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EXPORTING AND PRODUCTIVITY: THEORY AND EVIDENCE FROM UKRAINE

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Contents

[1] This section draws extensively on the Olley and Pakes (1996) and simply presents their methodological procedure. For greater detail, please, refer to the original paper.

Preface

I first wish to sincerely and especially thank my thesis advisors, Carlo Altomonte and Gianmarco I. Ottaviano who helped me consistently and constructively the entire way. Without their guidance and advice, this work could not be produced. I additionally thank Dr. Hylke Vandenbussche for a number of useful comments. I particularly thank Dr. Roger Lagunoff for the directed and extremely productive talks while I was a visiting scholar at Georgetown University. I would also like to thank Tatiana Andreyeva and Victoria Levin for valuable comments and proofreading. My special thanks go to my mother for moral support, patience and impeccable understanding.

Introduction

Implementing a sound economic policy is of crucial importance for developing and transition economies. Trade policy is one instrument that a government can use to promote economic development and growth. If there is evidence that exporting leads to improved firm performance and consequently better economic outcomes, should the government promote exporting to boost overall productivity?

The increasing availability of firm-level datasets and the development of models accounting for firm heterogeneity have allowed scholars to further broaden the scope of analysis in international trade: researchers have discovered a much higher extent of within-industry heterogeneity than previously thought, and a huge variation across industries in the distribution of firms by size or productivity. As a result, traditional results are challenged, and a new wave of implications for economic growth and welfare has arisen. In the paper, we provide a survey of these recent results, analysing in detail the main methodological problems and solutions provided by the literature. We conclude indicating possible lines of research.

The 'new' new trade theory incorporates some recently developed heterogeneous firm models. These models of firm production behavior postulate that existence of sunk costs of exporting lead to self-selection of firms into foreign markets, hence only the most productive firms will export. My first interest was to examine the empirical evidence of these implications on firms' performance. For this purpose, I use an unbalanced panel of Ukrainian manufacturing publicly listed firms to estimate total factor productivity (TFP) applying the semi-parametric estimation technique developed by Olley and Pakes (1996). The essence of this technique is to use firms' investment as a proxy to unobserved productivity to recover production function coefficients. Similarly to other empirical studies, I find that exporting firms are, on average, more productive. As a robustness check I re-estimate TFP using Levinsohn and Petrin (2003) methodology. Both methods produce very similar distributions of TFP across exporting and non-exporting firms. In line with previous research I try to distinguish between self-selection n and learning-by-doing. For this purpose I apply matching, which is widely used in micro-level studies. Matching appears to demonstrate that after controlling for self-selection based on observable characteristics, exporting does not contribute to firm productivity. I also find that more productive firms grow slower than less productive ones.

Though I do find that exporters have superior outcomes than non-exporters, however, the gap between two groups does not seem to be large. In other words, I do not find cutoff level of productivity which partitions firms according to their exporting status. Motivated by this finding I build on a trade model with heterogeneous firms developed by Melitz and Ottaviano (2007) adding the possibility of endogenous trade policy induced by a political economy argument. I concentrate on the short-run perspective where all entry has occurred and exit is not taking place. I show that the presence of subsidies creates a region in productivity distribution in which both exporters and non-exporters are present, consistently with what I observe in the data. I use a probabilistic voting model as in Persson and Tabellini (2000) with two competing candidates. 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. Next I test model predictions on the dataset that I have using Ukrainian legislation to identify enterprises that were given explicit state support in metals industry. I find that in line with model predictions supported plants differ from non supported and that state support changes productivity ranking of the firm that would prevail in the intervention-free world.

Chapter 1

Exploring International Trade from Below: a Survey of Firm Heterogeneity and Productivity Dynamics

(joint with Carlo Altomonte)

1.1 Introduction

International trade theory has evolved over time, shifting emphasis to the micro level analysis in "an attempt to explore international trade from below" (Bernard, 2006). Earlier theoretical work that looked at the international trade from the comparative advantage perspective could predict inter-industry trade flows between countries but it could not explain existence of the intra-industry trade. The so called new trade theory initiated with the work of Krugman (1979, 1980) and Helpman and Krugman (1985) used the concept of love of variety and increasing returns to scale to explain intra-industry trade flows, treating however all firms within a sector as homogenous. This assumption became increasingly challenged by the empirical evidence: thanks to the increasing availability of firm-level datasets (Helpman, 2006), researchers have discovered a much higher extent of within-industry heterogeneity than previously thought, along both the extensive (the number of firms that, e.g. export or invest abroad) and the intensive (the size of each firm) margins; they also found a huge variation across industries in the distribution of firms by size or productivity. As a result, a new wave of research has spun, which explores different dimensions of firm heterogeneity together with the relevant implications for aggregate results.

Bernard et al. (2003) built their model on the traditional Ricardian model of stochastic comparative advantage to explain the interconnection between exporting, size, and productivity. Assuming the existence of "iceberg" costs of exporting, they showed that, consistently with the empirical findings, only the more productive firms (those with the least marginal costs) are able to sell to other countries.

Along the same lines, Melitz (2003) built his model capitalizing on the Krugman (1980) new trade theory framework, to which he added firm heterogeneity (firms can have different productivity, measured as the inverse of marginal costs), fixed cost of entry in the market and iceberg-type transport cost. The individual firm productivity is drawn randomly from a given distribution. The firm are uncertain about the productivity level when they have to pay fixed costs of entry. Once they learn their productivity level, firms have to decide whether to stay in the market or exit. Given the productivity draws and free entry condition there will be some threshold level of productivity which will determine what firms will stay in the market. In this model, 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. The Melitz model also allows to study the implications of trade policy on firm performance. According to the model, trade liberalization will affect aggregate productivity by forcing the least productive firms out of the market and shifting market shares towards more productive firms (the so-called reallocation effect). In contrast to the Melitz model, Melitz and Ottaviano (2005) develop a model in which market size does have an effect on firm-level outcomes. As a result, in addition to the reallocation effect their model allows for a pro-competitive effect of trade liberalization, which manifests itself in falling prices (in addition to the reallocation effect present in the Melitz model).

Bernard et al. (2006) combine the monopolistic competition-heterogeneous firms' model with comparative advantages. In addition to heterogeneity among firms, they model heterogeneity among industries in the form of different factor intensities assuming also various degree of relative abundance of factors across countries. This model manages to capture both macroeconomic and microeconomic aspects of international trade: (1) relative export intensity of different industries in different countries; (2) existence of intra-industry trade; and (3) coexistence of exporting and non-exporting firms within the same industry.

Summing up, the 'new' new trade theory models have two features in common (Baldwin, 2005). First, firms within the same sector differ in terms of their marginal costs (inverse productivity). Second, partition in the sector occurs due to the presence of sunk costs of entry to both domestic and foreign markets. Hence, many traditional results of trade theory have been reinterpreted and tested within the latter framework.

For example, it has been shown that only firms at the top end of the productivity distribution will export, although the causal direction between the exporting activity and the productivity level of individual firms is still the subject of debate in the literature. The relationship between trade openness and productivity of an industry/country has also been analyzed: since access to bigger markets should lead to an improvement in the overall productivity, trade liberalization should improve productivity by promoting reallocation of market share towards more productive firms. It is however unclear whether any type of trade openness, or whether only trade openness in vertical (intermediates) versus horizontal industries does lead to productivity gains. Also, if one considers the issue of product heterogeneity within firms, rather than assuming that each firms produces only one variety, firms might be reacting to international pressures by switching their product mix towards products characterized by lower elasticities of substitution and, as a result, higher markups. If this is the case, the traditional finding of a general pro-competitive effect of trade would then be reverted.

Finally, also the spillover and convergence literature have been influenced by the new microfoundations of the international trade literature. In particular, the availability of large panel data of individual firms have allowed researchers to improve on a number of methodological points in the estimation of spillovers and total factor productivity (TFP): apart from the endogeneity problem, recent studies are also able to control for the selection bias that might arise from the entry and exit of firms given the unbalanced panel nature of the datasets, and the simultaneity bias induced by productivity shocks correlated with firm-level input usage (starting with Pavcnik, 2002). Moreover, spillovers have been differentiated in their effects arising through backward linkages, i.e. generated through contacts between multinational affiliates and local input suppliers (vertical spillovers), versus intra-industry effects (horizontal spillovers) or forward linkages (Smarzynska Javorcik, 2004). The use of refined, firm-specific TFP measures also allows to overcome the limits of the convergence literature, typically using labor share in value added as coefficient in the production function (instead of estimating this coefficient through a regression) and assuming constant returns to scale[1]. The modern techniques based on semi-parametric estimation of the production function allow instead for varying returns to scale and produce better TFP estimates than conventional methods such as OLS estimation of the production function, as one can control for the simultaneity bias which arises when inputs and the error term are correlated, as already discussed. Furthermore, it is also possible to control for another typical problem of TFP estimation, and namely the omitted price variable bias induced by the correlation between individual firms' prices and their used inputs (see Klette and Griliches, 1996), a problem which, if not properly taken into consideration, can lead to biased measures of spillovers/convergence.

In the remaining of the paper, we shall turn to explore the methodological problems related to each of these issues, discussing in details the solutions currently identified by the literature, i.e. implicitly providing a survey of what is nowadays the state-of-the art in the field.

1.2 TFP Estimation

1.2.1 General Issues

One of the main challenges in the productivity literature is related to the accurateness with which TFP growth and its relative levels are measured. The literature usually opts between two main approaches: the superlative index number approach and production function estimation (Griffith et al., 2004). An advantage of index numbers is that they allow for a more flexible form in the production function, typically a translog. However, the key assumptions behind the superlative index number measures are constant returns to scale and perfect competition, two

[1]Bernard and Jones (1996) openly discuss the restrictions imposed by the measure of labor productivity when performing a convergence analysis, and thus estimate various specifications of TFP. They however perform their analysis at the aggregate country/industry level, still imposing constant returns to scale.

features which seem to be restrictive. Hence majority of the studies calculate TFP as the Solow residual of an estimated firm-specific production function (Cobb-Douglas) of a form:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \varsigma_{it} \tag{1.1}$$

In particular, in order to calculate firm-specific productivity, researchers follow the standard approach of deflating balance sheet data using disaggregated industry price indexes. In the absence of the output data, output is often proxied with deflated sales, given the better quality of these time series with respect to the ones reporting value added. The number of employees is used as a proxy for the labour input, and the deflated value of tangible fixed assets as a proxy for capital. One has then to estimate within each industry semi-parametric productivity measures at the firm level.

The reason for calculating production functions at the industry level is clearly related to the implicit assumption, undertaken in the estimation, that marginal productivity (i.e. β_k and β_l) are constant across firms. If an industry is characterized by, e.g., higher economies of scale than the average, the estimation of a production function across industries would in fact lead to an upward bias in the estimated TFP. Along the same lines, if firms differ in any relevant characteristic (e.g. domestic from multinationals), then the relevant production functions should also be estimated separately, since the FDI status of a firm might have an effect on the choice of input factors, another potential source of bias in the estimates of productivity (Van Biesebroeck, 2005).

Finally, using ordinary least squares when estimating productivity implies treating labor and other intermediate inputs as exogenous variables. However, as pointed out by Griliches and Mareisse (1995), profit-maximizing firms can immediately adjust their variable inputs each time they observe a productivity shock, which makes input levels correlated with the same shocks. Since productivity shocks are unobserved by the econometrician, they enter in the error term of the regression. That is the error term cam be decomposed in two components: $\varsigma_{it} = \omega_{it} + \varepsilon_{it}$, where ω_{it} is productivity observed by the firm, and ε_{it} is a random shock to productivity. Hence, inputs turn out to be correlated with the error term of the regression, and OLS estimates of production functions suffer from the so-called simultaneity bias. Olley and Pakes (1996) and Levinsohn and Petrin (2003), henceforth OP and LP, have developed two similar semi-parametric estimation procedures to overcome this problem using, respectively, investment and material costs as instruments for the unobservable productivity shocks.

1.2.2 The Levinsohn and Petrin (2003) algorithm

Let y_t denote (the log of) a firm's output in a Cobb-Douglas production function of the form

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t \tag{1.2}$$

where l_t and m_t denote the (freely available) labour and intermediates inputs in logs, respectively, and k_t is the logarithm of the state variable capital. The error term has two components: η_t, which is uncorrelated with input choices, and ω_t, a productivity shock unobserved by the econometrician, but observed by the firm. Since the firm adapts its input choice as soon as it observes ω_t, inputs turn out to be correlated with the error term of the regression, and thus OLS estimates of production functions yield inconsistent results. To correct for this problem, Levinsohn and Petrin (2003), from now on LP, assume that the demand for intermediate inputs m_t (e.g. material costs) depends on the firm's capital k_t and productivity ω_t, and show that it is monotonically increasing in ω_t. Thus, it enables them to write ω_t as $\omega_t = \omega_t(k_t, m_t)$, expressing the unobserved productivity shock ω_t as a function of two observables, k_t and m_t. To allow for identification of ω_t, LP follow Olley and Pakes (1996) by assuming that ω_t follows a Markov process of the form $\omega_t = E[\omega_t|\omega_{t-1}] + \xi_t$, where ξ_t is a change in productivity uncorrelated with k_t. Using these assumptions one can rewrite Equation (1.2) as

$$y_t = \beta_l l_t + \phi_t(k_t, m_t) + \eta_t \tag{1.3}$$

where $\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t(k_t, m_t)$. By substituting a third-order polynomial approximation in k_t and m_t in place of $\phi_t(k_t, m_t)$, LP show that it is possible to consistently estimate the parameter $\widehat{\beta}_l$ and $\widehat{\phi}_t$ in Equation 1.3. For any candidate value β_k^* and β_m^* one can then compute a prediction for ω_t for all periods t, since $\widehat{\omega_t} = \widehat{\phi}_t - \beta_k^* k_t - \beta_m^* m_t$ and hence, using these predicted values, estimate $E[\widehat{\omega_t|\omega_{t-1}}]$. It then follows that the residual generated by β_k^* and β_m^* with respect to y_t can be written as

$$\widehat{\eta_t + \xi_t} = y_t - \widehat{\beta}_l l_t - \beta_k^* k_t - \beta_m^* m_t - E[\widehat{\omega_t|\omega_{t-1}}] \tag{1.4}$$

Equation (1.4) can then be used to identify β_k^* and β_m^* using the following two instruments: k_t and m_{t-1} provided that capital stock k_t is determined by the previous period's investment decisions, hence it does not respond to productivity shocks at time t, i.e. $E[\eta_t + \xi_t | k_t] = 0$; and also that the previous period's level of intermediate inputs m_{t-1} is uncorrelated with the error period at time t (which is plausible, e.g. in the case of material costs), then $E[\eta_t + \xi_t | m_{t-1}] = 0$. Employing these two moment conditions allows to get a consistent and unbiased estimator for β_k^* and β_m^* simply by minimizing the following expression:

$$\min_{(\beta_k^*, \beta_m^*)} \sum_h [\sum_t (\widehat{\eta_t + \xi_t}) Z_{ht}]^2 \tag{1.5}$$

with $Z_t \equiv (k_t, m_{t-1})$ and h indexing the elements of Z_t.

1.2.3 Levinsohn and Petrin (2003) versus Olley and Pakes (1996)

Both the LP and OP methodologies have been employed in the literature, and both present some shortcomings. The LP methodology has been criticized on the grounds that the conditional demand for materials itself depends on the productivity shock, and thus materials are not a valid instrument to solve the simultaneity bias. The OP methodology, instead, does not suffer from the latter shortcoming, since the investment function is entirely determined before the productivity shock takes places; moreover, the OP approach offers a correction for the selection bias, incorporating in the algorithm a fitted value for the probability of exiting from the sample. However, a major assumption of the OP approach is the existence of a strictly monotonous relationship between the instrument (investment) and output. This means that any observation with zero or negative investment has to be dropped from the data. If the latter exclusion is significant, as it is typically the case with Eastern European data, due to the substantial restructuring of the capital stock that has to be undertaken, the OP productivity estimates will be affected by an important selection bias. If one suspects that the latter is the case for a relevant share of the sample firms, it is appropriate to compute productivity through both approaches, in order to verify the extent to which the two methodologies yield different results.

However, it is important to notice that the distribution of TFP as retrieved through both the LP and OP algorithms tend to overlap over the entire sampling period, once normalizing the TFP of a given firm by the industry average. Hence, any bias in the estimation of TFP eventually induced by either the LP or the OP methodology seems to cancel out, provided that it is industry-specific and constant over time. It follows that any second-step estimating algorithm where TFP enters as a dependent variable in first differences (typically in order to control for the unobserved firm-specific heterogeneity) is not affected by the choice of either methodology.

1.2.4 The omitted price variable bias

Another important source of distortion in the estimation of TFP, not yet fully tackled by the literature, relates to the so-called omitted price variable bias in the measurement of domestic firms' productivity. Since the seminal paper of Klette and Griliches (1996), it is known that proxying physical inputs and outputs through nominal variables deflated by a broad price index might lead to biased productivity measures, due to an omitted price variable bias induced by the correlation between (unobserved) individual firms' prices and their used inputs[2]. Such a bias can potentially affect the estimated TFP, and hence any further analysis, in various ways.

On the one hand, inputs are positively correlated with the level of output, which is typically negatively correlated with prices. If individual firm prices remain in the error term due to improper deflating, then the error term and the inputs are positively correlated, which yields an underestimated coefficient of labor and materials, and an overestimated TFP (thus opposite to the simultaneity bias one gets by using OLS, as previously discussed). On the other hand, improper deflating leads to a measurement error in the input and output variables: if prices charged by domestic firms are below the industry average, e.g. due to the competition they face, the latter distortion will induce a downward bias in the estimated firm-specific TFP[3]. If, instead, domestic firms are able to source inputs at lower prices than the industry average, e.g. because of the lower quality of the intermediates they use, the measurement error will induce an upward bias in the estimated TFP. Hence, the impact of the omitted price variable bias on domestic firms' TFP is not a priori univocal, and should be controlled for.

One possible way to assess these critiques is to follow Katayama, Lu and Tybout (2003), who argue that taking industry and region-specific averages of firm-specific TFP measures al-

[2] Eslava et al. (2004) discuss this issue in their analysis of productivity of Colombian firms, where they can exploit the availability of firm-specific information on prices and quantities. DeLoecker (2005) provides a formal econometric discussion of the omitted price variable bias.

[3] Starting from firms' i revenues Y expressed as quantities time prices, and considering P_I as the industry average price index, taking logs of the deflated revenue we have $y_i - P_I = q_i + p_i - P_I$. To the extent that some domestic firms price below the industry average, we have that $(p_i - P_I) < 0$ and thus our observed deflated revenue and domestic firms' productivity measure are downward biased.

lows to partially counter the omitted price variable bias, since the cross-variation in productivity measures is much more problematic than the time variation of the population of plants. Alternatively, following the spirit of Klette and Griliches (1996), one can control for the degree of imperfect competition on the demand side of the market via a modification of the semi-parametric algorithm. De Loecker (2005) discusses it within the Olley and Pakes (1996) algorithm, assuming demand is differentiated across products.

Altomonte and Pennings (2006) modify the Levinsohn and Petrin (2003) algorithm, allowing for spatial substitutability in demand (as in Syverson, 2005), i.e. assuming that deviations of firms' prices of outputs and inputs (our measurement error) have a spatial component (e.g. they differ across regions) which can be controlled for by adding regional fixed-effects to the industry-specific production function estimation. In particular, with specific reference to Equations (1.2-1.5), note that the intercept β_0 of the production function is not separately identified in the Levinsohn-Petrin algorithm. It is thus possible to modify the algorithm by incorporating in Equation (1.3) regional fixed-effects. As a result, one can retrieve firm-specific TFP measures corrected for region-specific factors which might affect the pricing power of domestic firms.

1.3 Exporting firms and trade liberalization effects

Benefiting from a greater availability of the plant-level data economists started to investigate the relationship between international trade and firm performance. Existing empirical evidence can be grouped according to the subject of investigation. The first group includes studies that look at the changes in firms' performance in response to major trade policy shifts, such as trade liberalization. Pavcnik (2002) pioneered the utilization of the Olley and Pakes (1996) TFP estimation methodology in the area of international trade. In her paper she investigates productivity dynamics in the Chilean manufacturing industry during the 80s, when major Chilean trade reforms were occurring. She finds that increase in productivity of Chilean manufacturing plants in the import-competing sectors was associated with trade liberalization, while export-oriented sectors did not seem to be affected by this policy change. Uruguayan trade liberalization (Peluffo, 2004) seems to only weakly affect the productivity in manufacturing. Epifani (2002) in an extensive survey of micro-level evidence on the link between trade policy and firm productivity in developing countries concludes that there is evidence of trade liberalization bringing about productivity gains, especially in import-competing sectors, mainly through resource reallocation towards more productive agents.

The other stream of empirical literature focuses on the differences in performance of exporters and non-exporters. In particular, this group of studies tries to answer the question whether ex ante more productive firms self-select into exporting or whether exporting per se improves firm performance as compared to the firms that serve only the domestic market. In their pioneering work, Bernard and Jensen (1999) inspect the causality link between exporting and firm performance using U.S. manufacturing census. Their study shows that over the short term exporting firms tend to be more productive than domestic ones, although if one were to look at the longer horizons exporting firms do not outperform non-exporting in terms of productivity, which is however estimated residually through OLS. Girma et al. (2002) compare exporting and non-exporting U.K. firms by applying matching techniques widely used in labor economics. First, they estimate propensity score as a probability of being exporter. Then they match firms based on this score to compare productivity–estimated from OLS regressions with time-specific effects–of exporting and non-exporting firms with similar propensity score. They find evidence that exporting firms are more productive and that self-selection into exporting occurs. However, they also find that exporting firms become more productive over time. Delgado, Farinas and Ruano (2002) employ non-parametric tests to compare productivity distribution functions of exporters and non-exporters. Using a Spanish dataset they demonstrate higher levels of productivity for exporting firms, finding evidence in support of the self-selection rather than the learning hypothesis. Arnold and Hussinger (2005) also employ matching on propensity score for German exporters and non-exporters; they also confirm presence of self-selection but that exporting does not further affect productivity.

Alvarez and Robertson (2004) make an implicit assumption about the channel through which exporting may influence firms' productivity. They assume that different types of innovation undertaken by Chilean and Mexican plants are indicators of productivity changes and find that exposure to foreign markets is positively associated with technological advancements and innovations.

Recently several researchers have incorporated export status in the estimation of the productivity. One of the three methods used by Van Biesebroeck (2005) to approach the issue of self-selection versus learning-by-doing implies that past exporting experience might affect production choices. The three different estimation methods yield robust support to the claim that African firms experience improvements in productivity after entering foreign markets: that is, not only do exporters ex ante differ from their non-exporting counterparts, but also they become more productive within the exporting period. De Loecker (2007) suggests modification to Olley and Pakes methodology to correct for different market structures faced by exporting and non-exporting firms. Then he proceeds to estimate TFP using this procedure for the Slovenian manufacturing dataset. He finds that entering export market is associated with an increase in the TFP for new entrants. He also shows that export destination matters for productivity dynamics.

Following Bernard and Jensen (1999) it became common for researchers to estimate an exporting premium running the following regression:

$$\ln X_i = \alpha + \beta Export + \gamma Industry_i + u_i \tag{1.6}$$

where X_i is a firm characteristics such as value-added per worker, average wage, capital per worker, etc. *Export* is a dummy for current export status, and *Industry* is an industry dummy. The export premium, β, shows how exporters and non-exporters differ on average within the same industry. All of the previous studies find this premium to be statistically significant and positive: exporters outperform non-exporters in terms of productivity, wages, capital intensity.

This finding brings us to the question on what drives these exceptional performance of the exporting firms. Arnold and Hussinger (2005) use VAR in two variables to identify Granger causality between exporting and productivity. In particular they estimate a system in two equations where productivity and export status are explained by past values of the two variables:

$$\begin{aligned} TFP_{it} &= \alpha_1 TFP_{i,t-1} + \alpha_2 TFP_{i,t-2} + \beta_1 Export_{i,t-1} + \beta_2 Export_{i,t-2} + u_{it} \qquad (1.7) \\ Export_{it} &= \gamma_1 TFP_{i,t-1} + \gamma_2 TFP_{i,t-2} + \delta_1 Export_{i,t-1} + \delta_2 Export_{i,t-2} + v_{it} \end{aligned}$$

The results of the estimation seem to suggest that the direction of the causality is from productivity to exporting, that is the more productive firms self-select into the exporting.

Several studies implement matching based on propensity score to pinpoint the effect of exporting on the productivity. Matching has been widely applied in the labor economics literature and public policy area when one needs to evaluate effectiveness of a program. Matching is implemented when the treatment variable takes only two values (Duflo, 2000). In this case, exporting status is considered to be treatment, that is $T = 1$ if firm is exporting. The most important assumption behind matching is that the treatment is random when controlling for observable characteristics. If there are several observables on which treatment is conditional, the matching based on propensity score is used.

When applying a matching technique, researchers face a trade-off of satisfying the balancing property or capturing the maximum of firms' characteristics that are related to the firms' probability of becoming exporters. Arnold and Hussinger (2005) use one-to-one nearest neighbor method to match exporting and non-exporting firms. In their specification of the probit model of selection into exporting they use a lagged export dummy and a set of firm characteristics. They report that the difference between propensity scores for matched pairs lies in a very narrow range. In case of inclusion of lagged export the balancing property would not be satisfied since the distributions of the propensity scores for exporting and non-exporting groups would be lying very far apart[4].

De Loecker (2007), taking advantage of the Slovenian data, which exhibit a high degree of shifting in and out of the foreign market activity, looks only at the 'new' exporters. In the first stage he estimates propensity scores using the following model:

$$\Pr\left\{Start_{i,0}=1\right\}=\phi\left\{h(\omega_{i,-1},k_{i,-1},Private_{i,-1})\right\} \tag{1.8}$$

where $h(\cdot)$ is a full polynomial of the three variables: past productivity, capital stock and ownership). He finds that firms which start to export experience a productivity improvement both in terms of levels and growth rates.

A new line of research has been proposed recently by Bernard et al. (2007). They note that both empirical and theoretical strains of literature pay little if any attention to firms' imports. Availability of transaction-level trade data for the U.S. allows them to shed some light on the relationship between importing and exporting. They find that depending on the sector from one (in Printing and Related Support) to twenty six percent (in Computer and Electronic Products) of all firms both import intermediate inputs or materials and export final output (on average eight percent of all manufacturing firms are both importers and exporters). In a similar fashion as they did for exporters in the earlier work, they also identify 'import' premium by comparing main indicators of firm performance for importing and non-importing firms:

$\ln X_i=\alpha+\beta\,\mathrm{Im}port+\gamma Industry_i+\varepsilon_i$

Importing seems to be associated with higher wages, higher productivity and other indicators of better firm performance. As a possible explanation for this finding the authors suggest "international fragmentation of production" where stages of production are spread across na-

[4]Balancing property is said to be satisfied when the mean of variables describing firm characteristics is equal for two groups within a block

tional boundaries.

1.4 Spillovers

The literature on spillovers has identified several channels through which MNEs might affect domestic firms' productivity, but no conclusive evidence has been reached on this issue yet[5]. The standard spillover regression, relating domestic firms' TFP to the presence of MNEs in the industry-region pair (Model 1):

$$\ln(TPF_{it}) = \alpha + \beta HP_{zjt-1} + \gamma_z + \gamma_j + \gamma_t + \varepsilon_{it} \tag{1.9}$$

In Equation (1.9), $\ln(TPF_{it})$ is the (log of) TFP of firm i at time t and HP_{zjt} is the change in an index of horizontal penetration calculated as the ratio of multinational employees over total employment in the considered industry z, region j and year t. As it is standard in the literature, a positive and significant β would be interpreted as evidence of horizontal spillovers, while the lagged term is introduced in order to control for the potential endogeneity of the index (Aitken and Harrison, 1999).

A more refined specification has been followed by Smarzynska Javorcik (2004). Working on Lithuanian regional data and exploiting a measure of firm level productivity which controls for the simultaneity bias in firms' decisions, she has detected significant positive spillovers arising via backward linkages, i.e. generated through contacts between multinational affiliates and local input suppliers. She finds instead no clear evidence of the presence of either horizontal spillovers (intra-industry linkages) or spillovers through forward linkages. In particular, she

[5] In their survey Gorg and Greenaway (2004) discuss the inconclusive evidence emerging from several empirical contributions analyzing various channels of MNEs' spillovers.

tests the following specification:

$$\ln(TFP)_{ijrt} = \alpha_0 + \alpha_1 HP_{jr(t-1)} + \alpha_2 BP_{jr(t-1)} + \alpha_3 FP_{jr(t-1)} + \alpha_4 X_{j(t-1)} + \alpha_5 Z_i + \alpha_t + \alpha_r + \alpha_j \tag{1.10}$$

where i denotes the firm, j the industry and r the region at year t. The dependent variable $\ln(TFP)_{ijrt}$ is the (log of) total factor productivity of a firm i, in sector j and region r, calculated semi-parametrically; HP_{jrt} is an index of horizontal penetration, capturing the intra-industry presence of MNEs and calculated as the ratio of multinational employees over total employment in the considered industry j, region r and year t. The index BP_{jrt} measures the foreign presence in industries from which industry j's domestic firms are sourcing their inputs, thus accounting for forward linkages from MNEs to domestic firms. It is computed as the weighted sum of the horizontal penetration figures of all the suppliers' industries, according to the formula $BP_{jrt} = \sum_{k\ (if k \neq j)} \alpha_{jk}\ HP_{krt}$, where α_{jk} is the proportion of industry j's total inputs sourced from industry k, an information retrieved from the Input-Output Matrix. Analogously, the index FP_{jrt} measures the presence of multinationals' affiliates in industries which are sourcing inputs from sector j, thus accounting for backward linkages from MNEs to domestic firms. Specularly to the BP index, it is defined as $FP_{jrt} = \sum_{m\ (if m \neq j)} \beta_{jm}\ HP_{mrt}$, where β_{jm} is the proportion of output sold from industry j to m, out of industry j's total sales[6].

The covariates $X_{j(t-1)}$ control for the market structure that might affect the domestic firms' productivity: in particular, the literature has included in the specification for each industry j the Herfindahl Index, calculated using the market shares of all the firms in the sample; and the minimum efficient scale, proxied by the median firms' employment. Both covariates enter in the regression with their lagged values. Firm-specific heterogeneity in the dependent variable is also captured by proxies Z_i, e.g. the year of entry of each firm, which allows to test for

[6]Clearly, in the calculation of both the BP and FP indexes one has to exclude from the computation the inputs supplied and sourced within the same industry in order to avoid a double counting of the foreign presence, since any potential intra-industry effect is already taken into account by the HP index.

eventual structural differences in the productivity performance of different cohorts of entrants or the initial level of TFP of the domestic firms in the year of entry, thus testing whether initially less productive firms tend to experience higher productivity growth rates.

The specification reported in Equation (1.10) allows to control for endogeneity (by lagging one period the penetration indexes) and the unobserved, time, region and industry-specific characteristics that might affect the correlation between firm productivity and foreign presence (by including the time, region and industry fixed effects α_t, α_r, and α_j). Another typical econometric concern for this kind of estimates–the simultaneity bias in the measure of firm-level productivity–is addressed using the already discussed Levinsohn and Petrin (2003) methodology in order to calculate firm-level productivity estimates. Finally, since econometric analysis is performed on micro units using mainly aggregate variables as covariates (at the regional and industry level), it is appropriate to control for the potential downward bias in the estimated errors by clustering the standard errors for all firm-level observations belonging to the same region-industry pair.

1.4.1 Refinements of the spillover regression

The exclusion of individual firms' fixed-effects, which might also affect the correlation between firm productivity and foreign presence, is typically achieved by differencing the estimating equation, i.e. working with a difference-in-difference specification. However, a sound economic interpretation points to the fact that it might be appropriate to lag the covariates related to the MNEs' presence instead of differencing them over time. In fact, a difference-in-difference spillover regression imposes the assumption that changes in productivity of domestic firms are driven only by changes in the presence of MNEs, which is not necessarily true, since domestic firms might be affected differently by the same stock of MNEs over time via learning (e.g. Liu, 2006).

Moreover, in the traditional spillover regression, the presence of MNEs is measured by the ratio of multinational employees over total employment in the considered industry z, region j and year t. A positive and significant coefficient for the variable related to MNE's presence in the industry is then interpreted as evidence of horizontal spillovers[7]. A lag structure imposed on the MNE-related variables allows to control for the potential endogeneity of the MNEs' presence in the selected region-industry pair.

A model design of this kind implies, however, that an equiproportional increase in the MNEs' employment and the total employment (thus yielding a constant share) will have no effect on domestic firms' productivity. But if the absolute values of the elasticities of foreign and total employment are different, Castellani and Zanfei (2003) have shown that using only the ratio of foreign to total employment downwardly biases the estimate of the coefficient, and might thus be responsible for the lack of evidence on horizontal spillovers. As a result, it is appropriate to compare the standard model design, where spillovers are captured by the horizontal penetration index, with a model design where the presence of MNEs is identified by an absolute, rather than relative, index measuring the presence of the same multinationals operating in a given industry/region in a given year, controlling in this case for the industry-specific average investment size.

1.5 Convergence

Another stream of literature links international trade to convergence theory. Standard neoclassical economic theory suggests that, under diminishing returns and free movement of factors, per capita income levels within an economic area should converge over time to the same steady state value (Barro and Sala-i-Martin, 1991). However, such a view has been challenged since long by

[7] Vertical spillovers would then be measured by weighting the horizontal penetration index with the input-output coefficients, as in Smarzynska Javorcik (2004).

many authors[8], who have found a persistence of income disparities, arguing therefore that the pattern of cross-country growth is more consistent with endogenous growth, rather than neoclassical theories. Most of this early empirical literature has generally used either cross-section or time-series techniques. Islam (1995) advocates instead panel data approaches to estimate productivity growth convergence since, by incorporating country fixed effects, these models account for initial efficiency and thus test for conditional convergence. Lee, Pesaran and Smith (1997) comment that heterogeneity in speed of convergence from such a panel regression may bias the results. Bernard and Jones (1996) used both cross-section and time-series approach to measure the convergence of sectoral productivity in different industries with respect to aggregate productivity in a panel of fourteen OECD countries, and found no sign of convergence in manufacturing industries, but a different response of services. They also discussed the relevance of different concepts of convergence (β versus σ-convergence)[9] as well as the importance of properly measuring productivity in order to obtain unbiased results.

Recently, the increasing availability of disaggregated cross-country data has revamped an interest in explaining differences in the sources and speed of convergence. By regressing GDP growth on the interaction of lagged GDP and an indicator of financial development, Aghion, Howitt and Mayer-Foulkes (2005) show the positive effect of financial development on the speed of convergence. Other recent studies have looked at TFP growth instead, using the interaction between the distance to the technology frontier and a variable for the speed of convergence as explanatory variable for growth. Using the Penn World Tables, Benhabib and Spiegel (2005) explain differences in the cross-country speed of convergence through schooling. In a panel of 12 countries over the period 1974-1990, Griffith, Redding and Van Reenen (2004) use, in addition to schooling, absorptive capacity and imports as determinants for the speed of

[8]See Temple (1999) for a general overview of the empirical growth literature or Mohnen (1996) for a more specific survey of TFP growth.

[9]The concept of σ-convergence deals with the dispersion of productivity over time; β-convergence refers to a negative correlation between the initial level of productivity and its rate of growth. The latter is a necessary condition for σ-convergence, but not a sufficient one.

convergence. Schooling and absorptive capacity appear to positively affect the speed of convergence, while imports do not seem to have a significant effect. Employing a panel of 14 UK manufacturing industries, Cameron, Proudman and Redding (2005) do find that international trade significantly enhances the speed of technology transfer.

The refinements to the measurement of TFP previously discussed, together with the ability of micro-based data, now allow for a more detailed analysis in terms of convergence. First, from a methodological point of view, it is possible to derive regional and industry specific TFP measures as averages of firm-specific TFP estimated using the semi-parametric method by Levinsohn and Petrin (2003). The latter procedure allows to overcome the restrictions typical of the traditional approach, which uses the labor share in value added as coefficient in the production function (instead of estimating this coefficient through a regression) and assumes constant returns to scale. The semi-parametric estimation of the production function allows instead for varying returns to scale and produces better TFP estimates than conventional methods. In addition, by using industry averages, measurement error is reduced, resulting in lower standard errors of the estimated coefficients. Furthermore, in the convergence analysis one needs to deal with the omitted price variable bias induced by the correlation between individual firms' prices and their used inputs (see Klette and Griliches, 1996). Failing to take this bias into account, the resulting estimated speed of convergence could be upward biased.

Moreover, in contrast to the recent literature on the speed of convergence, micro-funded dataset allow to take a more regional and sectoral perspective, thus testing new explanations for the speed of convergence. Sectoral and regional data on FDI inflows allow for a more direct test of the significance of openness on the speed of convergence with respect to country specific trade data. As an industry specific variable, the minimum efficient scale (MES) may affect the speed of convergence as firms in industries where firms are larger on average are more likely to possess a sufficient level of absorptive capacity, as argued by Aitken and Harrison (1999). Another industrial variable that is related to absorptive capacity and may affect the speed of convergence is the average ratio of intangibles to total assets. Finally, the distance from the region to the capital is a region-specific variable that may have an impact on the speed of convergence.

1.6 Concluding remarks

Advances in the statistical software and increased data availability at the firm or even product-level have shifted the focus in international economics from the macroeconomic perspective to a disaggregated, micro-founded one. Researchers have been actively engaged in studying the mechanisms through which international trade influences decisions and performance outcomes of the economic agents. While economists are unanimous on the effects of the international trade on the consumers, the business side of the economy offers a wide range of questions, whose answers have not been clearly defined yet. One of the biggest research questions in this area has been concentrated on exporting activity and firm performance, in particular whether firms self-select into foreign markets and/or improve their performance through learning from the foreign experience. That is, if exporting firms are growing faster in absolute (own productivity growth) or relative terms (market share reallocation). The growing stream of empirical literature seems to be in favor of the self-selection idea recently theorized in models with heterogeneous firms, thus finding limited support for the learning-by-exporting hypothesis.

Another question on the research agenda has been focused on the presence of foreign economic agents in the home economy through foreign direct investment. Various studies not only look if these firms outperform domestically owned firms but also if their presence affects other firms belonging to the same sector (horizontal spillovers) or firms that are forwardly or backwardly linked to them through the production chain (vertical spillovers). To this extent, a renewed interest has also arisen concerning the implications of spillovers for the convergence of domestic firms to the productivity frontier.

Finally, we would like to outline some future lines of research in this area.

Once the hypothesis of self-selection of the most productive firms has been established, now the question shifts to the determinants of the firms' decisions to go abroad. What are the factors that would influence the resolution, timing and choice of the activity to be undertaken in the foreign market (e.g. FDI versus exporting)? What are the forces that determine which markets to be 'conquered' first (e.g. institutions in both home and host countries)?

More attention is also needed to the importing side of the international activity. Recently available data on the importing activity of firms find a strong correlations between imports and exports. But what are the linkages between exporting and importing? Is it possible that exporting firms are more productive simply because they better select their imports of intermediates?

Finally, a further dimension of firm heterogeneity which has just started to be explored (Bernard et al., 2006a) is related to the issue of product heterogeneity within firms: some firms might react to international competition endogenously self-selecting into the production of a different product mix composed of asymmetric products, each one developed according to a different technology. The implications of this finding are challenging many of the traditional results established by the international trade literature, and as such constitute another very promising line of research.

Chapter 2

Exporting and Firm Performance: Evidence from Ukrainian Economy

2.1 Introduction

Implementing a sound economic policy is of crucial importance for developing and transition economies. Trade policy is one instrument that a government can use to promote economic development and growth. This paper contributes to the growing body of empirical literature that tries to investigate the linkages between foreign trade and economic outcomes at the plant level. My objective is to provide a better understanding of the impact of access to foreign markets on firm performance in Ukraine. If there is evidence that exporting leads to improved firm performance and consequently better economic outcomes, should the government promote exporting to boost overall productivity?

Earlier theoretical work related to the so-called "new theory" treated all firms within a sector as homogenous. However, growing empirical research at the firm level has shown that firms are very different even within 4-digit sectors. Differences in performance are often driven by whether firms serve only the domestic market or also export their products. Challenged by the empirical evidence on the diversity among firms, a number of theoretical models featuring heterogeneous firms have been developed. Melitz (2003) introduced heterogeneity among the producing agents by assuming that firms differ in their productivity Melitz and Ottaviano (2007) further exploited the possibility of variation among firms by allowing for changing elasticities of substitution between differentiated goods. As summarized by Baldwin (2005), two main features of the heterogeneity models are (1) firms with different marginal costs in same sector and (2) fixed costs of entry to both domestic and foreign markets. The main implications of these models are: (a) exporters should significantly differ from non-exporting firms in terms of productivity; (b) access to a bigger market should lead to an improvement in productivity; and (c) trade liberalization should foster reallocation of market share towards more productive firms.

Existing empirical evidence can be divided into two main streams. The first stream includes studies tracking changes in firms' performance resulting from major trade policy shifts, such as trade liberalization. One of the first attempts to investigate the relationship between industry- and plant-level productivity and trade policy empirically was made by Pavcnik (2002). In this study she used a dataset covering Chilean manufacturing enterprises. As her dataset spanned more than a decade at the time when major Chilean trade reforms were occurring, Pavcnik was able to track changes in productivity associated with trade policy instruments. She found empirical support for the hypothesis that increasing productivity of Chilean manufacturing plants in the import-competing sectors was associated with trade liberalization, while export-oriented sectors did not seem to be affected by this policy change. Peluffo (2004) as well observes only weak evidence of a positive effect of Uruguayan trade liberalization on the industries' productivity; she also shows that technology and market structure seem to be important for explaining differences in performance.

For an extensive survey of micro-level evidence on the link between trade policy and firm productivity in developing countries, see Epifani (2003), who concludes that there is evidence of trade liberalization bringing about productivity gains, especially in import-competing sectors, mainly through resource reallocation towards more productive agents.

The other stream of empirical literature focuses on the causes of superior performance by exporters; that is, whether more productive firms self-select into entering foreign markets or it is exporting that makes those firms that engage in it differ from their counterparts that serve only the domestic market. Bernard and Jensen (1999) inspect the causality link between exporting and firm performance using U.S. manufacturing data. They attempt to determine whether more productive ex ante firms self-select into exporting or whether exporting per se improves firm performance. The study shows that over longer horizons exporting firms do not outperform non-exporters in terms of productivity. However, the TFP numbers they use are estimated residually from the production function with coefficients obtained by simple OLS. As Olley and Pakes (1996) have shown, OLS produces biased estimates of the coefficient on the variable input (labor, in this case); thus, the Bernard and Jensen finding of no superior performance by exporters may, in part, be driven by their estimation technique. Girma et al. (2002) compare exporting and non-exporting U.K. firms by applying matching techniques using TFP, as estimated from OLS regressions with time-specific effects. They find evidence that exporting firms are more productive and that self-selection into exporting occurs. However, contrary to earlier evidence, they find that exporting firms become more productive over time. Arnold and Hussinger (2005) also employ matching for German exporters and non-exporters to show that self-selection is present but that exporting does not further affect productivity. Delgado, Farinas and Ruano (2002) using a Spanish dataset demonstrate higher levels of productivity for exporting firms, finding evidence in support of the self-selection rather than the learning hypothesis. Alvarez and Robertson (2004) make an implicit assumption about the channel, through which exporting influences firms' productivity. They assume that different types of innovation undertaken by Chilean and Mexican plants are indicators of productivity changes and find that exposure to foreign markets is positively associated with technological advancements and innovations. Recently Van Biesebroeck (2005) has approached the issue of self-selection versus learning-by-doing with three different estimation methods yielding robust support to the claim that African firms experience improvements in productivity after entering foreign markets: that is, not only do exporters ex ante differ from their non-exporting counterparts, but also they become more productive within the exporting period.

Summing up, there is convincing evidence that exporting firms, on average, are more productive than their counterparts oriented only to domestic markets. However, whether the exporters' performance improves as a result of sales in foreign markets remains unclear. My research contributes to the latter stream of research.

To estimate plant-level productivity I utilize the methodology developed by Olley and Pakes (1996)[1] in their seminal paper on telecommunication industry in the U.S. This methodology

[1] Hereinafter referred to as O-P

was further used in a number of empirical papers studying the effects of different policy shocks on the industrial dynamics.

The idea behind the O-P methodology is in eliminating two potential biases when estimating production function coefficients. The first type of bias is attributed to simultaneity of the choice of variable inputs. The second bias arising in the estimation of the production function by OLS is caused by selection, due to the pattern of firm exit from the market; firms with greater capital stock will remain in the market thus biasing the coefficient on capital. Olley and Pakes use a multi-stage four-order polynomial expansion to recover the coefficients on labor, capital, and age of firm. I estimate both specifications–with and without age–however, making a conjuncture that age will be negatively associated with the total factor productivity given the liquidity crunch that many firms in transition economies face.

Given the limited nature of my dataset and in order to check the robustness of my TFP estimates, I apply two other approaches, a technique developed by Levinsohn and Petrin (2003), who use intermediate inputs to proxy for unobserved productivity instead of using investment; and a modified O-P approach which takes into account potential differences between exporters and non-exporters (De Loecker, 2005). Though the coefficients obtained by the these methods differ somewhat, the encouraging result is that the distributions of productivity indices (TFP) for the whole sample look very much the same. Since my main interest is not in estimating precise production function coefficients but in obtaining a consistent estimate of TFP, I ignore these observed differences and continue with the modified O-P methodology.

To my knowledge, there have been very few attempts to investigate exporting and firm performance for countries in transition, and especially, countries of the former Soviet Union. The main reason for such neglect is clearly data unavailability for this set of countries. Obviously, statistics agencies of these countries do collect information and reporting of business entities; however, as in the case of Ukraine, the state statistics committees do not release the data on individual enterprises to the public. Hence, the only possible source of data is various surveys and the reporting of the publicly listed (joint stock) companies. I am not aware of any survey in Ukraine that extensively covers production data, including fixed assets and investment. At the same time, joint stock companies are required by law to report on an annual basis all business-related information, such as balance sheets, production quantities,and other statistics. This enables me to estimate these companies' production functions. Another advantage of this data is that starting in 1999 these companies have to report their exporting/importing activity. Interestingly, the reporting forms also contain questions on the level of perceived competition and on the main competitors faced by the company. The time coverage of the dataset is 2000-2002.

After obtaining estimates of the production function and subsequently TFP, I can investigate the impact of exporting on firm performance. Throughout my analysis I use two normalized measures of TFP. The first is simply a plant's TFP divided by the average productivity in the industry in a given year. The second index, used by Pavcnik (2002), normalizes the above productivity index by taking into account the productivity of a plant with mean output and mean input level in a base year (in my case, it is 2000), that is, subtracting this "average" plant's productivity from the estimated productivity of a given plant in a given year. The advantage of the latter approach is that it is insensitive to measurement units and also possesses the transitivity property. A simple comparison of kernel density estimates shows that the unconditional distribution of both TFP indices for exporters is shifted to the right; that is, without controlling for other factors, exporters, on average, are more productive than non-exporters (average value of the first index is around 1.14 for exporters and 0.90 for non-exporters, the respective numbers for the second index are around 0.65 and -0.1, respectively).

To disentangle the impact of exporting on productivity and to control for other observable characteristics of the firms that could influence the differences in the performance of the two groups, I estimate different specifications with TFP as the dependent variable. Lagged export status as well as percentage change in export volumes seem to be positively correlated with TFP in the current period, even if one-period lag of TFP is included.

The next step I take is to determine whether exporters are different because of self-selection or because of learning-by-doing. Initially, I try to see whether lagged productivity affects the probability of exporting and/or exports as a share of total sales. Lagged TFP does seem to affect probability of exporting as well as export volumes in some specifications even when lagged exports is included; however, the result is not robust to changes in the set of other RHS variables.

Since my dataset's time coverage is not long enough to run any causality tests, I employ two different matching methods. The first is kernel matching solely on propensity score, while the second is a combination of matching on propensity score and Mahalanobis metric matching within specified caliper. Matching allows a comparison of outcomes of interest of the treated group with control group based on some observable characteristics that influence the probability of being treated (exporting, in my case) (Heckman et al. 1998). Both methods show that the difference between exporters and non-exporters disappear once self-selection is controlled for.

This paper is organized as follows. Section 2 deals with theoretical underpinnings. Section 3 describes data and methodology. I present results of the estimation in Section 4. I conclude paper with final remarks in Section 5.

2.2 Theoretical background

Earlier theoretical work related to the so-called "new theory" treated all firms within a sector as homogenous. However, growing empirical research at the firm level has shown that firms seem to be different in terms of productivity even within 4-digit sectors. Differences in performance are often explained by whether firms serve only the domestic market or also export their products. Challenged by the empirical evidence on the diversity among firms, a number of theoretical models featuring heterogeneous firms have been developed. Melitz (2003) introduces heterogeneity among the producing agents by assuming that firms differ by their productivity, which is 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 the firms face the same fixed costs of entry (incurred prior to the realization of the productivity draw), only firms above a certain productivity threshold will stay in the market. The Melitz model allows us to study the implications of trade policy on firm performance. In this model, 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 by forcing the least productive firms out of the market and shifting market shares towards more productive firms (reallocation effect).

Melitz and Ottaviano (2005) further exploited the possibility of diversity among firms by allowing for changing elasticities of substitution between differentiated goods. In contrast to the Melitz model, here market size does have an effect on firm-level outcomes. As a result, the model allows for a pro-competitive effect of trade liberalization, which manifests itself in falling prices (in addition to the reallocation effect present in the Melitz model). According to the Melitz and Ottaviano model, productivity will affect the size of the firm, the prices it charges as well as mark-ups, with more productive firms being larger, charging lower prices, and having bigger mark-ups. Hence, in this model, the direction of causality is from productivity to size and not from size to productivity as would be implied by, for example, the effect of increasing returns to scale. Empirical literature routinely uses firm size variables as controls in determining the relationship between firm characteristics and firm performance (see, for example, Castany et al. 2005). In this paper I am also trying to investigate the link between size and productivity, and the results I obtain provide support to the implications of the Melitz and Ottaviano model.

Bernard et al. (2003) use a modified version of the Ricardian model of stochastic comparative advantage to explain the interconnection between exporting, size, and productivity. 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. Thus, this model provides an explanation to the well-documented phenomenon of the presence of both exporting and non-exporting firms in the same 4-digit industry.

In another model, Bernard et al. (forthcoming) 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 relative abundance of factors of production varies across countries. This model manages to capture both macroeconomic and microeconomic aspects of international trade: (1) relative export intensity of different industries in different countries; (2) existence of intra-industry trade; and (3) coexistence of exporting and non-exporting firms within the same industry.

Helpman et al. (2004) study the effect of heterogeneity among firms on their decision whether to export or set up a subsidiary (FDI). Since the former is associated with lower fixed costs, only most productive will use FDI to serve foreign market. Schematic representation of the models is presented in Figure 1 where the Pareto distribution of productivity[2] with various cutoff points is plotted. Firms to the left of the cutoff point φ^D will not produce, firms in the interval between φ^D and φ^E will serve only the domestic market, while firms to the right of φ^E will export. As discussed above, Helpman et al. show that outward-oriented firms will be further partitioned into exporting firms and firms engaged in FDI (the far-right cutoff point φ^{FDI}).

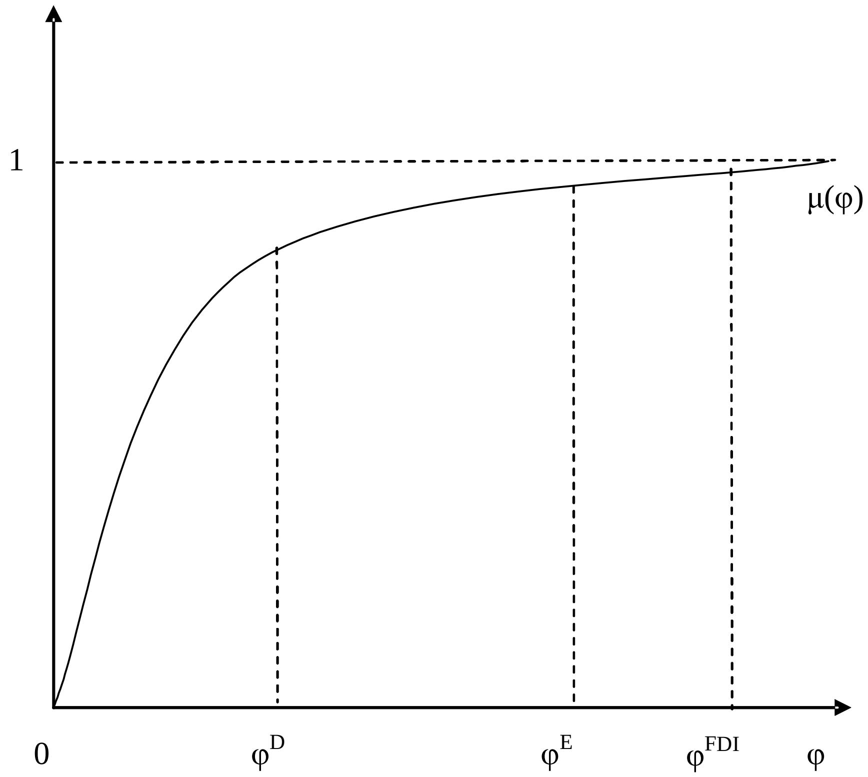
In a model developed by Yeaple (2005), firms are identical ex ante and become heterogeneous because they choose to use different technologies and different types of workers. The

[2]Without loss of generality, Melitz and Ottaviano assume the Pareto distribution of the marginal costs (which is the inverse of producitivity in the Melitz model).

model implies that exporting firms are those that employ superior technology with lower unit costs and higher-skilled workers.

As summarized by Baldwin (2005), two main features of the heterogeneity models are (1) firms with different marginal costs in the same sector and (2) sunk costs of entry to both domestic and foreign markets. The main implications of these models are: (a) exporters should significantly differ from non-exporting firms in terms of productivity; (b) access to a bigger market should lead to an improvement in productivity; and (c) trade liberalization should foster reallocation of market share towards more productive firms.

Figure A. Productivity distribution and cutoffs for exporting and FDI



2.3 Data and Methodology

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

[Insert Figure 1]

The dataset is an unbalanced panel of 1,665 manufacturing enterprises[3]. In total, there are slightly less than 10000 observations, with 90-95 per cent of the observations (depending on the reporting year) reflecting firms that were in operation at the time. One 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; it closely replicates the structure of manufacturing in the Ukrainian economy. 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 2). Descriptive statistics for the sample can be found in Table 1. It should be noted that around 20 per cent of the observations have zero investment and thus, as discussed below, 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

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

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 other 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.

A first look at the data suggests that exporter status seems to be associated with better indicators of firm performance. Simple OLS regressions of the main performance variables in per worker terms on the export dummy are presented in the Table 3. Exporting firms seem to be bigger in terms of both number of employees and production volume; they also invest more and pay, on average, higher wages.

[Insert Table 3]

To estimate plant-level productivity I utilize the methodology developed by Olley and Pakes (1996) in their seminal paper on telecommunication industry in the U.S. This methodology was further used in a number of empirical papers studying the effects of different policy shocks on the industrial dynamics. I use two specifications of the production function when estimating by the O-P methodology – with and without firm age. In contrast to Olley and Pakes, who postulate that older enterprises are more productive since they have longer experience in market operations, my prior is that for a country in transition, such as Ukraine, age could actually negatively affect productivity. The reason behind this hypothesis is that the older the plant is, the more outdated the machinery and equipment it uses. Given the credit constraints faced by the enterprises in transition economies, plants are often unable to modernize their production processes to keep up with the technical progress.

The idea behind the O-P methodology is in eliminating two potential biases when estimating production function coefficients. The first type of bias is attributed to simultaneity of the choice variable inputs. Assuming a Cobb-Douglas production function and representing it in logarithmic form:

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

where

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

that is, it consists of two parts: ω_{it} is productivity observed by the firm, and ε_{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 multi-stage polynomial approximation to recover the coefficients on labor and capital as well as firm age. A detailed description of their methodology can be found in Section A2 in the Appendix. 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.

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

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

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.

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

The advantage of the latter is that it is insensitive to measurement units and also possesses the transitivity property.

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 the fact that exporters and non-exporters potentially face different market structures (De Loecker, 2005). Both methods follow closely the O-P methodology: the L-P methodology specifies using intermediate inputs to proxy for productivity instead of investment. Their approach is especially useful for datasets that have numerous observations with zero investment. Although problem the problem of zero-investment entries is not particularly pressing in my case, but taking into account a short time span and also limited number of observations in my dataset, I use this approach to re-estimate the coefficients of the production function by sub-industries in order to check the robustness of the estimates. The second approach modifies the O-P methodology by adding 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 versus non-exporting could influence the firms' investment decisions or exit decisions. Several authors investigating the export-productivity link have attempted to solve this problem explicitly by 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. De Loecker (2005) introduces current export status in the investment and exit decision. Since I am using De Loecker's methodology I describe it in greater detail in Section A2 of the Appendix and hereinafter will refer to this methodology as D-L or export-augmented O-P, or modified O-P, interchangeably.

The next step is to determine whether performance of exporters is different from that of non-exporters because of self-selection or because of learning-by-doing. Since my dataset's time coverage is not long enough to run any causality tests I employ two different matching methods. The first is kernel matching solely on propensity score, while the second is a combination of matching on propensity score and Mahalanobis metric matching within a specified caliper. Matching allows a comparison of outcomes of interest between the treated group and the control group, based on some observable characteristics that influence the probability of being treated (exporting, in my case) (Heckman et al. 1998). The kernel matching estimator uses information on the entire set of controls assigning a smaller weight to the observations lying farther away in terms of propensity score from a given treated observation. The second method matches observations not only on the propensity score but also on a set of key covariates using the Mahalanobis distance. As Rubin and Thomas (2000) show, combining the two methods helps to reduce most of the balancing bias.

When applying a matching technique, I face a trade-off of satisfying the balancing property or capturing the maximum of firms' characteristics that are related to the firms' probability of becoming exporters. Following Girma et al. (2002), I am estimating the following probit model, where the dependent variable is the export dummy, controlling for year and industry effects:

$$\Pr(Export = 1) = f(TFP_{t-1}, \mathrm{Si}ze_{t-1}, Wage_{t-1}, Ownership_{t-1})$$

where

TFP_{t-1} is lagged TFP index

$\mathrm{Si}ze_{t-1}$ is number of employes in log lagged one-period

$Wage_{t-1}$average wage paid lagged one period

$Ownership_{t-1}$discrete variable taking on values from 0 to 3 and coded in the following way:

$=1$ if state share is equal or exceeds 25%,

$=2$ if management share is equal or exceeds 25% but state share does not exceed 24%;

$=3$ if foreign share is equal or exceeds 25% but state share does not exceed 24%;

$=0$ Otherwise.

My model is more parsimonious than the one used in other studies; for example, I do not include lagged export status as a predictor for exporting. Given that exporting seems to be a highly persistent activity and the absence of significant entry in and exit from the foreign market in my dataset, inclusion of lagged export will never allow the satisfaction of the balancing property (i.e. for the mean of variables describing firm characteristics to equal for two groups within a block) since the distributions of the propensity scores for exporting and non-exporting groups will be lying very far apart.

Matching has been already applied in similar studies of other countries' data. Arnold and Hussinger (2005) use one-to-one nearest neighbor method to match exporting and non-exporting firms. In their specification of the probit model of selection into exporting they use a lagged export dummy and a set of firm characteristics. They report that the difference between propensity scores for matched pairs lies in a very narrow range. De Loecker (2005), taking advantage of the Slovenian data, which exhibit a high degree of shifting in and out of the foreign market activity, looks only at firms that started to export over the period. In particular, he estimates propensity scores using the following model:

$$\Pr\left\{Start_{i,0}=1\right\}=\phi\left\{h(\omega_{i,-1},k_{i,-1},Private_{i,-1})\right\}$$

where $h(\cdot)$ is a full polynomial of the three variables. He finds that firms which start to export experience a productivity improvement both in terms of levels and growth rates. His approach is definitely less sensitive to this trade-off between satisfying balancing property and using bigger set of observables to build propensity score as lagged export status does not enter into probit specification.

2.4 Results

2.4.1 Input coefficients and TFP

I estimate production functions separately for each 2-digit industry. Given the fact that production function implies that it is real output which is produced with inputs, 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 4 presents labor and capital coefficients estimated using the following methodologies: OLS, original Olley and Pakes, export-augmented Olley and Pakes, as well as Levinsohn and Petrin methodology. As expected, the OLS coefficients on variable input (labor) are much higher, confirming the presence of an upward bias caused by simultaneity. The Olley and Pakes procedure eliminates this bias, producing lower coefficients on labor. Most of the coefficients on capital are not statistically significant at the conventional levels. One possible explanation is that all three nonparametric procedures use nonlinear minimization at the last stage of estimation to recover coefficients on capital; given the limited number of observations, this may lead to bigger standard errors. The last part of the table shows coefficients from the second specification of the production function with age. My prior that age is negatively correlated with productivity is confirmed only for metallurgy where coefficient on age is negative and significant, while for other sectors it is either positive or not significant. The possible explanation for this could be that metallurgy is the most capital intensive sector and hence outdated equipment is more detrimental in influencing productivity than accumulated experience in the market.

[Insert Table 4]

I proceed by estimating the two productivity indices as defined in Section 3. Table 5 shows the resulting productivity indices calculated from estimates of the input coefficients obtained by the three nonparametric methods discussed above. Even at first glance, the average values of both types of indices allow me to conjecture that all three methods and both specifications with and without age produce very similar estimates of total factor productivity. Further examination of the kernel density plots of TFP distributions across different methods confirms the above hypothesis: indeed, the distributions look very much the same (Figures 2-4). I consider this as confirmation of the robustness of my TFP estimates. Since it is productivity and not coefficients per se that is the focal point of my research, I will use only one the set of indices estimated with the export-augmented Olley and Pakes approach for econometric analysis in the subsequent sections, since it is methodologically more consistent and allows me to control for different market structures for exporting and non-exporting firms.

[Insert Figures 2, 3 & 4]

2.4.2 Exporting and Productivity

In line with other studies, I define a plant to be exporter if it shipped abroad at least 5% of total output. 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.

[Insert Table 6]

Moreover, productivity distribution for non-exporters appears to be more dispersed, except for the chemicals industry. Differences between the two groups are further confirmed by the kernel density plots[4] estimated by the three nonparametric methods (Figures 5-7), showing unconditional distribution of total factor productivity for the two groups, where the distribution of the exporting group is shifted to the right.

[Insert Figures 5, 6 & 7]

Though the productivity distribution for exporters seems to (weakly) stochastically dominate the productivity distribution for the non-exporting group the two distributions do overlap

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

implying that we cannot draw a clear line that would separate exporters from non-exporters according to the productivity level. This finding is not completely in line with the predictions of the theoretical models described in Section 2.2.

To disentangle the impact of exporting and control for other observable firm characteristics that could affect the differences in the performance of the two groups, I estimate different specifications with TFP indices as the dependent variables. The results are presented in Table 7. Lagged export status as well as exports as per cent of total sales and change in exporting status seem to be positively correlated with the TFP of the current period, even when a one-period lag of the TFP index is included. The effect seems to be robust to the inclusion of other controls, such as location, size, and ownership. As found by other studies (see e.g. Arnold and Smarzynska Javorcik 2005) increase in the foreign-owned share is positively associated with the improvement in the total factor productivity. Previous studies linking ownership and firms performance in Ukraine also demonstrate that management-owned firms are doing better than firms with other ownership structure (Andreyeva, 2003).

[Insert Table 7]

When I repeat the same exercise now putting export variables on the LHS and regressing lagged productivity indices on a set of controls, I also find that lagged TFP seems to be important in affecting export volumes, when lagged export and other control variables are included (Table 7). This simple exercise does not allow me to determine the causality between exporting and productivity. Higher share of foreign ownership seems to increase both probability of exporting and level of exports. Interestingly, perceived competition index, which was constructed based on the responses of the firms to the question on the level of competition defined for the main competitors, seems to be negatively associated with the both level of exports and export dynamics.[5]

[5] The index is continuous and ranges from 0 to 3 with the low values meaning low level of perceived competition from the main competitors of a plant.

[Insert Table 8]

As discussed in Section 2.3, several studies (Arnold and Hussinger 2005; Girma et al. 2002, De Loecker 2005) have applied matching based on propensity score to uncover the underlying relationship between exporting and firm performance, but they delivered mixed evidence on whether exporting leads to better performance.

The results of the two matching methods for both indices are presented in Tables 9-10. The first table contains results of the estimation of the probit model defined in Section 2.3, where the probability of exporting is estimated as a function of some observable characteristics. All the observables but two are statistically important in determining probability of exporting, only lagged productivity and foreign ownership (defined above in Section 2.3) does not seem to affect the probability of exporting. Table 10 shows that two methods deliver different set of results. The first method shows that the difference in performance between exporting and non-exporting firms seems to remain when controlling for the observable characteristics such as ownership, location, past performance, etc., while the second method appears to imply the non-persistence of the TFP differential between the two groups after controlling for self-selection: when controlling for observable characteristics the fact that a plant is exporter does not contribute to the better performance of this plant. The latter finding is in line with the majority of the previous studies on the other countries I also do not find empirical evidence for the learning-by-doing hypothesis. As discussed in section 2.3, I use the more parsimonious probit model for estimation of the propensity score. I am rather cautious in interpreting my results, since I might be attributing differences in productivity to exporting when they are indeed caused by other observed or unobserved firm characteristics.

[Insert Table 9 & 10]

2.4.3 Productivity and Size

As discussed in Section 2.2, one of the implications of the Melitz and Ottaviano model is that it is productivity that drives the differences in the size of firms within an industry. To investigate this link I construct a simple cross-section regression.

$$\Delta Size_t = f(\Delta TFP_{t-1}, TFP_{t-2}, Z)$$

$$\Delta TFP_t = f(\Delta Size_{t-1}, Size_{t-2}, Z)$$

where Z is a vector of control variables and $\Delta X_{t-1} = X_{t-2} - X_{t-1}$ and $\Delta X_t = X_{t-1} - X_t$

The results of the estimation are presented in Table 11. Both the two-period lagged productivity (productivity in t-2) and the change in productivity (from t-2 to t-1) seem to be positively associated with the increase in size measured as a log of the number of employees (from t-1 to t). At the same time, the lagged change in size does not seem to affect the change in productivity. The negative coefficient on the two-period lagged size suggests that relatively smaller firms saw a bigger improvement in productivity.

[Insert Table 11]

Productivity affects both size and exporting status. All the previous studies have found exporters to be significantly larger than non-exporting firms. Given the results in the previous subsection, I can hypothesize the direction of the links between exporting, size, and productivity. As more productive firms become larger, they are more likely to export if exporting is associated with some fixed costs. Obviously to make a stronger conclusion on the direction of causality one would need a longer panel to see whether this pattern holds. Another approach would be to investigate this issue using firm-level data from other countries.

2.4.4 Exporting Spillovers and Productivity Dynamics

Both Melitz and Melitz-Ottaviano models predict that as a result of access to bigger markets will increase overall productivity by reallocating market share to more efficient plants and exit of the plants with high costs (lower productivity). Table 12 investigates this implication. The first column shows weighted mean of plant productivities where weights are given by plant's output share in total industry output, second column is for unweighted average productivity. The third column shows the so called reallocation effect estimated as sample covariance between productivity and output (Olley and Pakes, 1996). Both weighted and unweighted mean productivity don't have a clear pattern across industries. For three sectors out of six, both mean productivities went up. For two sectors, paper and wood and construction materials, the reallocation effect increased over time and was a driving force for increase in the industry-level productivity. For other sectors, changes in industry-level productivity were stemming from changes in both average productivity and reallocation.

[Insert Table 12]

When I examine productivity dynamics I find that being exporter in the past is associated with a decline in the total factor productivity controlling for size, industry and location (Table 13). Either there is catching up of non-exporters resulting from spillover effect or exporters' productivity decreases, or both trends. Sample mean test shows that on average exporters became less productive while for non-exporters there is no statistical difference between means for 2000 and 2005. However, I cannot attribute this decline in productivity only to the export status. When I include lagged productivity index, the coefficient on the export status becomes statistically insignificant, in other words, export status does not determine productivity path when initial level of productivity is controlled for. This conclusion is consistent with the matching results of Section 2.4.2 where I find that exporting per se does not determine firm-level outcomes. To distinguish I repeat the same exercise but divide the sample according to the sign of the change in the productivity (column 4 and 5 in the Table). The results suggest that there is convergence in terms of productivity, that is the firms that were more productive in 2000 saw smaller increase in their productivity, while initial level of productivity has no impact on the negative change in the productivity which is in line with the productivity decomposition result described above.

[Insert Table 12]

2.5 Concluding remarks

In this paper, I examine the empirical implications of the new theoretical models with heterogeneous firms regarding the interlinkages between productivity, exporting, and size. As previous studies have shown, exporters are different from non-exporters. Many studies have found that it is self-selection of firms that drives this difference; that is, exporters ex ante are different from domestic counterparts. To estimate productivity I employed the semi-parametric procedure developed by Olley and Pakes, which delivers consistent estimates of the TFP as confirmed by the comparison of the productivity distribution estimates obtained with two other approaches. As my results showed, Ukrainian exporters indeed seem to be more productive than Ukrainian non-exporters. However, this difference does not seem to be robust when I control for observable characteristics of the plants using matching techniques. Matching delivers mixed evidence, however, as I use a more parsimonious probit model for estimation of the propensity score. I treat this result with caution since I might be attributing differences in productivity to exporting when they are actually caused by other observed or unobserved firm characteristics.

Interested in other implications of the models I look into the effects of productivity on size. I find that productivity appears to affect both size and exporting status. All the previous studies have found exporters to be significantly larger than non-exporting firms. The results that I obtained seem to suggest that as more productive firms become larger, they are more likely to export if exporting is associated with some fixed costs. Obviously to make a stronger conclusion on the direction of causality one would need a longer panel to see whether this pattern holds. Another approach would be to investigate this issue using firm-level data from other countries.

2.6 Appendix.

2.6.1 Olley and Pakes (1996) methodology[6]

O-P assumes the Cobb-Douglas production function expressed in logs:

$$y_{it} = \beta_0 + \beta_a a_{it} + \beta_k k_{it} + \beta_l l_{it} + \varsigma_{it} \tag{2.1}$$

where, in turn, error term consists of two parts: productivity observed by the firm ω_{it}, which follows Markov process over time and random shock to productivity ε_{it}.

$$\varsigma_{it} = \omega_{it} + \varepsilon_{it} \tag{2.2}$$

Firms maximize their discounted profits given their perceptions about the future evolution of the market structure. At time t, a firm makes two decisions: (1) whether to produce or exit and (2) how much to invest. In particular, firms with productivity level below some threshold will exit from the market. The exit rule then:

$$X_t = \begin{cases} 1 & \text{if } \omega_t \geq \underline{\omega}_t(a_t, k_t) \\ 0 & \text{otherwise} \end{cases}$$

Investment decision will depend on the observed productivity, current stock of capital and also the experience (age) of the firm. Hence, investment at time t can be formalized as follows:

$$i_t = i_t(\omega_t, a_t, k_t) \tag{2.3}$$

Further, Olley and Pakes make assumption of productivity strictly increasing in investment, which allows to express unobservable ω_t as a function of investment, capital and age.

[6]This section draws extensively on the Olley and Pakes (1996) and simply presents their methodological procedure. For greater detail, please, refer to the original paper.

$$\omega_t = h_t(i_t, a_t, k_t) \tag{2.4}$$

Simple estimation of the production function using OLS will produce two types of biases: (1) endogeneity (simultaneity) biases arises since firms choose inputs conditional on their perceptions about ω_t, as a result coefficients on variable inputs will be biased upward. Second type of bias is caused by firms exiting decisions. The threshold productivity is decreasing in capital and hence firms which have larger capital stock will stay in the market at lower level of ω_t. This will produce downward bias in the capital coefficient.

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:

$$\begin{aligned} y_{it} &= \beta_l l_{it} + \phi_t(i_t, a_t, k_t) + \varepsilon_{it} \text{ where} && (2.5) \\ \phi_t(i_t, a_t, k_t) &= \beta_0 + \beta_a a_{it} + \beta_k k_{it} + h_t(i_t, a_t, k_t) && (2.6) \end{aligned}$$

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,

$$
\begin{aligned}
\Pr(X_{t+1} &= 1|\underline{\omega}_{t+1}(a_{t+1},k_{t+1}),J_t) = \\
&= Pr(\omega_{t+1} \geq \underline{\omega}_{t+1}(a_{t+1},k_{t+1})|\underline{\omega}_{t+1}(a_{t+1},k_{t+1}),\omega_t) \\
&= \psi_t(\underline{\omega}_{t+1}(a_{t+1},k_{t+1}),\omega_t) \\
\Pr(X_{t+1} &= 1|\underline{\omega}_{t+1}(a_{t+1},k_{t+1}),J_t) = \psi_t(i_t,a_t,k_t) = P_t \qquad (2.7)
\end{aligned}
$$

At the final stage, the coefficients on age and capital are retrieved by estimating the following equation using h non-linear algorithm since coefficients on age and capital enter in non-linear way:

$$y_{t+1} - \beta_l l_{t+1} = \alpha + \beta_a a_{t+1} + \beta_k k_{t+1} + \sum_{j=0}^{4-m}\sum_{m=0}^{4} \beta_{mj}\widehat{h}_t^m \widehat{P}_t^J + e_{t+1} \qquad (2.8)$$

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

This step concludes O-P algorithm.

De Loecker (2005) modification

De Loecker drops age as a state variable and introduces export status dummy into investment function

$$i_t = i_t(\omega_t, e_t, k_t) \qquad (2.9)$$

Similarly to O-P he continues to assume that productivity follows Markov process. However, now export status also affects survival probability of the firm: as exporting firms are on average more capital abundant and they will be more prone to stay in the market even at lower realizations of productivity. To control for this, De Loecker includes export dummy into second-stage estimation of survival probability:

$$\Pr(X_{t+1} = 1 | \underline{\omega}_{t+1}(e_{t+1}, k_{t+1}), J_t) = \psi_t(i_t, e_t, k_t) = \widetilde{P}_t \tag{2.10}$$

The final stage equation includes export-adjusted probability of survival:

$$y_{t+1} - \beta_l l_{t+1} = \alpha + \beta_k k_{t+1} + \sum_{j=0}^{4-m} \sum_{m=0}^{4} \beta_{mj} \widehat{\widetilde{h}}_t^m \widehat{\widetilde{P}}_t^J + e_{t+1} \tag{2.11}$$

where $\widehat{\widetilde{h}}_t = \widehat{\widetilde{\phi}}_t - \beta_k k_t$

and where $\widehat{\widetilde{\phi}}_t$ is estimated as predicted value from $\phi_t(i_t, e_t, k_t) = \beta_0 + \beta_k k_t + h_t(i_t, e_t, k_t)$

Chapter 3

Exporting and Productivity under Endogenous Trade Policy: Theory and Evidence from Ukraine

3.1 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

[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).

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 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 state support in the form of writing off tax arrears and preferential tax rates based on data from 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 signif-

[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.

icantly 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.

[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.

3.2 Exporting and Productivity: Stylized Facts

The description of the dataset could be found in Section 2.3 of Chapter 2.

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. 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 14]

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 15]

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 16). The superior performance of exporters compared to non-exporters in terms of productivity should be reflected in other indicators of firm outcomes such as higher wages, returns on capital and profits.[6]

[Insert Table 16]

[6] 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.

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.

3.3 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)[7], 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 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.[8]

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.

3.3.1 Open economy with an exogenous subsidy

The theoretical model 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).

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

Hence the preferences are characterized by different degrees of substitutability between

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

[8] Brander (1995) makes an overview of the existing trade literature dealing with strategic trade policy. He shows that optimal trade policy crucially depends on the underlying assumptions about the market structure (oligopoly, duopoly, Bertrand versus Cournot) and type of the competition (third market or reciprocal markets).

numeraire good and differentiated goods (α and η) as well as among the degree of product differentiation among the latter goods (varieties) denoted by γ.

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

Then the market demand for a variety $i \: \varepsilon \: \Omega^*$(where Ω^* 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 (γ) and substitutability with a numeraire good (α and η), number of consumed differentiated goods (N) and average price of differentiated goods ($\overline{p}$) defined as $\frac{1}{N}\int_{i\varepsilon\Omega^*} p_i di$:

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

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

$$\int_{o}^{c_D} \pi(c)dG(c) - f_E = 0 \qquad (3.1)$$

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 (π), mark-ups (μ), quantities produced (q) and prices charged (p). The short run equilibrium in this economy is then determined by the free entry condition (3.1) 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.[9] In this framework subsidy can be considered as an exogenous shock hitting firms' profits with a probability β after they have entered the market.[10] If some of the firms receive a subsidy their profits from export will thus be:

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

[9]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).

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

I follow Melitz and Ottaviano in parametrizing the cost distribution as a Pareto distribution. Given this assumption, the export profits can be represented as follows[11].

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

Then the profits of the subsidized firms become:

$$\pi_X(c, s_X) = \frac{L^*}{4\gamma}(z^*)^2(c_X - c)^2 + f(s) \tag{3.2}$$

I assume that subsidy enters firms' profits but it does not increase profits in 1 to 1 ratio.[12]

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 (3.2), 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

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

[12] 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.

supported group, then[13]:

$$
\begin{aligned}
\frac{L^*}{4\gamma}(z^*)^2(c_X-c)^2+f(s) &= \frac{L^*}{4\gamma}(z^*)^2\left(c'_X-c\right)^2 \\
\left(c'_X-c\right)^2 &= (c_X-c)^2+\frac{f(s)4\gamma}{L^*(z^*)^2} \qquad (3.3)
\end{aligned}
$$

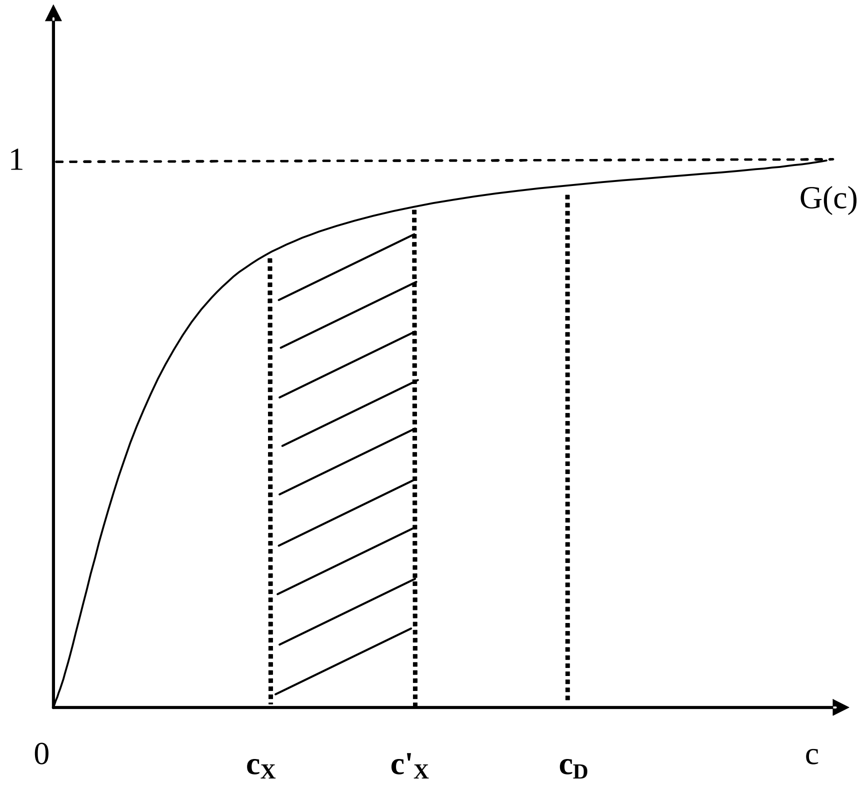
The above equality implies that the subsidized group will face lower productivity cutoff to enter the export market. Therefore, in the region between c'_X and c_X (Figure B), some firms that would not export without subsidy will actually export, while the others with the same level of productivity but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

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

[13] In the alternative specification:

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

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



3.3.2 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.

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:

$$w^{iJ} = k^J W^J(s^J) + (\sigma^{iJ} + \delta)V_R \tag{3.4}$$

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

σ^{iJ} is a party bias which is individual-specific,

δ 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 ϕ^J, and the density for popularity shock is summarized by ψ.

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:

$$W^J(s^J) = \pi_D^J + \pi_X^J - \tau + f(s^J) \tag{3.5}$$

Where as in the previous case π_D^J is the profits from selling on domestic market, π_X^J profit from exporting, τ is a tax and $f(s^J)$ is the extra profits resulting from the trade policy, as firms can receive export subsidies or other forms of support from the government. Given the government budget constraint, $L\tau = \sum_J^{N_E} L^J s^J$, the tax rate is determined as follows: $\tau = \sum_J^{N_E} \frac{L^J}{L} s^J$, where L is total population, L^J is number of workers in plant J, and 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.

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.

The cumulative distribution of individual-specific party bias for firm J can be represented as follows:[14]

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

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

$$\lambda_O = \sum_J \frac{L^J}{L} t^J \phi^J \left[\sigma^J + \frac{1}{2\phi^J}\right] \tag{3.6}$$

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:

$$p_O = \Pr\left[\lambda_O \geq \frac{1}{2}\right] = \frac{1}{2} + \frac{\psi}{\phi}\left[\sum_J \frac{L^J}{L} t^J \phi^J k^J \left[W^J(s_O^J) - W^J(s_R^J)\right]\right]^{15} \tag{3.7}$$

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

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

[15]Party O wins if it gets at least half of the votes, that is if $\lambda_O \geq \frac{1}{2}$. Using (3.6), the proability of winning is thus given by:

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

Taking into account properties of the uniform distrubtion this expression becomes (3.7).

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 (3.5). Then FOC to the above maximization problem considering two plants I and J is given by:

$$\frac{L^J}{L}\frac{t^J\phi^J}{\phi}k^J\frac{\partial f(s_O^J)}{\partial s_O^J} - \frac{L^J}{L}\sum_J^{N_E}\frac{L^J}{L}\frac{t^I\phi^I}{\phi}k^I = 0 \tag{3.8}$$

$$\frac{\partial f(s_O^J)}{\partial s_O^J} = \frac{\sum_J^{N_E}\frac{L^I}{L}t^I\phi^I k^I}{t^J\phi^J k^J} \tag{3.9}$$

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

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 (3.9) simplifies to:

$$\frac{\partial f(s_O^J)}{\partial s_O^J} = \frac{\sum_I^{N_E}\frac{L^I}{L}t^I k^I}{t^J k^J} \tag{3.10}$$

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 β 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.[16] As an alternative in the Appendix derive results for the case when workers hold a portfolio of stocks of other firms.

Model implications

The model generates several testable implications. Equation (3.10) 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). Politicians will support plants whose profits are more responsive to governmental intervention. More formally:

H1. Since state-owned plants are usually older and less efficient and find it difficult to compete in the market [17], 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. Political support changes the productivity distribution by inducing a structural shift for the politically connected group as demonstrated in Section 3.1

3.4 Testing the model: specification and results

First, I estimate the share of exporters whose TFP is below industry average (Table 17) 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.

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

[17] 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).

[Insert Table 17]

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.[18] 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.[19] 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 18. 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 18]

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

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

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.

According to H3, 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 8]

To validate this finding, I try to build a counterfactual to the existing situation by estimating a hypothetical TFP for supported plants 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 firms which are not listed in the 'experiment resolution'. I can directly use TFP and not an index because I am considering only metallurgical plants, 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

μ_{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 19]

Next, I get the predicted value of TFP conditional on the other indicators of firm performance. Below I report the predicted and actual 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 20). 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 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 20]

Primarily the governmental support was given to large exporting firms, however as Figure 8 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.

One of the theoretical results of the suggested model is that the size of the firm measured as number of employees has no effect on the policy platform, i.e. does not matter for receiving subsidy. This result is justified on the grounds that larger firms are more costly for governmental support and stems from the assumption of an electoral system with proportional representation (Persson and Tabellini, 2000) which increasingly replaces mixed or majoritarian electoral system in countries in transition. Although, it goes in line with the economic model where the size of a firm is determined by its productivity but not the number of employees, it does not seem to be confirmed empirically in this case as the subsidized firms are statistically larger than non-subsidized (Table 21). This might be explained by the possible 'economies of scale' in the governmental support and suggest further direction for theoretical model improvement.

3.5 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 plants 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).

3.6 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 α^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)

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

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

Which is similar to the expression of the base model (9) and has the same implications for the trade policy. However, in addition to the two parameters of the base model, there is also parameter α, the share of stock of a proper plant in the workers' portfolio. The higher this parameters the more "favored" a plant is.

Figure 1. Export dynamics and Real GDP growth in 1996-2004

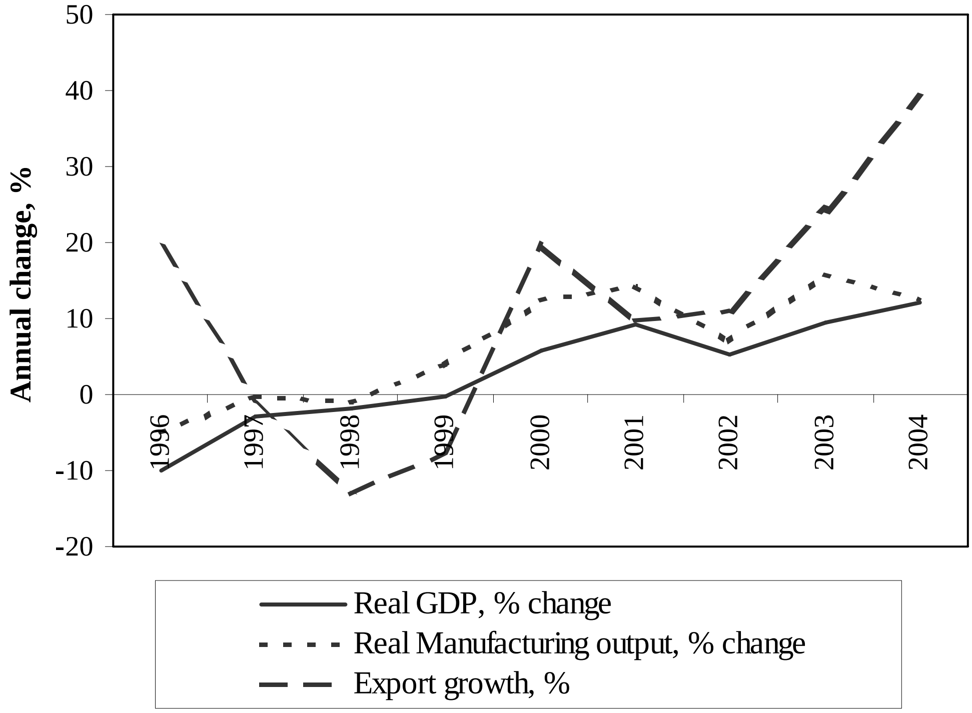


Table 1. Industrial division

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. Export status and main indicators of firms' performance

Variable	Coefficient	Standard error	Obs	R^2
Output	0.245	(0.027)**	8154	0.34
Net sales	0.261	(0.026)**	8162	0.33
Value added	0.226	(0.030)**	7456	0.24
Machinery and equipment	0.104	(0.028)**	8036	0.08
Investment	0.313	(0.054)**	5099	0.16
Average wage	0.164	(0.014)**	8122	0.46

Table 4. Input coefficients

	OLS		O-P		O-P with export		L-P		OLS with age			O-P with age		
	Labor	Capital	Labor	Capital	Labor	Capital	Labor	Capital	Labor	Capital	Age	Labor	Capital	Age
Metals	1.023	0.076	0.758	0.257	0.759	0.328	0.427	0.382	1.033	0.101	-0.299	0.723	0.204	0.159
	(0.062)	(0.051)	(0.077)	(0.086)	(0.075)	(0.066)	(0.098)	(0.136)	(0.066)	(0.053)	(0.063)	(0.080)	(0.053)	(0.148)
Chemicals	0.862	0.310	0.493	0.118	0.398	0.043	0.085	0.504	0.754	0.400	0.024	0.449	-0.006	-0.548
	(0.074)	(0.060)	(0.086)	(0.129)	(0.094)	(0.196)	(0.125)	(0.179)	(0.077)	(0.061)	(0.097)	(0.090)	(0.178)	(0.722)
Machinery	1.163	-0.040	0.786	0.138	0.804	0.005	0.448	0.168	1.139	-0.037	-0.015	0.781	0.043	0.516
	(0.022)	(0.018)	(0.030)	(0.034)	(0.030)	(0.033)	(0.060)	(0.053)	(0.024)	(0.019)	(0.034)	(0.030)	(0.048)	(0.547)
Paper and wood	0.881	0.325	0.605	0.135	0.681	0.169	0.282	0.189	0.832	0.387	-0.167	0.604	0.178	-0.184
	(0.059)	(0.043)	(0.084)	(0.064)	(0.084)	(0.056)	(0.089)	(0.130)	(0.063)	(0.044)	(0.066)	(0.093)	(0.047)	(0.133)
Construction materials	1.078	0.229	0.761	0.279	0.758	0.268	0.329	0.331	1.068	0.258	-0.028	0.748	0.206	-0.165
	(0.038)	(0.028)	(0.050)	(0.074)	(0.049)	(0.060)	(0.073)	(0.109)	(0.042)	(0.029)	(0.058)	(0.053)	(0.067)	(0.196)
Textiles and footwear	0.766	0.333	0.525	0.021	0.441	0.018	0.549	0.407	0.730	0.362	0.174	0.517	0.015	0.438
	(0.042)	(0.036)	(0.058)	(0.086)	(0.061)	(0.083)	(0.104)	(0.122)	(0.044)	(0.037)	(0.075)	(0.059)	(0.101)	(0.189)

Table 5. Comparison of TFP indices across methods.

	Exporters	**Non-exporters**
Prodindex1 (O-P)	1.131	0.924
Prodindex1 (O-P with age)	1.018	0.989
Prodindex1 (O-P with exports)	1.133	0.923
Prodindex1 (L-P)	1.156	0.908
Prodindex2 (O-P)	0.898	0.283
Prodindex2 (O-P with age)	0.986	0.415
Prodindex2 (O-P with exports)	0.937	0.247
Prodindex2 (L-P)	0.962	0.173

Table 6. Comparison of TFP indices estimated by O-P with export by industries.

Prodindex 1	Exporters		Non-exporters	
	Mean	STD	Mean	STD
Metals	1.060	0.259	0.891	0.310
Chemicals	1.202	0.275	0.855	0.256
Machinery	1.123	0.348	0.911	0.401
Paper and wood	1.376	0.547	0.923	0.606
Construction materials	1.165	0.552	0.975	0.808
Textiles and footwear	1.118	0.227	0.885	0.332
Total	1.133	0.350	0.923	0.546

Prodindex 2	Exporters		Non-exporters	
	Mean	STD	Mean	STD
Metals	0.581	0.928	-0.047	1.096
Chemicals	1.568	1.588	-0.426	1.484
Machinery	0.918	1.072	0.263	1.225
Paper and wood	1.201	1.199	0.190	1.298
Construction materials	0.887	0.767	0.545	1.179
Textiles and footwear	0.964	1.027	-0.067	1.470
Total	0.937	1.103	0.247	1.279

Figure 2. Kernel density of TFP index for exporters and non-exporters estimated by O-P with age.

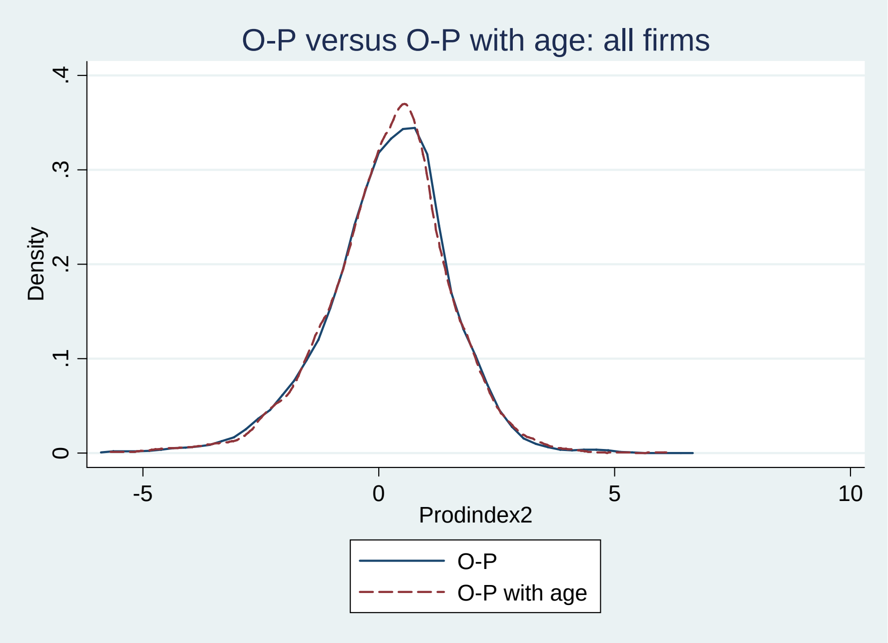


Figure 3. Kernel density of TFP index1 estimated by O-P and modified O-P.

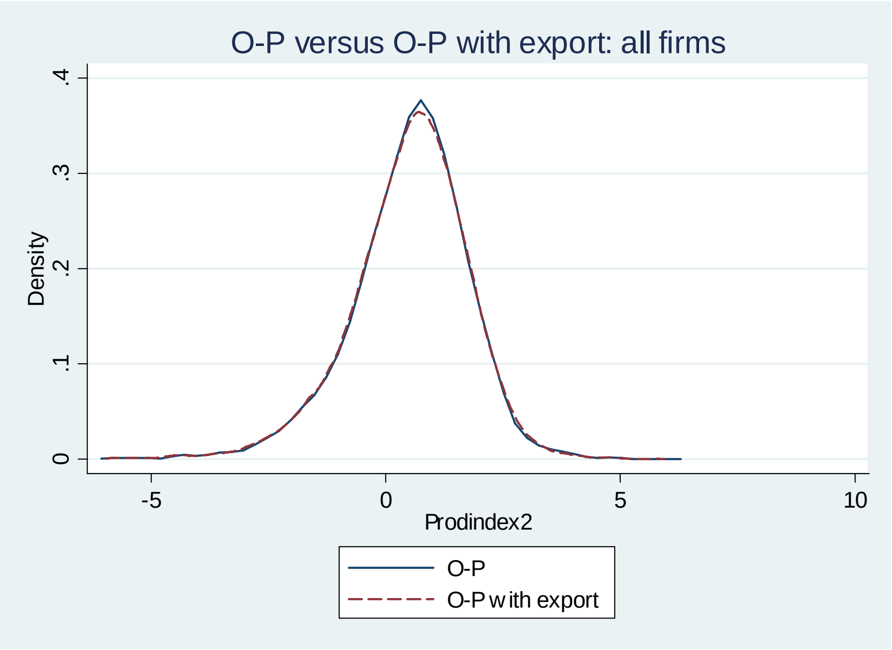


Figure 4. Kernel density of TFP index1 estimated by O-P and L-P.

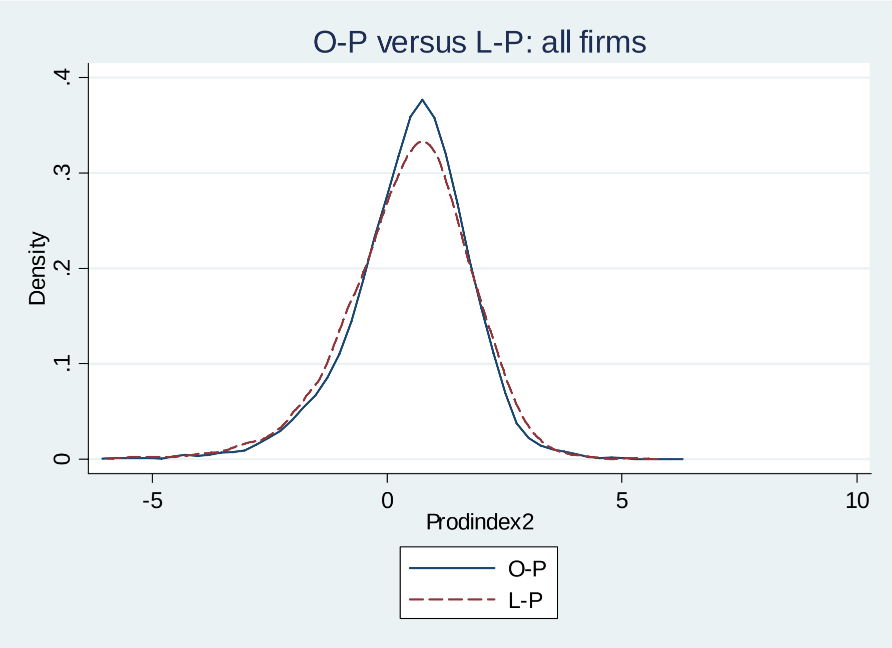


Figure 5. Kernel density of TFP index for exporters and non-exporters estimated by O-P.

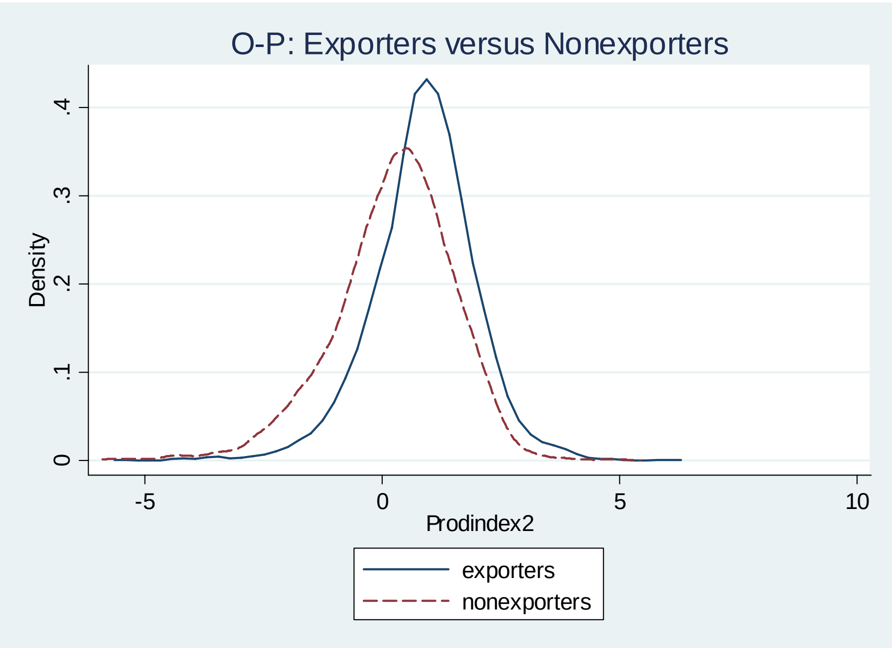


Figure 6. Kernel density of TFP index for exporters and non-exporters estimated by modified O-P.

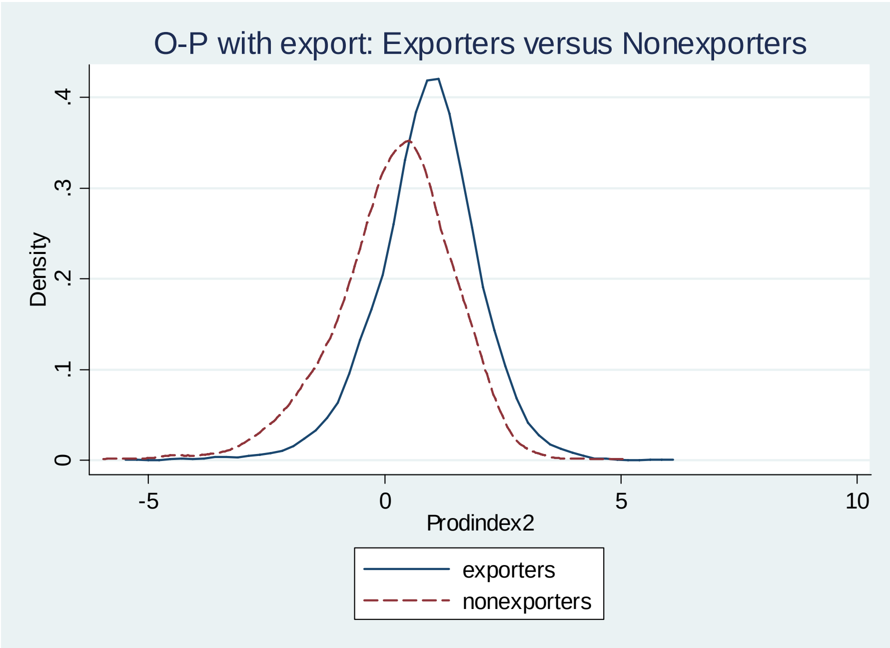


Figure 7. Kernel density of TFP index for exporters and non-exporters estimated by L-P.

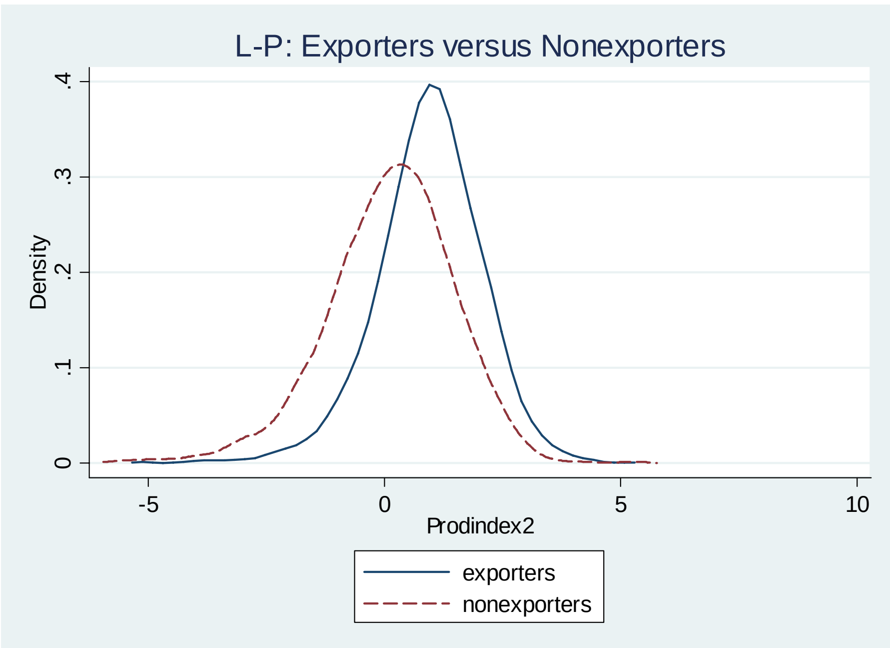


Table 7. Chicken or egg: Lagged exports and current TFP[§]

	TFP1	*TFP2*	*TFP1*	*TFP2*	*TFP1*	*TFP2*
Lagged export status	0.073	0.173				
	(0.009)**	(0.024)**				
Change in export, (%t-%(t-1))			0.001	0.005	0.001	0.004
			(0.000)**	(0.001)**	(0.000)**	(0.001)**
Lagged TFP1	0.540		0.553		0.495	
	(0.021)**		(0.021)**		(0.022)**	
Lagged TFP2		0.706		0.728		0.652
		(0.014)**		(0.013)**		(0.015)**
Age	0.000	0.000	0.000	0.001	0.000	-0.001
	(0.000)	(0.000)	(0.000)*	(0.000)*	(0.000)	(0.000)
Foreign share	0.001	0.003	0.002	0.003	0.001	0.001
	(0.000)**	(0.001)**	(0.000)**	(0.001)**	(0.000)**	(0.001)*
State-owned share	0.000	0.000	0.000	0.000	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)**	(0.000)**
Management share	0.000	0.000	0.000	0.001	0.001	0.002
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)**	(0.001)**
Size					0.059	0.144
					(0.005)**	(0.011)**
Constant	0.450	0.145	0.466	0.456	0.192	-0.308
	(0.027)**	(0.056)**	(0.028)**	(0.054)**	(0.029)**	(0.081)**
Observations	5571	5571	5480	5480	5480	5480
R-squared	0.42	0.58	0.42	0.58	0.44	0.6

[§] Year dummies, industry dummies and regional dummies are included.
Robust standard errors in parentheses, * significant at 5% level; ** significant at 1% level

Table 8. Chicken or Egg: Lagged TFP and Change in Exports§

	Change in exports	*Change in exports*	*Change in exports*	*Exports, % sales*	*Change in exports*	*Exports, % sales*
Lagged export status				35.453		33.172
				(0.679)**		(0.747)**
Lagged export , %	-0.119	-0.116	-0.127		-0.149	
	(0.010)**	(0.011)**	(0.011)**		(0.012)**	
One-period lagged TFP1	1.670		1.088	2.297	0.437	1.287
	(0.278)**		(0.156)**	(0.221)**	(0.154)**	(0.224)**
Two-period lagged TFP		1.522				
		(0.282)**				
Age	0.009	0.011	0.007	-0.018	-0.007	-0.039
	(0.005)	(0.005)*	(0.005)	(0.009)	(0.005)	(0.009)**
Foreign share	0.037	0.028	0.033	0.17	0.019	0.145
	(0.012)**	(0.015)	(0.012)**	(0.021)**	(0.012)	(0.020)**
State-owned share	-0.004	-0.006	-0.004	0.041	-0.015	0.022
	(0.008)	(0.010)	(0.008)	(0.011)**	(0.008)	(0.011)*
Management share	-0.003	-0.002	-0.003	0.019	0.011	0.039
	(0.008)	(0.009)	(0.008)	(0.013)	(0.008)	(0.013)**
Size					1.554	2.422
					(0.172)**	(0.245)**
Constant	-0.777	-0.112	0.203	-1.758	-7.588	-14.437
	(0.931)	(1.074)	(0.931)	(1.47)	(1.214)**	(1.817)**
Observations	5864	4482	5864	5864	5863	5863
R-squared	0.07	0.07	0.07	0.55	0.09	0.56

§ Year dummies, industry dummies and regional dummies are included.
Robust standard errors in parentheses, * significant at 5% level; ** significant at 1% level

Table 9. Probability of Exporting as a Function of Observables.

	Exporting	Exporting
Lagged TFP1	0.103	
	(0.057)	
Lagged TFP2		0.090
		(0.023)**
Lagged size	0.518	0.504
	(0.018)**	(0.018)**
Lagged wage	0.408	0.349
	(0.049)**	(0.050)**
State owned	-0.277	-0.269
	(0.059)**	(0.059)**
Management owned	0.207	0.202
	(0.054)**	(0.054)**
Foreign owned	0.111	0.107
	(0.075)	(0.076)
Constant	-2.37	-2.382
	(0.204)**	(0.187)**
Observations	5930	5930

§ Industry dummies and regional dummies are included.
Robust standard errors in parentheses, * significant at 5% level; ** significant at 1% level

Table 10.1. ATT estimation with the Kernel Matching method (bootstrapped standard errors)

Productivity index 1

Treated	Controls	ATT	Std. Err.	t-stat
2087	3156	0.081	0.030	2.719

Productivity index 2

Treated	Controls	ATT	Std. Err.	t-stat
2087	3207	0.374	0.080	4.676

Table 10. 2. ATT estimation with the combined propensity score and Mahalanobis method (bootstrapped standard errors)

Productivity index 1

Treated	Controls	ATT	Std. Err.	z-stat
2087	3156	0.040	0.020	1.99

Productivity index 2

Treated	Controls	ATT	Std. Err.	z-stat
2087	3202	0.092	0.059	1.57

Table 11. Size and Productivity[§]

	Change in size, t-(t-1)	*Change in TFP, t-(t-1)*
Two-period lagged TFP	0.158	
	(0.019)**	
Change in TFP, (t-1)-(t-2)	0.191	
	(0.029)**	
Two-period lagged size		-0.003
		(0.004
Change in size, (t-1)-(t-2)		0.008
		(0.017
Age	0.000	0.000
	(0.000)	(0.000)
Foreign share	0.000	0.000
	(0.000)	(0.000)
State-owned share	0.000	0.000
	(0.000)	(0.000)
Management share	0.001	0.000
	(0.000)**	(0.000)
Constant	-0.26	0.021
	(0.033)**	(0.029)
Observations	4372	4390
R-squared	0.07	0.01

[§] Industry dummies and regional dummies are included.
Robust standard errors in parentheses, * significant at 5% level; ** significant at 1% level

Table 12. Productivity decomposition (Olley and Pakes, 1996)

Industry	*Year*	*Weighted industry productivity*	*Unweighted industry productivity*	*Reallocation effect*
Metals	2000	1.00	0.75	0.23
	2001	0.92	0.77	0.17
	2002	0.82	0.80	0.15
	2003	1.03	0.84	0.20
	2004	1.03	0.88	0.22
	2005	1.14	1.00	0.19
Chemicals	2000	1.00	0.66	0.31
	2001	0.99	0.68	0.29
	2002	1.01	0.70	0.29
	2003	1.07	0.71	0.32
	2004	1.16	0.76	0.34
	2005	1.16	0.80	0.31
Machinery	2000	1.00	0.68	0.32
	2001	1.01	0.74	0.30
	2002	1.08	0.79	0.28
	2003	1.21	0.87	0.32
	2004	1.27	0.92	0.33
	2005	1.35	0.99	0.35
Paper and Wood	2000	1.00	0.67	0.52
	2001	0.94	0.63	0.50
	2002	1.12	0.80	0.44
	2003	1.43	0.82	0.50
	2004	1.55	0.92	0.46
	2005	1.65	1.07	0.40
Construction materials	2000	1.00	0.64	0.44
	2001	1.14	0.78	0.41
	2002	1.47	0.95	0.57
	2003	1.45	1.14	0.34
	2004	1.59	1.30	0.33
	2005	1.69	1.44	0.35
Textiles	2000	1.00	0.80	0.23
	2001	1.07	0.86	0.23
	2002	1.13	0.88	0.25
	2003	1.18	0.90	0.25
	2004	1.22	0.97	0.19
	2005	1.19	0.98	0.19

Table 13. Productivity Dynamics‡

	Pooled			*ΔTFP>0*	*ΔTFP<0*
	Change in TFP, (t-2)-t	*Change in TFP, (t-2)-t*	*Change in TFP, (t-2)-t*	*Change in TFP, (t-2)-t*	*Change in TFP, (t-2)-t*
Export status at t-2	-0.091	-0.076	-0.010	-0.035	0.066
	(0.029)**	(0.031)*	(0.031)	(0.025)	(0.046)
TFP1 at t-2			-0.951	-0.871	-0.007
			(0.039)**	(0.041)**	(0.048)
Size			0.128	0.076	0.031
			(0.012)**	(0.010)**	(0.017)
Constant	0.388	0.368	0.618	1.207	-0.739
	(0.020)**	(0.068)**	(0.096)**	(0.083)**	(0.131)**
Industry dummy	No	Yes	Yes	Yes	Yes
Region dummy	No	Yes	Yes	Yes	Yes
Observations	4198	4198	4198	2921	1277
R-squared	0.00	0.01	0.22	0.35	0.01

‡ Robust standard errors in parentheses, * significant at 5% level; ** significant at 1% level

Table 14. 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 15. 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 16. 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 17. 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 18. 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

Figure 8. Productivity distribution in Metals for Four Groups of Plants

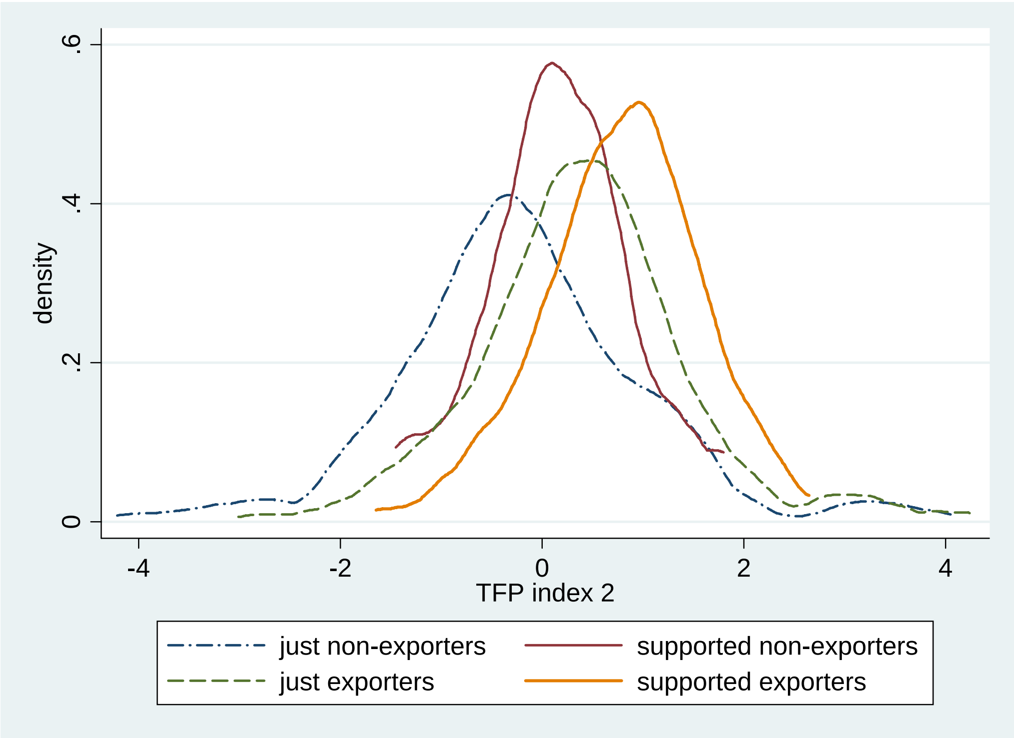


Table 19. Quantile Regression Results for Unsupported Group

	Log TFP
Average wage	0.730 (0.098)**
Capital per worker	-0.177 (0.033)**
Output per worker	0.470 (0.042)**
Profit margin	0.012 0.73
Constant	-6.441 (0.657)**
Year dummies	Yes
Observations	164
Pseudo R2	0.4451

Table 20. Results of t-test on actual and predicted TFP by subgroups

		t-stat	p-value
diff = mean(delta S=0) - mean(delta if S=1)			
H_o: diff = 0		-3.2982	0.0011
mean(diff) = mean(actual TFP – predicted TFP)			
H_o: mean(diff) = 0	ALL	3.0225	0.0027
	Unsupported	0.4337	0.6649
	Supported	4.8589	0.0000

Table 21. 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

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