with some fixed costs as well, only the most productive firms will serve both the domestic and foreign markets. Trade liberalization will affect aggregate productivity in the economy by forcing the least productive firms out of the market and shifting market shares towards more productive firms (i.e. a reallocation effect). Melitz and Ottaviano (2007) advance the possibility of variation among firms by allowing for changing elasticities of substitution between differentiated goods. In these models, only the most productive firms within an industry become exporters, that is firms are partitioned according to productivity cutoff levels. Bernard et al. (2003) use a modified version of the Ricardian model of stochastic comparative advantage also to explain the link between exporting, size, and productivity. Similar to previous models they assume the existence of "iceberg" costs of exporting, which allow only more productive firms (those with the least marginal costs) to sell to other countries. In another model, Bernard et al. (2007b) follow Melitz (2003) by combining monopolistic competition and unit costs that depend on firm productivity. In addition to heterogeneity among firms, industries are characterized by different factor intensities, while the relative abundance of factors of production varies across countries. Helpman et al. (2004) study the effect of firm heterogeneity on their decision whether to export or set up a subsidiary (engage in foreign direct investment, FDI). Since the latter is associated with higher fixed costs, firms will endogenously sort into domestic, exporting or FDI according to their productivity level.

As summarized by Baldwin (2005), two main features of the 'new' new trade theory are: (1) firms have different marginal costs within the same sector and (2) there exist fixed costs

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[1]For an extensive survey of micro-level evidence on the link between foreign market activities, trade policy and firm productivity see Tybout (2003); for developing countries and countries in transition, see Epifani (2003).

of entry to both domestic and foreign markets. The main implications of these models suggest that: (a) exporters should significantly differ from non-exporting firms in terms of productivity due to high cost of exporting; (b) access to a bigger market should lead to an improvement in productivity; and (c) trade liberalization should foster reallocation of market shares towards more productive firms.

The more recent trade models look at the interaction between decisions to go internationally and to innovate. Lileeva and Trefler (2007) model firms' decisions to export and innovate using a heterogeneous response model and test it on a Canadian dataset. They find that new exporters increased their productivity by adopting product-innovative technology. Costantini and Melitz (2007) develop a model where firms make joint decisions to export and innovate once they chose to enter the domestic market. Firms invest in R&D in anticipation of trade liberalization, and such innovation results in a one-time shift in productivity draws. Though these models generate partition of firms into a larger number of groups within an industry (those that sell domestically and innovate, export and innovate, etc.), similarly to the earlier models, they imply the existence of clear thresholds of productivity to determine firms' exporting status.

My paper provides both a theoretical and empirical contribution to this stream of trade literature. To this extent, I use a unique dataset of Ukrainian publicly listed companies with a time coverage spanning from 2000 to 2005.[2] Joint stock companies are required by law to report annually all business-related information, including data from balance sheets, production and other statistics sufficient for reliable estimation of their production functions. Another advantage of this dataset is that it includes data on foreign trade activities of these firms (required to be declared publicly from 1999). I can also identify firms that received a state support in the form of writing off tax arrears and preferential tax rates based on data from the Ukrainian legislation.

I start by estimating firm-level total factor productivity (TFP) utilizing the methodology developed by Olley and Pakes (1996).[3] In order to check the robustness of my TFP estimates, I also apply two other approaches, a technique developed by Levinsohn and Petrin (2003), who use intermediate inputs to proxy for unobserved productivity instead of investment as in O-P; and a modified O-P approach which takes into account potential differences between exporters and non-exporters (De Loecker, 2007).[4]

I estimate an export premium following Bernard and Jensen (1999) and look at the productivity distribution for exporters and non-exporters. Similar to previous studies (Bernard and Jensen (1999) for the U.S.; Arnold and Hussinger (2005) for Germany; Delgado, Farinas and Ruano (2002) for Spain, De Loecker (2007) for Slovenia), I find that exporters differ significantly

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[2]Statistical agencies of the former Soviet Union countries, as in case of Ukraine, collect firm-level data but do not release them to the public. The only available source of firm-level data is various surveys of individual firms and reports of publicly listed joint stock companies.

[3]Hereinafter referred to as O-P. This methodology was further used in a number of empirical papers studying the effects of different policy shocks on the industrial dynamics.

[4]Though the coefficients obtained through these methods differ somewhat, the distribution of productivity indices (TFP) for the whole sample look similar. Since my main research interest was in obtaining a consistent estimate of TFP dynamics overtime rather than estimating precise production function coefficients, I continue with the modified O-P methodology.

from firms not involved in international trade. The export premium between the two groups of firms varies substantially across industries. I also find a significant overlap in productivity levels of Ukrainian manufacturing exporters and non-exporters, a result which is not completely in line with the existing trade models with clear productivity thresholds for exporters.

Motivated by this finding, I extend a trade model of heterogeneous firms developed by Melitz and Ottaviano (2007) by adding endogenous trade policy induced by a political economy argument. I show that the presence of exogenous subsidies creates a region in the productivity distribution where both exporters and non-exporters are present, as observed in my data.[5]

Next I endogenize trade policy by adding an electoral competition stage. In particular, I use a probabilistic voting model as in Persson and Tabellini (2000) with two competing candidates. Using Ukrainian legislation, I identify firms that received explicit government support in the form of tax exemptions, writing off accrued arrears, granting tax payment deferment. In line with the model predictions, I show that supported plants differ from non supported. I also show that in the presence of government interventions, conventionally estimated TFP may not reflect true economic efficiency, thus leading to an overlap in productivity distributions of exporters and non-exporters, since political support alters the productivity ranking of the firm that would have prevailed in the intervention-free world.

The paper is organized as follows: next section presents preliminary results from the analysis of productivity trends in the Ukrainian manufacturing sector. In Section 3, I describe a theoretical model motivated by empirical findings for Ukraine. Section 4 presents results of the model calibration. I conclude with final remarks.

## 2 Exporting and Productivity: Stylized Facts

### 2.1 Data and Methodology

The dataset I use for the estimation was assembled from the publicly available annual reports of the Ukrainian open joint stock companies. The advantage of this dataset is that it covers a substantial amount of the firm-related information, including ownership, output, stock of capital, credit position, among other indicators. The dataset in use covers the period 2000-2005[6], which was characterized by the growth in the volume of manufacturing output, exports and real GDP, with exports contributing a significant share of the GDP growth.

[Insert Figure 1]

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[5] Although I use the word 'subsidy', it does not restrict trade policy to this tool only . For example, Faccio (2004) investigates political connections between firms and government officials and finds it as a wide-spread phenomenon with the varying magnitude across countries. Khwaja and Mian (2005) identify government support to Pakistani firms as the volume of funds available and preferential borrowing rates.

[6] Though the annual reports are available for the earlier years as well, the lack of information on exporting and investment prior to 2000 makes them unusable for the purpose of this paper.

The dataset is an unbalanced panel of 1,665 manufacturing enterprises[7]. In total, there are more than 9900 observations for the six years, with 90-95 per cent of the observations (depending on the reporting year) reflecting firms that were in operation at the time. Another important advantage of the dataset is that it has extensive regional coverage: information is available for firms representing all 25 oblasts (regions) and two cities, Kiev and Sevastopol, which are administratively equated to regions. Moreover, it closely replicates the structure of manufacturing in the Ukrainian economy. Descriptive statistics can be found in Table 2. Although machinery has the highest number of firms, it comes only second if one were to look at the industrial output share in total manufacturing (Table 1). It should be noted that around 20 per cent of the observations have zero investment and thus, as discussed further, were not used for estimation of the production function coefficients. The majority of the enterprises are relatively large and old, since joint stock companies were created on the basis of the existing enterprises previously owned by the state. Given the above and the fact that firm size is positively associated with exporting, exporters are overrepresented in this sample and constitute around 40 per cent of all firms with average shipments abroad being around 15 per cent of total sales. I follow a conventionally accepted definition of exporting firms as a firm that ships abroad at least 5% of their total output in a reporting year. Export volumes to the former Soviet Union (FSU) countries are, on average, higher than exports to rest of the world countries; however, there seems to be a gradual shift in the export orientation of Ukraine towards the latter, which is also documented at the macroeconomic level (WB 2005). Twenty-five per cent of the firms imported raw materials in the period under consideration. Around 50 per cent of all firms were both importing raw materials and exporting final output.

[Insert Table 1 & 2]

The highest share of exporters is observed in metallurgy– around 60 per cent of all firms in this sector exported at least some of their output. In aggregate, this sector contributed 44.5, 41.4, and 39.7 per cent to the total volume of the country's exports in 2000, 2001, and 2002, respectively (WB 2005). Around 80 percent of the exporters in metallurgy shipped to countries outside of the FSU. This number is even higher for textiles, where many exporting plants work on a give-and-take basis, producing clothes and footwear for Western companies. As expected, producers of construction materials are less likely to export their products (less than 13 per cent of all producing plants export). Exporting activity seems to be very persistent with lagged export status crucial in predicting exporting in the current period: the correlation coefficient is close to 0.8. The latter finding of a high persistency of exporting is consistent with the evidence of sunk costs of serving foreign markets.

To estimate plant-level productivity I utilize the methodology developed by Olley and Pakes (1996). The idea behind the O-P methodology relies on elimination of two potential biases when estimating production function coefficients. The first type of bias is attributed to simultaneity

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[7]The dataset does not contain plants of the food-processing industry.

of the choice variable inputs. Assuming a Cobb-Douglas production function and representing it in logarithmic form one has:

$y_{it} = \beta_0 + \beta_a a_{it} + \beta_k k_{it} + \beta_l l_{it} + \varsigma_{it}$,  where

$y_{it}$ is output of firm $i$ at time $t$,

$a_{it}$ is age of firm $i$ at time $t$,

$k_{it}$ is capital of firm $i$ at time $t$,

$l_{it}$ is labor employed at firm $i$ at time time $t$, respectively.

The error term can be decomposed as follows:

$\varsigma_{it} = \omega_{it} + \varepsilon_{it}$

that is, it consists of two parts: $\omega_{it}$ is the productivity observed by the firm, and $\varepsilon_{it}$ is a shock to productivity not observed by the firm. Thus, productivity observed by firms and unobserved by econometricians will influence the firms' choice of the variable input (labor) causing the OLS coefficients on labor to be biased upwards. The second bias arising in the estimation by OLS is the selection bias, which is due to firms' exiting from the market. Olley and Pakes use multistage polynomial approximation to recover the coefficients on labor and capital as well as firm age.

To resolve these two problems O-P suggested alternative to OLS estimation procedure, which they prove to deliver consistently estimated coefficients on the inputs.

At the first stage, consistent estimate of the labor coefficient is obtained by estimating the following specification:

$$
\begin{aligned}
y_{it} &= \beta_l l_{it} + \phi_t(i_t, a_t, k_t) + \varepsilon_{it} \quad \text{where} \\
\phi_t(i_t, a_t, k_t) &= \beta_0 + \beta_a a_{it} + \beta_k k_{it} + h_t(i_t, a_t, k_t)
\end{aligned}
$$

Function $\phi_t(i_t, a_t, k_t)$ is approximated with 3rd or 4th order polynomial series in triple $i_t, a_t, k_t$.

In order to consistently estimate coefficients on capital and age, O-P first estimate probability of staying in the market at time $t + 1$ conditional on perception of the productivity realization which in turn depend on the available capital stock and age of the firm at time $t$. Formally,

$$
\begin{aligned}
\Pr(X_{t+1} &= 1 | \underline{\omega}_{t+1}(a_{t+1}, k_{t+1}), J_t) = \\
&= Pr(\omega_{t+1} \geq \underline{\omega}_{t+1}(a_{t+1}, k_{t+1}) | \underline{\omega}_{t+1}(a_{t+1}, k_{t+1}), \omega_t) \\
&= \psi_t(\underline{\omega}_{t+1}(a_{t+1}, k_{t+1}), \omega_t) \\
\Pr(X_{t+1} &= 1 | \underline{\omega}_{t+1}(a_{t+1}, k_{t+1}), J_t) = \psi_t(i_t, a_t, k_t) = P_t
\end{aligned}
$$

At the final stage, the coefficients on age and capital are retrieved by estimating the following equation using a non-linear algorithm:

$$
y_{t+1} - \beta_l l_{t+1} = \alpha + \beta_a a_{t+1} + \beta_k k_{t+1} + \sum_{j=0}^{4-m} \sum_{m=0}^{4} \beta_{mj} \widehat{h}_t^m \widehat{P}_t^J + e_{t+1}
$$

where $\widehat{h}_t = \widehat{\phi}_t - \beta_a a_t - \beta_k k_t$.

Alternatively, age could be dropped from the production function assuming that the output is produced with only two inputs, capital and labor. I estimate production function without age to ensure sufficient degrees of freedom for the non-linear procedure in the last stage of algorithm. Since one of the O-P assumptions is that investment is an increasing function of unobserved productivity, I use only observations with non-zero investment when estimating the production function. This may lead to a selection bias in estimated coefficients if plants with zero investment differ significantly from investing plants. Another possible bias may arise due to the fact that the fact that exporters and non-exporters potentially face different market structures. Therefore, as a robustness check I re-estimate input coefficients using the Levinsohn and Petrin (L-P) approach as well as a recently developed approach that takes into account exporting status of the firms (De Loecker, 2007). Both methods follow closely the O-P methodology: the L-P methodology specifies using intermediate inputs to proxy for productivity instead of investment. The second approach modifies the O-P methodology by adding an export status variables to the first two estimation stages. In their original paper, Olley and Pakes estimate production function coefficients for the U.S. telecommunication industry. Since this industry could be treated as a non-tradable sector, they did not make any assumptions on how exporting could influence firms' investment or exit decisions. Several authors investigating the export-productivity link have attempted to solve this problem by explicitly controlling for export status within the O-P methodology. For example, Van Biesebroeck (2005) uses lagged export status as a state variable in the investment decision and exit decision, while De Loecker (2007) introduces current export status in the investment and exit decision. As mentioned above I use the

Upon estimating coefficients on inputs I can calculate total factor productivity. To make meaningful comparison of the results I use two types of productivity indices. The first index is obtained by dividing the TFP of a given plant by the industry simple average TFP in a particular year.

$$
\begin{aligned}
TFP &= y_{it} - \widehat{y}_{it} = y_{it} - \widehat{\beta}_l l_{it} - \widehat{\beta}_k k_{it} \\
\text{Prodindex 1} &= \frac{y_{it}}{\overline{y}_{jt}}
\end{aligned}
$$

The second index, used by Pavcnik (2002), normalizes the productivity index by taking into account the productivity of the plant with mean output and mean input level in a base year (in my case, it is 2000), that is, subtracting it from the estimated productivity of a given plant in a given year.

$$\widehat{y}_{it} = \widehat{\beta}_l l_{it} + \widehat{\beta}_k k_{it}$$
$$y_r = \overline{y}_{i,base}$$
$$\widehat{y}_r = \widehat{\beta}_l \overline{l}_{i,base} + \widehat{\beta}_k \overline{k}_{i,base}$$
$$\text{Prodindex 2} = y_{it} - \widehat{y}_{it} - (y_r - \widehat{y}_r)$$

## 2.2 Results

I estimate production functions separately for each 2-digit industry. Given the fact that production function implies real output as a left/had side variable in the production function, before starting any estimation I deflate all nominal values using 2-digit industry-specific producer price indices. As discussed in the literature (see, for example, Pavcnik 2002), the right approach would be to use firm-level prices to convert nominal output into real. Deflation using industry-specific indices may attribute a higher level of productivity to the plants that simply charge higher mark-ups and are not necessarily more productive. However, according to the Melitz-Ottaviano model, more productive firms (lower-cost firms in the model) will be the ones to charge higher mark-ups. Hence, the resulting productivity estimates may be biased only if the above result of the Melitz-Ottaviano model is not true.

Table 3 presents labor and capital coefficients estimated using the following methodologies: original Olley and Pakes, export-augmented Olley and Pakes, as well as Levinsohn and Petrin methodology.

[Insert Table 3]

Productivity index 2 presented in Table 4 shows the evolution of average industry productivity overtime. In all the sectors productivity has improved overtime relative to the base year.

[Insert Table 4]

As I am interested in the relative performance of exporting and non-exporting firms I look at the first two moments of the TFP distributions for the two groups. In line with other studies, I define a plant to be exporter if it shipped abroad at least 5% of total output.

[Insert Table 5]

Table 5 compares the two TFP indices for exporting and non-exporting groups across industries. For all industries exporting firms are, on average, doing better in terms of productivity. Moreover, productivity distribution for non-exporters appears to be more dispersed. Differences between the two groups are further confirmed by the kernel density plot[8] estimated by the O-P

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[8]Kernel density plots are for productivity index 2 to make meaningul comparison across time and across industries.

methodology (Figures 2), showing unconditional distribution of total factor productivity for the two groups, where the distribution of the exporting group is shifted to the right. The resulting distribution is normalized through the use of the productivity index, which takes into account industry specific effects and time trends. This result is robust across different methods of estimation (Figure 3-4), despite of the fact that the input coefficients obtained through these three methods differ somewhat. Since my main research interest is obtaining consistent estimate of TFP overtime rather than estimating precise production function coefficients, I continue with the modified O-P methodology.

[Insert Figures 2, 3 & 4]

Though the existing theoretical models[9] predict much superior performance by exporting firms the resulting productivity distributions for Ukraine do not seem to follow the clear cutoff implication. This leads to the first finding that I will try to explain later in the paper that we cannot draw a clear line that would separate exporters from non-exporters according to the productivity level.

Next I estimate export premium as suggested by Bernard and Jensen (1999). I regress outcome variables on the export dummy controlling for industry and year fixed effects. I use quantile regressions also known as least-absolute value models (LAV or MAD) to mitigate possible problems with mean regression in the presence of outliers. The results for the entire manufacturing are presented in Table 4. Consistent with the previous empirical studies for other countries, Ukrainian exporters seem to have higher productivity, wages, output and capital per worker, as well as profits and returns on capital. To control for the possible differences between the firms of different size, I estimate export premium for two groups of plants: those employing more than 1000 employees (very large) and those with less than 1000 employees. The export premium decreases once the size effect is taken into account with relatively smaller exporting plants ripping higher benefits from exporting in terms of productivity but not financial performance.

[Insert Table 6]

To get a more detailed picture I look at the industry breakdown of exporting premiums. Table 7 demonstrates that exporters performance relative to domestic counterparts seem to be quite heterogeneous across industries.

[Insert Table 7]

If we rank sectors according to the effect of exporting on productivity the smallest export premium is found in construction materials industry, then followed by machinery, textiles and metals (Table 8). The superior performance of exporters compared to non-exporters in terms

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[9]See, for example, Melitz (2003), Melitz and Ottaviano (2007), Helpman et al. (2004).

of productivity should be reflected in other indicators of firm outcomes such as higher wages, returns on capital and profits.[10]

[Insert Table 8]

However, the ranking according to the productivity measure is not preserved when other performance measures are considered: as mentioned above while according to the productivity measures the worst performance of exporters is found in the construction materials industry, the export premium in terms of other performance measures seems to be the lowest for the metallurgical sector. In other words, metals exporters seem to enjoy an export premium on productivity twice of that of construction materials exporters, the export premia on wages and return on capital are below those in constructions industry. Such an inconsistency between the productivity versus other performance outcomes across industries is the second empirical result to be discussed in the next section.

## 3   From empirics to the theory: possible explanation

The detected evidence of a certain overlap in the productivity distribution of exporters versus non-exporters, as well as the heterogeneous patterns of the export premium indicators, could be explained by the presence of government interventions aimed at supporting exporting firms in a given industry. To this extent, Legeida (2001) provides a classification of implicit and explicit subsidies in the Ukrainian economy. According to her estimates, the most heavily cross-subsidized industries in the Ukrainian economy in late 90s early 00s were mining, ferrous metals, machine building and agriculture. Eremenko and Lisenkova (2002) note that policy tools used to support metallurgical sector range from implicit subsidies (debt write-offs, inter-enterprise soft budget constraints, cross-subsidization by lower prices for intermediate goods) to explicit ad-valorem subsidies, the latter being granted mainly to large exporters. They estimate that these subsidies amounted to around USD 500 millions during 2000-2001.

How does the latter relate to the exporting status of a firm? Serving foreign markets is often associated with significant costs associated with setting up local offices or/and dealer networks. As governments are often concerned with promoting exports (e.g. to boost economic growth)[11], they try to achieve this goal with specific trade policy measures. International trade theory does not have a clear answer whether an active trade policy is desirable from the welfare point of view. Baldwin (1992) contrast the implications of the traditional trade theory assuming competitive markets with the new trade theory under imperfect competition. While the earlier stream of trade theory does not advocate for intensive government intervention, later contributions to trade theory which borrowed tools from the Industrial Organization literature (e.g. Brander

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[10]Exporting may not necessarily have effect on profits, in general. But in the case of monopolistic competition– which is used in the trade models with heterogeneous firms–more productive firms enjoy higher profits. And, consequently, since exporters are at the upper end of the productivity distribution, their profits are expected to be higher than profits of domestic counterparts.

[11]As discussed below, export was a driving force behind the recent GDP growth in Ukraine (Figure 1).

and Spencer, 1985) postulated the possibility of strategic trade policy. They argued that if firms of two countries are competing in a third country market, which is imperfectly competitive, governments by means of trade policy (subsidy, tax, tariff) can ensure higher profits for domestic exporting firms at the expense of the other countries' exporting firms.[12]

Linking the possibility of strategic trade policy by the government to the analysis of performance of exporting firms, in the next section I present a model that tries to explain the two previously discussed empirical findings. I introduce export as an exogenous shock to the firm's profits in the original Melitz and Ottaviano (2007) model. Next, I incorporate a trade policy determination stage into the model.

## 3.1 Open economy with an exogenous subsidy

In this section I present a theoretical model that follows Melitz and Ottaviano (2007). The consumer side of the economy is represented by identical $L$ consumers with quasi-linear preferences over the numeraire good ($q_o^c$) and differentiated goods ($q_i^c$).

$$U = q_o^c + \alpha \int_{i \epsilon \Omega} q_i^c di - \frac{1}{2} \gamma \int_{i \epsilon \Omega} (q_i^c)^2 di - \frac{1}{2} \eta \left( \int_{i \epsilon \Omega} q_i^c di \right)^2$$

Hence the preferences are characterized by different degrees of substitutability between numeraire good and differentiated goods ($\alpha$ and $\eta$) as well as by the degree of product differentiation among the latter goods (varieties) denoted by $\gamma$.

Consumers maximize utility given the following budget constraint:

$$p_o q_0 + \int_{i \in \Omega} p_i q_i d_i \leq E$$

The maximization yields the following inverse demand for a variety $i$ assuming that $q_o^c > 0$:

$$p_i = \alpha - \gamma q_i^c - \eta Q^c$$

where $Q^c = \int_{i \in \Omega} q_i^c di$ is the aggregate consumption of differentiated goods in consumer's bundle.

Then the market demand for a variety $i \epsilon \Omega^*$ (where $\Omega^*$ is a subset of differentiated goods s.t. $q_o^c > 0$) depends on its price ($p$), size of the market ($L$), degree of differentiation among varieties ($\gamma$) and substitutability with a numeraire good ($\alpha$ and $\eta$), number of consumed differentiated goods ($N$) and average price of differentiated goods ($\bar{p}$) defined as $\frac{1}{N} \int_{i \epsilon \Omega^*} p_i di$ :

$$q_i \equiv L q_i^c = \frac{\alpha L}{\eta N + \gamma} - \frac{L}{\gamma} p_i + \frac{\eta N}{\eta N + \gamma} \frac{L}{\gamma} \bar{p}$$

The production side of the economy is divided into two sectors: one that produces numeraire

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good with constant returns to scale and the other sector dealing with differentiated goods. Both sectors use labor as the only input into production. However, while the numeraire sector is competitive and has free entry, the differentiated product sector is characterized by costly entry ($f_E$) since entrants have to incur sunk costs. Investment is a stochastic process with draws distributed according to some commonly known distribution $G(c)$. Once the draws are realized each entrant considers whether to stay and produce or exit. Since the entry cost is sunk this decision depends on an entrant's draw of costs and expected future profits which are in turn determined by the economy distribution of productivity.

The free entry condition for the differentiated products sector is then given by:

$$\int_o^{c_D} \pi(c)dG(c) - f_E = 0 \tag{1}$$

where $c_D$ is a cutoff point for costs, such that firms with costs above it exit the domestic market. This threshold incorporates the influence of the average price and number of varieties (firms) on the firms' profits ($\pi$), mark-ups ($\mu$), quantities produced ($q$) and prices charged ($p$). The short run equilibrium in this economy is then determined by the free entry condition (1) and the zero cutoff profit condition $c_D = p(c_D)$, where $p(c_D)$ is a price charge by the firm with a cutoff level productivity. Then the number of firms in the market is determined by $N_E = N/G(c_D)$. Firms can export, but, exporting is costly due to the existence of iceberg-type trade cost ($z > 1$) . Assumptions on segmented market and constant returns to scale allows for separate profit functions for domestic and foreign markets.

$$
\begin{aligned}
\pi_D(c) &= [p_D(c) - c]\, q_D(c) & \text{domestic profits} \\
\pi_X(c) &= [p_X(c) - z^*c]\, q_X(c) & \text{export profits}
\end{aligned}
$$

where $*$ denotes a foreign country.

I concentrate on the short-run perspective implying that all entry has occurred and exit is not taking place; therefore, the number of firms and productivity distribution (inverse of the costs) are fixed.[13] In this framework subsidy, $s$, can be considered as an exogenous shock hitting firms' profits with a probability $\beta$ after they have entered the market.[14] If some of the firms receive a subsidy their profits from export will thus be:

$$\pi_X(c) = (p_X(c) - z^*c)\, q_X(c) + f(s)$$

I follow Melitz and Ottaviano in parametrizing the cost distribution as a Pareto distribution.

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[13] This assumption seems to be relevant for Ukrainian economy where inefficient plants do continue to "hang out" in the market either producing little or not producing at all (often selling inventories and renting out fixed assets).

[14] Without loss of generality I use subsidy in a broad sense as any kind of government intervention affecting firms profits.

Given this assumption, the export profits can be represented as follows[15].

$$\pi_X(c) = \frac{L^*}{4\gamma} (z^*)^2 (c_X - c)^2$$

Then the profits of the subsidized firms become:

$$\pi_X(c, s_X) = \frac{L^*}{4\gamma} (z^*)^2 (c_X - c)^2 + f(s) \tag{2}$$

I assume that subsidy enters firms' profits but it does not increase profits in 1 to 1 ratio.[16]

Alternative expression in case of a price subsidy:

$$\pi_X(c) = (p_X(c) + f(s) - z^*c) q_X(c)$$

Which is equivalent to the case of subsidy per unit produced :

$$\begin{aligned}
\pi_X(c) &= (p_X(c) - z^*c) q_X(c) + f(s)q_X(c) = \\
&= \frac{L^*}{4\gamma} (z^*)^2 (c_X - c)^2 + f(s)\frac{L^*}{2\gamma}z^*(c_X - c) \\
&= \frac{L^*}{4\gamma} (z^*)^2 (c_X - c)^2 \left[1 + \frac{2f(s)}{z^*(c_X - c)}\right]
\end{aligned}$$

For analytical simplicity I will use expression (2), although the derived results will still be valid for the alternative price subsidy. If we denote with $c'_X$ a cutoff level of costs for the supported group, then[17]:

$$\begin{aligned}
\frac{L^*}{4\gamma} (z^*)^2 (c_X - c)^2 + f(s) &= \frac{L^*}{4\gamma} (z^*)^2 (c'_X - c)^2 \\
(c'_X - c)^2 &= (c_X - c)^2 + \frac{f(s)4\gamma}{L^* (z^*)^2} \tag{3}
\end{aligned}$$

The above equality implies that the subsidized group will face lower productivity cutoff to enter the export market. Therefore, in the region between $c'_X$ and $c_X$ (Figure A), some firms that would not export without subsidy will actually export, while the others with the same level of productivity but without subsidy will serve only domestic market generating overlap in the productivity distribution between exporting and non-exporting firms.

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[15] For a detailed derivation of the profit functions, see Melitz and Ottaviano (2007).

[16] Such functional form allows for different subsidy alternatives. It should be noted that in Ukraine subsidies have been granted in the form of tax reductions (e.g. from overall 30% to 9, then 15 for metallurgical sector), elimination of other levies and fees, writing off of tax arrears. Also, at some point in time free economic zones were created which granted tax priviledges to specific enteprises.

[17] In the alternative specification:

$$\frac{L^*}{4\gamma} (z^*)^2 (c_X - c)^2 + s_X \frac{L^*}{2\gamma}\tau^* (c_X - c) = \frac{L^*}{4\gamma} (z^*)^2 (c'_X - c)^2$$

$$(c'_X - c)^2 = (c_X - c)^2 + \frac{2s_X}{z^*} (c_X - c)$$

**Figure A.** Productivity distribution and cutoffs for exporting in the presence of subsidy
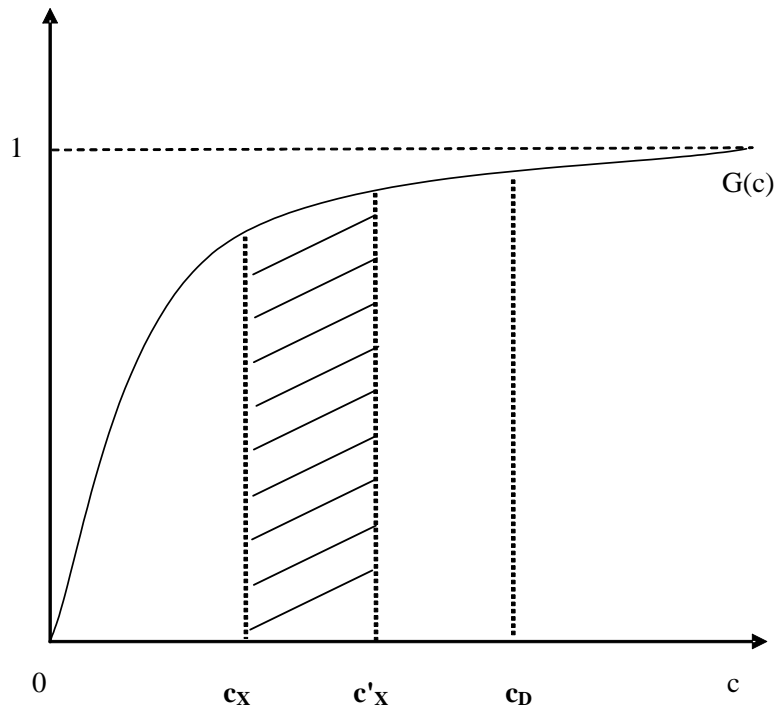


## 3.2 Open economy with a political economy stage:

There are several approaches that could be used to model the political environment. One of them is to assume that politicians engage in electoral competition to win the office. In this set up there is no role for organized groups since politicians decide on the policy platform; voters (groups of voters) influence policy indirectly via some intrinsic characteristics which "attract" politicians. That is, voters behave passively without exerting any special effort (e.g. in the form of pressure, contributions, bribes) to affect the policy platform that competing politicians choose in equilibrium.

The second approach is to introduce organized groups that will actively find ways to influence either probability of winning of their preferred candidate or the policy decision, or both. Grossman and Helpman (1994) develop a model of lobbying in the form of campaign contribution to manipulate trade policy in their preferred direction. In this model the politicians are already in office. Grossman and Helpman (1996) introduce a model where lobbies contributions are aimed either at the electoral support of a given party or to influence the choice of policy. Mitra (1999) models endogenous lobby formation and identifies industry features that are associated with a higher probability of lobbying. In particular, more capital abundant and geographically concentrated industries are more likely to form a lobby and, consequently, receive more protection. More concentrated ownership and less elastic demand for goods produced is also conducive to lobbying. Using Grossman and Helpman (1994) lobbying model Bombardini (2005) shows that industries with more dispersed size distribution are more likely to be organized in lobby and hence will be protected.

I apply probabilistic voting model of electoral competition as in Persson and Tabellini (2000). In this setup subsidy is chosen by politicians competing for office to influence election outcome. The choice can be justified on the grounds that politicians often have motivations for political favors other than campaign contributions, e.g. vote shares, employment, etc. In my model voters are grouped according to employment place. Voters can be ideologically biased toward one of the candidates. I assume that economic policy affects all voters working at a plant in the same way. I show that firms with voters that put greater emphasis on economic policy, less ideologically biased (with more swing voters), and plants with higher turnout rates among the workers, will be "attractive" for politicians' support, and thus will have higher probability of becoming "politically connected", receive export subsidy or another type of support. Hence my paper is related to a recent work by Muuls, M. and P. Petropoulou (2006) where the distribution of economic activity is modelled to affect trade policy choice when politicians compete for office. The main implication of their model is that industries located in the electoral districts that are pivotal and have many swing voters are more likely to be protected is empirically confirmed for the US economy.

### 3.2.1 Setup

There are two parties $P = O, R$, which try to win office. Before the elections two parties choose a policy vector (trade policy in this case) which they will implement if they are elected. It is assumed that parties can commit to the policy they announce before the elections.

All voters work at a specific firm and have ideological bias toward one of the parties. The utility of a voter $i$ working at a firm $J$ is described by the following:

$$w^{iJ} = k^J W^J(s^J) + (\sigma^{iJ} + \delta)V_R \qquad (4)$$

Where $V_R = 1$ if party $R$ wins election and $= 0$ otherwise.

$k^J$ is firm-specific parameter

$W^J(s^J)$ is the effect of trade policy discussed below

$\sigma^{iJ}$ is a party bias which is individual-specific,

$\delta$ is a random popularity shock for all voters.

Both individual party bias and popularity shock are uniformly distributed. The former within each firm on the interval: $\left[-\frac{1}{2\phi^J}, \frac{1}{2\phi^J}\right]$, and the latter for the entire economy on the interval: $\left[-\frac{1}{2\psi}, \frac{1}{2\psi}\right]$.

Given the properties of the uniform distribution, the density of individual party shocks for each plant is summarized by $\phi^J$, and the density for popularity shock is summarized by $\psi$.

Firms are also distinguished by the extent to which they care more about economic policy relative to the ideology, $k^J$. I assume that economic policy affects all the voters working at the specific plant in a similar way:

$$W^J(s^J) = \pi_D^J + \pi_X^J - \tau + \frac{f(s^J)}{\lambda(L^J)} \qquad (5)$$

Where as in the previous case $\pi_D^J$ is the profits from selling on domestic market, $\pi_X^J$ profit from exporting, $\tau$ is a tax, $f(s^J)$ is the extra profits resulting from the trade policy, as firms can receive export subsidies or other forms of support from the government and $\lambda(L^J)$ is a scaling factor decreasing in the firm size and representing the economies of scale in the governmental support.[18] Given the government budget constraint, $N_E\tau = \sum_J s^J$, the tax rate is determined as follows: $\tau = \frac{1}{N_E}\sum_J s^J$, where $N_E$ is the short-run equilibrium number of firms in the economy.

The 2007 snap elections to the Ukrainian Parliament provide some anecdotal evidence on the validity of the assumption that voters can be grouped by the place they work at. One of the parties competing for the seat in the parliament showed indeed an interesting pattern of the votes distribution. Though overall this party did not even reach the required threshold of 3% to enter Parliament. It managed to get more than 50 and 35 per cent of votes in two electoral districts in the same city, respectively. Further look at the more detailed information on votes reveals that even within the two districts the distribution of votes was far away from being homogenous. According to unofficial information such "concentrated" support of this party could be explained by the geographical location of the giant heavy industry plant believed to be connected to one of the party leaders. The fact is that the party received around 90 thousand votes in these two districts and the plant official's employment in the year before the election was around 77 thousand employees. Definitely, without detailed information on the employment of the voters one cannot claim that there is a direct link between the two number; however, this "coincidence" speaks for itself.

The timing is as follows:

1. Two parties simultaneously and noncooperatively decide on the trade policy to ensure winning of the elections.

2. Voters vote.

3. Trade policy is implemented.

4. Firms produce and export depending on the implemented trade policy.

### 3.2.2 Solution

In order to determine equilibrium in the model, we need first to determine a "swing" voter - a voter which is indifferent between two parties, i.e. voter with the ideological bias equal to 0:

$$\sigma^J = w^J(s_O^J) - w^J(s_R^J) - \delta$$

All voters of plant $J$ with $\sigma^{iJ} \leq \sigma^J$ would vote for party $O$.

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[18] The scaling factor was first introduced by Barten (1964) in a household decision model and had been widely used in the household literature.

The cumulative distribution of individual-specific party bias for firm $J$ can be represented as follows:[19]

$$F(\sigma^J) = \frac{\sigma^J - \left(-\frac{1}{2\phi^J}\right)}{\frac{1}{2\phi^J} - \left(-\frac{1}{2\phi^J}\right)} = \frac{\sigma^J + \frac{1}{2\phi^J}}{\frac{1}{2\phi^J} + \frac{1}{2\phi^J}} = \phi^J\left(\sigma^J + \frac{1}{2\phi^J}\right)$$

The vote share that the party $O$ gets given the distributional assumptions is thus:

$$\lambda_O = \sum_J \frac{L^J}{L} t^J \phi^J \left[\sigma^J + \frac{1}{2\phi^J}\right] \tag{6}$$

where $t^J$ is the probability that voters of plant $J$ will turn out to vote and is firm-specific. Then the probability of party $O$'s winning elections is given by:

$$p_O = \Pr\left[\lambda_O \geq \frac{1}{2}\right] = \frac{1}{2} + \frac{\psi}{\phi}\left[\sum_J \frac{L^J}{L} t^J \phi^J k^J \left[W^J(s_O^J) - W^J(s_R^J)\right]\right] \text{[20]} \tag{7}$$

Where $\phi = \sum \frac{L^J}{L}\phi^J$ and is average density across plants. The objective function of the two parties is symmetrical and represents a weighted social welfare function where the voters utility working at a given firm is weighted by the firm size ($L^J$), their turnout rate ($t^J$) and their responsiveness to economic policy ($k^J$).

In equilibrium politicians choose trade policy to maximize their objective function:

$$\max_{s_O^J} p_O = \frac{1}{2} + \frac{\psi}{\phi}\left[\sum_J \frac{L^J}{L} t^J \phi^J k^J \left[W^J(s_O^J) - W^J(s_R^J)\right]\right]$$

Where $W^J(s_O^J)$ is given by (5). Then FOC to the above maximization problem considering two plants $I$ and $J$ is given by:

$$\frac{L^J}{L}\frac{t^J\phi^J}{\lambda(L^J)}k^J\frac{\partial f(s_O^J)}{\partial s_O^J} - \frac{L^J}{L}\sum_J \frac{t^I\phi^I k^I}{N_E} = 0 \tag{8}$$

$$\frac{\partial f(s_O^J)}{\partial s_O^J} = \frac{\lambda(L^J)\sum_J \frac{t^I\phi^I k^I}{N_E}}{t^J\phi^J k^J} \tag{9}$$

By concavity of utility function and symmetry both parties offer the same policy platform $s_O^J = s_R^J$ in equilibrium.

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[19]Recall that cummulative density function for uniform distribution is given by:

$$F(x) = \frac{x - a}{b - a} \quad \text{for } a \leq x < b$$

[20]Party O wins if it gets at least half of the votes, that is if $\lambda_O \geq \frac{1}{2}$. Using (6), the proability of winning is thus given by:

$$p_O = \Pr\left[\lambda_O \geq \frac{1}{2}\right] = \Pr\left[\sum_J \frac{L^J}{L} t^J \phi^J k^J \left[W^J(s_O^J) - W^J(s_R^J)\right] \geq \delta \sum_J \frac{L^J}{L} t^J \phi^J\right]$$

Taking into account properties of the uniform distrubtion this expression becomes (7).

To concentrate on the plant characteristics I assume that voters are ideologically similar across plants, namely that $\phi^J = \phi^I$ for $i \neq j$. Hence expression (9) simplifies to:

$$\frac{\partial f(s_O^J)}{\partial s_O^J} = \frac{\lambda(L^J) \sum_I \frac{t^I k^I}{N_E}}{t^J k^J} \tag{10}$$

Given the government budget constraint the revenue part is given by $L\tau$. Since subsidies are costly for the government the government supports only a fraction of firms $\beta$ with the highest values of $t^J k^J$.

In the above setup I assumed that every voter is a stakeholder only in the firm he works for, which is often the case in transition economies.[21] As an alternative in the Appendix derive results for the case when workers hold a portfolio of stocks of other firms.

### 3.2.3 Model implications

The model generates several testable implications. Politicians will support plants whose profits are more responsive to governmental intervention. Equation (10) implies that governmental support to a given firm $J$ (higher subsidy $s^J$) increases in voters turnout ($t^J$) and/or if its voters care more about economic (trade) policy than ideology (higher $k^J$). Size of the firm ($L^J$) enters the expression (10) indirectly through the scaling factor and . Bigger firms will be favored by the government because of the existence of the economies of scale. This result is different from Persson and Tabellini (2000) where the size of the group does not matter for receiving transfers. In their model, though votes increase in the group's size, the provision of per capita public good also makes the bigger groups of voters expensive to "buy". In my model, the subsidy is given to the firm and though bigger firms receive bigger subsidies, the size of the subsidy is not determined on per worker basis.

More formally:

H1. Since state-owned plants are usually older and less efficient and find it difficult to compete in the market [22], $k^J$ is increasing in the state ownership. As a result, since political support is increasing in $k^J$, I should expect higher state share in the subsidized/supported plants.

H2. Plants concentrated in location with more active voters (higher $t^J$) will receive higher subsidization.

H3. The size of the plant is expected to positively influence the probability of receiving political support.

H4. Political support changes the productivity distribution by inducing a structural shift for the politically connected group as demonstrated in Section 3.1

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[21] This is especially true for my dataset of open joint stock companies, where many firms have been owned by the workers and management.

[22] Previuos studies for Ukraine have found state-owned enterprises to be lacking behind in terms of efficieny and competitiveness (see e.g. Andreeva (2003), Melnichenko (2002) and Zelenyuk V. and V. Zheka (2004).

# 4 Testing the model: specification and results

First, I estimate the share of exporters whose TFP is below industry average (Table 9) across sectors. Not surprisingly, the metallurgical sector stands out with more than 22% of exporters with productivity below industry average. Given the peculiarity of exporting in textile sector one should not be surprised with a rather higher share of exporters below industry average in this industry as majority of these enterprises works under given-taken schemes with foreign partners.

[Insert Table 9]

Next, I directly test model implications regarding governmental intervention thanks to the unique feature of my dataset that allows me to exactly identify the recipients of one of the forms of the governmental support. A specific legislation passed in 1999 in fact established the initiation of an economic experiment aimed "at the increase in production volumes in the metals and mining sectors via extension of tax privileges". In particular, tax privileges included writing off all the tax arrears that accumulated prior to July 1st 1999.[23] It also allowed delays in tax payment up to 36 months without penalty (zero rate tax credit). The word 'experiment' in the title clearly implied that tax privileges were granted only to some enterprises in the metallurgical sector. The list of participants have been slightly modified in the subsequent years. The experiment was supposed to end in 2002; however, a new set of legislative acts was adopted to continue with experiment.[24] Finally it was abolished in 2005.

Concentrating on the metallurgical industry I can thus construct a variable *Support* as a binary variable taking values 1 for entire period if firm was listed in both laws and 0 if was not listed in any. Some plants were added along the way and some were excluded, hence the variable *Support* for this groups alternates between 0 and 1.

To test Hypothesis H1 I conduct a t-test on equality of means for the variables related to the state ownership in the two groups of firms in 2000. The variable $State - controlled$ takes value of 1 if state owns more than 25% of shares in a given firm and 0 otherwise. The variable *State share* is a continuos variable denoting direct state ownership. The results of the test for two variables are presented in Table 10. As expected, I find that the both the percentage of state-controlled plants and share, owned by the state, is higher for the plants included in the experiment and hence benefiting from governmental support.

[Insert Table 10]

At the time being, I cannot directly test Hypothesis H2 although the anecdotal evidence presented in Section 3.2. may serve as an indirect empirical support.

The third prediction of the model implies that the supported firms should be bigger in terms of the number of employees than unsupported firms. Table 11 empirically confirms this

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[23]Law of Ukraine on Economic Experiment in Mining and Metals Industry, dated July 14th, 1999.

[24]Law of Ukraine on Further Stimulation of of Mining and Metals Industry, dated January 17th, 2002

prediction: I find the statistically significant difference between the average number of employees in two groups of exporters.

[Insert Table 11]

According to H4, government interventions are expected to change the productivity distribution within the industry. I thus plot the kernel density for four groups of firms divided according to export status and political support. As Figure 5 demonstrates, the productivity schedule for politically supported plants is reallocated to the right, revealing a structural shift. Therefore, in the presence of subsidization or other forms of state support, the TFP measure estimated as residual of the standard Cobb-Douglas function (with value added as dependent variable) might not reflect true efficiency, since 'supported firms' can have access to subsidized intermediate inputs decreasing in this way material costs and inflating valued added.

[Insert Figure 5]

To validate this finding, I try to build a counterfactual to the existing situation by estimating a hypothetical TFP for supported firms as if it would be without political support. To this extent, I first regress log TFP on a set of other performance indicators which are hypothesized to be independent of the political support using only a subset of exporting firms, which are not listed in the 'experiment resolution'. I can directly use TFP and not an index because I am considering only metallurgical firms, hence I need only to control for time trend in productivity, which I do by using year fixed effects. As before I use quantile regressions estimating the median effect for the following specification.

$$\log TFP_{jt} = \alpha_o + \alpha_1 w_{jt} + \alpha_2 k_{jt} + \alpha_3 y_{jt} + \alpha_1 \mu_{jt} + \upsilon_{jt}$$

where $TFP_{jt}$ is firm $j$ total factor productivity in level in year $t$

$w_{jt}$ is average wage paid by firm $j$ to its employees

$k_{jt}$ is capital per employee

$y_{jt}$ is output per employee

$\mu_{jt}$ is profit margin defined as profit (loss) before taxation divided by operating revenue / turnover multiplied by 100

Three of these four performance measures are positively associated with productivity, while capital intensity seems to be going against productivity. This finding could be explained by the fact that most plants are still using obsolete and inefficient machinery and equipment.

[Insert Table 12]

Next, I get the predicted value of TFP conditional on the other indicators of firm performance. Below I report the predicted and earlier estimated mean values of log TFP as well as the difference between the two.

| Support | Actual TFP | Predicted TFP | Difference |
|---------|-----------|---------------|------------|
| 0 | 3.238 | 3.300 | 0.012 |
| 1 | 3.765 | 3.469 | 0.237 |
| All | 3.419 | 3.359 | 0.094 |

Even a first look at the predicted and actual values of TFP shows differences between the two groups. To statistically validate this observation I use mean t-test (Table 12). First, I can reject the null hypothesis that differences between actual and predicted TFP are the same for two groups. In case of unsupported plants, I cannot reject the null hypothesis that means of the predicted TFP and the actual TFP are the same; whereas for 'supported' group the two means are not equal according to t-test. This results holds even if I control for size of the firm in the counterfactual specification (Table 14). This gives support to my hypothesis that government interventions alter the productivity ranking and, hence, conventionally estimated TFP is likely to be biased in the presence of governmental interventions.

[Insert Table 13 & Table 14]

Primarily the governmental support was given to large exporting firms, however as Figure 5 demonstrates the productivity distribution of supported non-exporting firms is also shifted to the right relative to the unsupported non-exporting group. This result seems to suggest that in this particular case the existing overlap of the two distributions may also be driven by the governmental support to the non-exporting plants.

## 5    Concluding Remarks

In this paper I propose a theoretical model motivated by the statistical analysis of firm performance in Ukrainian manufacturing. Although exporting seems to be on average associated with better firm level outcomes, differences between exporting and non-exporting firms vary across industries. An analysis of productivity distributions for the two groups shows that there exist significant ranges of productivity where the two groups coexist, differently from the clear-cut predictions of the theoretical models. I suggest a political economic explanation to this finding. I build my work on a recent heterogenous firm model developed by Melitz and Ottaviano (2007) adding an electoral competition stage in order to endogenize the trade policy. I test the implications of the model on the data for metallurgical sector, exploiting the fact that I can identify in the Ukrainian legislation the firms that receive some of kind of government support. In line with theoretical prediction, I find that state-owned and larger firms are more likely to be favored by the government policy. Government intervention is also hypothesized to change productivity distribution that would prevail in a laissez-faire world. I find that conventionally estimated TFP does not seem to capture actual efficiency in the presence of government intervention.

Despite of the fact that the model is motivated by the findings from a transition economy my work can be extended to the case of developed economies as the presence of politically connected firms is a well-documented fact (Faccio, 2004).

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**Figure 1.** Export dynamics and Real GDP growth in 1996-2004
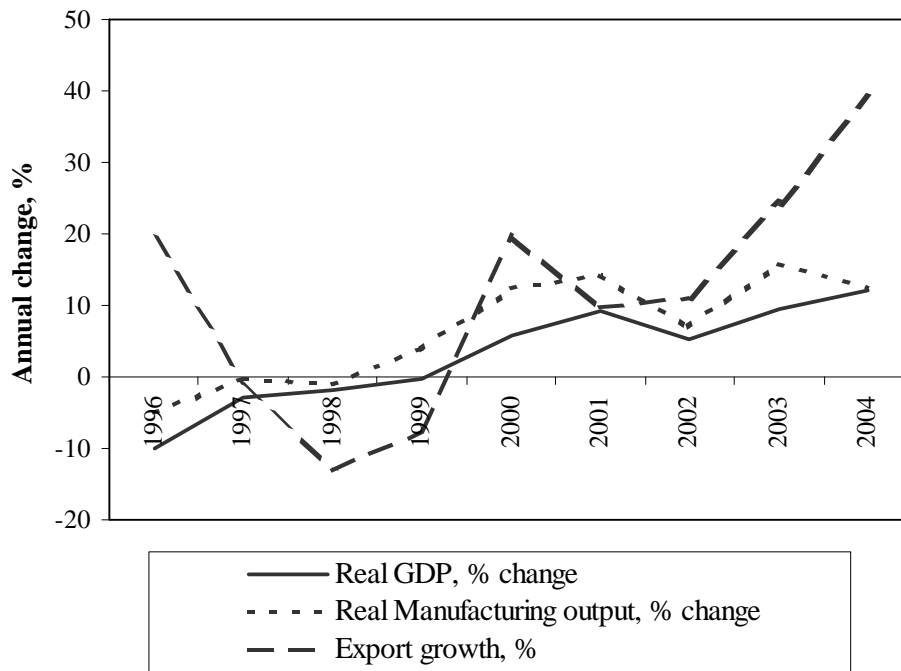
**Table 1**. Industrial division

| Industry | Observations | Industry sales as %, data set | Industry sales as %, economy* |
|---|---|---|---|
| Metals | 636 | 65.03 | 54 |
| Chemicals | 624 | 7.72 | 10.5 |
| Machinery | 4728 | 20.07 | 24.8 |
| Paper and wood | 942 | 2.32 | 3.7 |
| Construction materials | 1902 | 3.87 | 4.5 |
| Textiles and footwear | 1110 | 1.00 | 2.5 |
| Total | 9942 | 100 | 100 |

* For comparison manufacturing total sales are calculated excluding food-processing and resource-extracting and gas-, water- power-generating industries


**Table 2.** Descriptive statistics

| Variable | Mean | SD | Obs |
|---|---|---|---|
| Age | 51.1 | 30.2 | 8343 |
| Employees | 739 | 2710 | 8343 |
| Output | 58846.4 | 415443.5 | 8340 |
| Net sales | 60416.1 | 425612.4 | 8345 |
| Value added | 16947.3 | 124627.4 | 8282 |
| Investment | 1789.6 | 15512.6 | 6109 |
| Machinery and equipment | 7233.3 | 39473.8 | 8203 |

**Table 3.** Input coefficients estimated by three different methods

| | O-P | | O-P with export | | L-P | |
|---|---|---|---|---|---|---|
| | Labor | Capital | Labor | Capital | Labor | Capital |
| Metals | 0.758 | 0.257 | 0.759 | 0.328 | 0.427 | 0.382 |
| | (0.077) | (0.086) | (0.075) | (0.066) | (0.098) | (0.136) |
| Chemicals | 0.493 | 0.118 | 0.398 | 0.043 | 0.085 | 0.504 |
| | (0.086) | (0.129) | (0.094) | (0.196) | (0.125) | (0.179) |
| Machinery | 0.786 | 0.138 | 0.804 | 0.005 | 0.448 | 0.168 |
| | (0.030) | (0.034) | (0.030) | (0.033) | (0.060) | (0.053) |
| Paper and wood | 0.605 | 0.135 | 0.681 | 0.169 | 0.282 | 0.189 |
| | (0.084) | (0.064) | (0.084) | (0.056) | (0.089) | (0.130) |
| Construction materials | 0.761 | 0.279 | 0.758 | 0.268 | 0.329 | 0.331 |
| | (0.050) | (0.074) | (0.049) | (0.060) | (0.073) | (0.109) |
| Textiles and footwear | 0.525 | 0.021 | 0.441 | 0.018 | 0.549 | 0.407 |
| | (0.058) | (0.086) | (0.061) | (0.083) | (0.104) | (0.122) |

**Table 4.** The evolution of average productivity (Prodindex 2), by industry

| Metals | Chemicals | Machinery | Paper | Construction materials | Textiles and Footwear |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 |
| 1.08 | 1.13 | 1.22 | 0.90 | 1.21 | 1.27 |
| 1.21 | 1.30 | 1.40 | 1.36 | 1.47 | 1.37 |
| 1.34 | 1.36 | 1.69 | 1.42 | 1.76 | 1.49 |
| 1.52 | 1.73 | 1.86 | 1.68 | 2.01 | 1.84 |
| 2.01 | 2.06 | 2.11 | 2.11 | 2.22 | 1.86 |

**Table 5.** Comparison of TFP indices across industries.

| Productivity index 1 | Exporters | | Non-exporters | |
|---|---|---|---|---|
| | Mean | STD | Mean | STD |
| Metals | 1.070 | 0.278 | 0.876 | 0.339 |
| Chemicals | 1.223 | 0.313 | 0.835 | 0.340 |
| Machinery | 1.129 | 0.314 | 0.906 | 0.349 |
| Paper and wood | 1.306 | 0.336 | 0.937 | 0.377 |
| Construction materials | 1.161 | 0.269 | 0.977 | 0.338 |
| Textiles and footwear | 1.309 | 0.783 | 0.697 | 1.261 |
| Manufacturing | 1.163 | 0.418 | 0.904 | 0.503 |

| Productivity index 2 | Exporters | | Non-exporters | |
|---|---|---|---|---|
| | Mean | STD | Mean | STD |
| Metals | 0.545 | 1.004 | -0.177 | 1.239 |
| Chemicals | 1.323 | 1.298 | -0.305 | 1.424 |
| Machinery | 1.030 | 1.244 | 0.138 | 1.360 |
| Paper and wood | 1.544 | 1.436 | 0.001 | 1.556 |
| Construction materials | 1.323 | 1.087 | 0.466 | 1.438 |
| Textiles and footwear | 0.778 | 0.809 | 0.117 | 1.355 |
| Manufacturing | 0.994 | 1.190 | 0.166 | 1.417 |

**Figure 2.** Kernel density of TFP index (Prodindex 2) for exporters and non-exporters estimated by O-P.
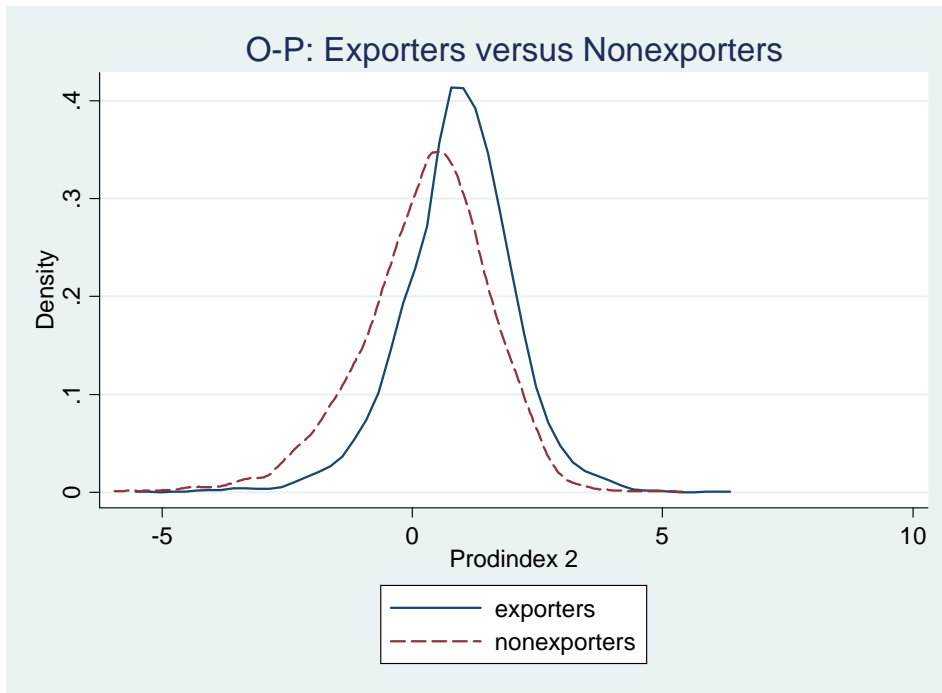


**Figure 3.** Kernel density of TFP index (Prodindex 2) for exporters and non-exporters estimated by modified O-P.
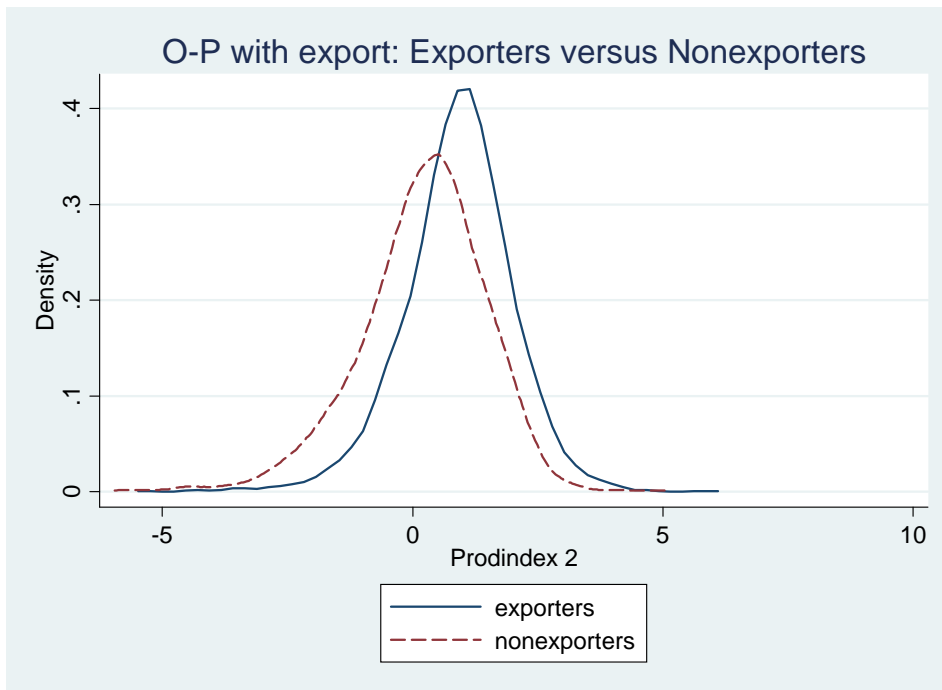
**Figure 4.** Kernel density of TFP index (Prodindex 2) for exporters and non-exporters estimated by L-P.



**L-P: Exporters versus Nonexporters**

exporters
nonexporters
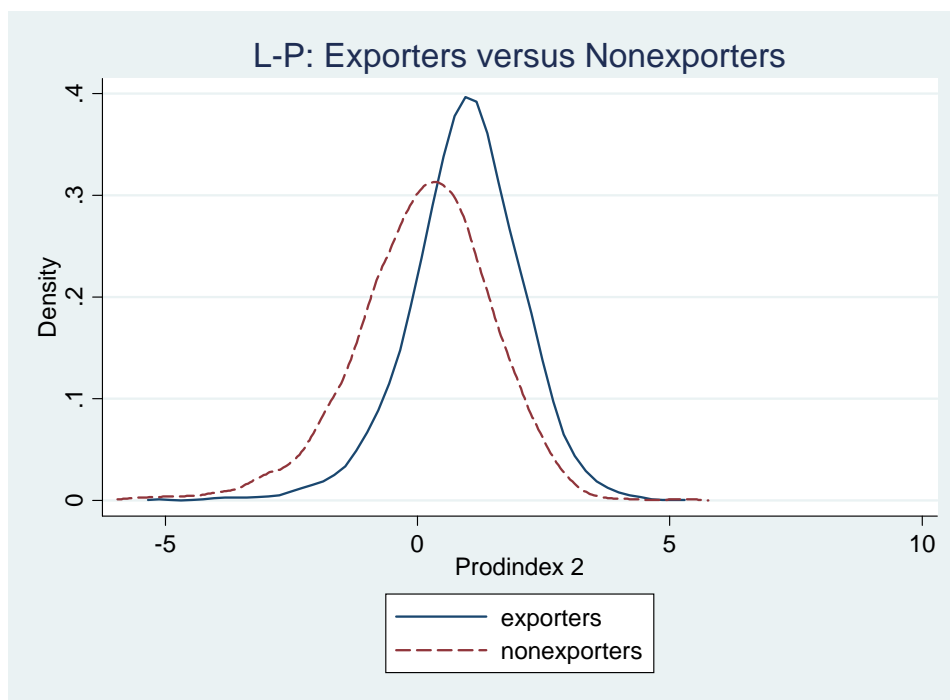
**Table 6**. Export Premium

| Outcomes | Export premium, % | | |
|---|---|---|---|
| | All | >1000 employees | <1000 employees |
| Labor productivity | 31.1 | 21.4 | 24.6 |
| TFP | 78.6 | 41.2 | 61.5 |
| Average wage | 25.5 | 14.3 | 21.7 |
| Output per worker | 41.0 | 31.3 | 31.2 |
| Capital per worker | 2.9 | 0.4 | 0.6 |
| Return on total assets | 2.19 | 2.53 | 1.62 |
| Profit margin | 3.54 | 2.37 | 3.23 |

**Table 7.** Export Premium by Industries.

| | Metals | Chemicals | Machinery | Paper | Construction materials | Textiles |
|---|---|---|---|---|---|---|
| Labor productivity | 31.7 | 50 | 29 | 69.7 | 16.3 | 34.5 |
| TFP | 61.7 | 145.1 | 81 | 138 | 35.6 | 59.6 |
| Average wage | 25.6 | 31.8 | 26.4 | 38.5 | 25.8 | 28.9 |
| Output per worker | 67.0 | 84.4 | 42.4 | 100.4 | 33.3 | 4.7 |
| Capital per worker | 21.3 | 8.2 | 8.5 | 57.8 | 31.7 | 54.5 |
| Return on total assets | 1.33 | 2.75 | 1.87 | 5.37 | 2.55 | 3.35 |
| Profit margin | 1.43 | 4.32 | 3.62 | 6.74 | 2.61 | 7.21 |

**Table 8.** Industry Ranking by Performance Measures

| TFP | Labor productivity | Average wage | Profit margin | Returns on total assets |
|---|---|---|---|---|
| Constructions | Constructions | Metals | Metals | Metals |
| Textiles | Machinery | Constructions | Constructions | Machinery |
| Metals | Metals | Machinery | Machinery | Construction materials |
| Machinery | Textiles | Textiles | Chemicals | Chemicals |
| Chemicals | Chemicals | Chemicals | Paper | Textiles |
| Paper | Paper | Paper | Light | Paper |

**Table 9**. Share of exporters with TFP below industry average.

| Industry | Share, % |
|---|---|
| Metals | 22.61 |
| Chemicals | 9.06 |
| Machinery | 11.24 |
| Paper | 2.83 |
| Construction materials | 3.25 |
| Textiles and footwear | 13.69 |

**Table 10.** Results of t-test on State Ownership in 2000.

| | t-stat | p-value |
|---|---|---|
| diff = mean(state-controlled if S=0) – mean(% state- controlled if S=1) | | |
| $H_o$: diff = 0 | -3.0924 | 0.0027 |
| | | |
| mean(diff) = mean(state share, % if S=0 – state share, % if S=1) | | |
| $H_o$: diff = 0 | -2.1012 | 0.0393 |

**Table 11**. Results of t-test on firm size (number of employees) by subgroups

| | t-stat | p-value |
|---|---|---|
| diff = mean(size if S=0) - mean(size if S=1) | | |
| $H_o$: diff = 0 | -4.2797 | 0.0001 |

**Figure 5.** Productivity distribution in Metals for Four Groups of Plants
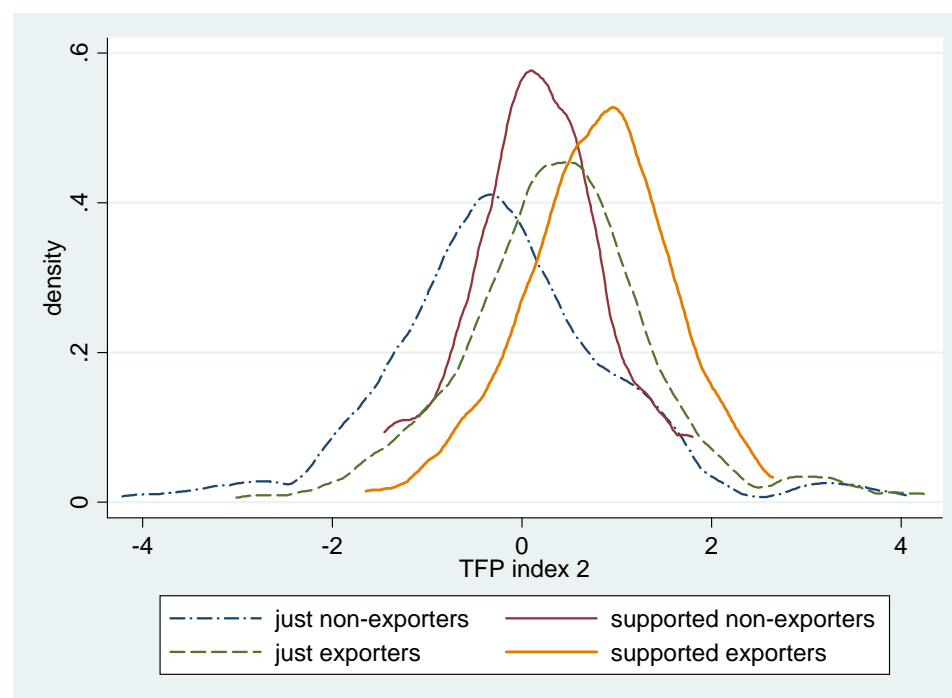


**Table 12**. Quantile Regression Results for the Unsupported Group of Exporters

|  | *Log TFP* | *Log TFP* |
| --- | --- | --- |
| Average wage | 0.730 | 0.559 |
|  | (0.098)** | (0.127)** |
| Capital per worker | -0.177 | -0.297 |
|  | (0.033)** | (0.045)** |
| Output per worker | 0.470 | 0.445 |
|  | (0.042)** | (0.054)** |
| Profit margin | 0.012 | 0.009 |
|  | (0.003)** | (0.004)* |
| Size |  | 0.140 |
|  |  | (0.028)** |
| Constant | -6.441 | -4.531 |
|  | (0.657)** | (0.867)** |
| Year dummies | Yes | Yes |
| Observations | 164 | 164 |
| Pseudo R2 | 0.445 | 0.468 |

**Table 13**. Results of t-test on estimated and predicted TFP by subgroups

|  |  | t-stat | p-value |
|---|---|---|---|
| diff = mean(delta S=0) - mean(delta if S=1) |  |  |  |
| H$_o$: diff = 0 |  | -4.4272 | 0.0000 |
| mean(diff) = mean(actual TFP – predicted TFP) |  |  |  |
| H$_o$: mean(diff) = 0 | ALL | 3.4567 | 0.0006 |
|  | Unsupported | -0.2514 | 0.8018 |
|  | Supported | 5.9208 | 0.0000 |

**Table 14**. Results of t-test on estimated and predicted TFP by subgroups controlling for size

|  |  | t-stat | p-value |
|---|---|---|---|
| diff = mean(delta S=0) - mean(delta if S=1) |  |  |  |
| H$_o$: diff = 0 |  | -2.8539 | 0.0046 |
| mean(diff) = mean(actual TFP – predicted TFP) |  |  |  |
| H$_o$: mean(diff) = 0 | ALL | 1.3514 | 0.1773 |
|  | Unsupported | -1.3159 | 0.1900 |
|  | Supported | 2.7969 | 0.0060 |

# Appendix

## Stock Portfolio.

If all voters hold balanced portfolio of all firms:

$$w^{iJ} = k^J \sum_{n=1}^{N_E} \alpha^n W^n(s^n) + (\sigma^{iJ} + \delta) V_R \tag{A1}$$

where $\alpha^n$ is the share of firms $n$'s stock in the portfolio and $\sum_{n=1}^{N_E} \alpha^n = 1$

As before:

$$W^J(s^J) = \pi_D^J + \pi_X^J - \tau + f(s^J) \tag{A2}$$

Given this assumption the vote share that the party $O$ gets will be again given by:

$$\lambda_O = \sum_J \frac{L^J}{L} t^J \phi^J \left[ \sigma^J + \frac{1}{2\phi^J} \right] \tag{A3}$$

The probability of party $O$'s winning of the elections is given by:

$$p_O = \Pr\left[ \lambda_O \geq \frac{1}{2} \right] = \frac{1}{2} + \frac{\psi}{\phi} \left[ \sum_J \frac{L^J}{L} t^J \phi^J k^J \left[ \sum_{n=1}^{N_E} \alpha^n W^n(s_O^n) - \sum_{n=1}^{N_E} \alpha^n W^n(s_R^n) \right] \right] \tag{A4}$$

In equilibrium $s_O^J = s_B^J$.

Trade policy will be determined in equilibrium by:

$$\max_{s_O^J} p_O = \frac{1}{2} + \frac{\psi}{\phi} \left[ \sum_J \frac{L^J}{L} t^J \phi^J k^J \left[ \sum_{n=1}^{N_E} \alpha^n W^n(s_O^n) - \sum_{n=1}^{N_E} \alpha^n W^n(s_R^n) \right] \right]$$

Where $W^n(s_O^n)$ is given by (2)

$$\frac{L^J}{L} \frac{\phi^J}{\phi} \frac{\alpha^J t^J k^J}{\lambda(L^J)} \frac{\partial f(s_O^J)}{\partial s_O^J} - \frac{L^J}{L} \sum_J \frac{\phi^I}{\phi} \alpha^I t^I k^I = 0 \tag{A5}$$

$$\frac{\partial f(s_O^J)}{\partial s_O^J} = \frac{\lambda(L^J) \sum_J \frac{\alpha^I t^I \phi^I k^I}{N_E}}{\alpha^J t^J \phi^J k^J} \tag{A6}$$