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DID EU ACCESSION IMPROVE THE EFFICIENCY OF FIRMS FROM TRANSITIONAL COUNTRIES?

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ABSTRACT

This study tests the proposition that trade liberalisation results in improved firm performance by considering the effects of EU accession in 2004 or 2007 on firms in transitional economies. It uses a sample of 27 transitional countries, some of which became EU members and some of which did not, taken from the BEEPS surveys for 2005 and 2013. Using stochastic frontier analysis and a number of matching approaches it finds that EU membership was linked to significantly better firm performance. The paper recognises that EU membership is more than just membership of the single market and it adopts a two step approach. In the first step EU membership is shown to be linked to internationalisation. The second step provides evidence that internationalisation was linked to significantly better firm performance.. The study concludes that the trade liberalisation (single market) element of EU membership is linked to higher productivity and higher profitability.

DID EU ACCESSION IMPROVE THE EFFICIENCY OF FIRMS FROM TRANSITIONAL COUNTRIES?

1. Introduction

The link between international trade and productivity at the firm level has been extensively discussed in the economics literature and reviews include Greenaway and Kneller (2007) and Wagner (2012). The link between exports and higher firm level productivity has been the most explored. A number of studies find evidence of two effects - self-selection (only more efficient firms become exporters) and learning by doing (exporting creates further efficiency gains). A smaller number of studies have linked firm level productivity to importing. In part these also point to self-selection and learning by doing effects for import competing firms since only the more efficient firms survive. These effects have a strong foundation in economic theory (see e.g. Tybout, 2003). In addition, a number of studies also point to the productivity-enhancing effects of imported inputs. As Wagner (2012) notes, the literature has tended to focus on productivity while other aspects of firm performance, such as profitability, have been under researched.

From the perspective of transitional countries, the importance and relevance of strengthening firm efficiency is obvious. That international trade results in greater firm efficiency - even if just self-selecting efficient firms for entry and less efficient firms for exit - in itself implies that trade liberalisation should create firm level efficiency gains. A number of existing studies have looked at the effects of trade liberalisation (as opposed to the effects of e.g. exporting) on firm or industry level productivity. The majority of these concern unilateral tariff reductions, but a few focus on regional trade arrangements. This study considers the accession of transitional countries to the European Union (EU) in 2004 and 2007. In particular, it focuses on the consequences for firms in transitional countries of joining the EU single market. The EU single market includes tariff liberalisation, but is substantially wider as it removes not just tariffs but also non-tariff barriers. This also means that potential efficiency gains are not restricted to goods but also extend to services.

Methodologically, a common approach to analysing the effects of trade liberalisation is to estimate a model of total factor productivity (TFP) using the approach of Olley and Pakes (1996) or the modified version proposed by Levinsohn and Petrin (2003). This study, in part, is in this tradition, but uses a stochastic production frontier approach to estimate firm efficiency. A smaller number of studies, such as Mallick and Yang (2013), have used a

propensity score matching approach. This study also uses both a propensity score matching, the (related) Inverse Probability Regression Weighted Adjustment (IPWRA) matching estimator and Generalised Propensity Score (GPS) matching analysis.

The study uses the 2005 and 2013 BEEPS surveys conducted by the European Bank for Reconstruction and Development (EBRD) and the World Bank. This provides a rich source of data on firms from 27 transitional countries. For reasons discussed later, panel estimation is not feasible with these data. Our basic approach is to compare firms in those transitional economies that became EU members with carefully matched firms from economies that did not. Since the authors recognise that any one cross-section might reflect circumstances that were unique to a particular point in time two different cross-sections were used – 2005 and 2013.

The conclusions are robust with respect to each of the four estimators used – stochastic frontier, propensity score matching, IPWRA and GPS analysis – and with respect to both cross-sections. In each case, there is a statistically significant association between EU membership and firm performance, which can be shown to be associated with increased internationalisation (exports and foreign ownership).

2. Review of Literature

There exists an extensive literature linking trade to firm level performance. Greenaway and Kneller (2007) provide an excellent review of research up to that date and Wagner (2012) a more recent overview of the literature. Much of this literature focuses on productivity and, in particular, the links between exporting and productivity. A number of studies also consider the effects of imports on firm level productivity. Existing research has not been restricted to the effects of trade on firm level productivity but also foreign direct investment.

The theoretical basis of the analysis is derived from the review of the implications of modern trade theory for firm level studies provided by Tybout (2003). Amongst the central theoretical predictions of the firm level effects of the removal of trade barriers are the following:

- Import competing firms reduce production in response to trade liberalisation (and exporting firms increase production)
- Increased exposure to foreign competition increases plant or firm level efficiency

As Bolatto and Sbracia (2016) note, the gains from trade (import and export) can be de-composed into selection (increased efficiency in surviving firms) and re-allocation effect (an increase in weight of more efficient exporting industries). Following Wagner (2012), many studies of the link between exporting and firm efficiency identify two mechanisms by which this occurs. These are self-selection (only more efficient firms succeed against international competition in the first place) and learning by doing effects (the process of exporting itself strengthens productivity). A large number of studies, reviewed by Wagner (2012), also consider the effects of importing on the productivity of firms who themselves import. In the main, the effects on the productivity of firms (and sometimes industries) who compete against imports in domestic markets tend to be addressed by studies of the effects of trade liberalisation on firm efficiency. These are discussed later in this section.

The most widely researched area in the empirical literature concerns the links between exporting and firm level productivity. Das et al (2007) examine determinants of firm export decisions for three Colombian industries and find evidence of substantial sunk costs for entry with the expectation of substantial expected future earnings from exports. Of relevance to this study is that they also find that favourable export policy changes can affect the decision to export. Van Biesebroeck (2005) considered the effects of exporting on productivity for a sample of manufacturing firms from nine African countries to assess whether trade liberalisation might create productivity gains. The study found productivity gains from exporting was a function of exploiting scale economies, increased demand and a more reliable client base. De Loecker (2007) uses a propensity score matching approach to analyse the effects of exporting on productivity for a sample of firms from Slovenia. This study found a significantly higher export premia for firms exporting to high income countries. Girma et al (2004) also use a matching approach and find evidence of both self-selection and learning by doing effects of exporting on firm productivity.

A number of studies examine the effect of inward FDI on firm performance. Most notably, these concern spillover effects, an issue not addressed by this paper, but some also consider the effects of foreign ownership on firm performance. Konings, (2001), in a study of three eastern European countries, examined whether or not firms with foreign ownership performed better than those that were domestically owned. He found this to be the case only in Poland. Girma et al (2005), in a study of UK firms, found that both foreign ownership (by UK firms of foreign firms) and exporting were associated with higher productivity but that

the effect of foreign ownership was the stronger of the two. Arnold and Hussinger (2010), in a study of German firms, also found strong firm level productivity effects for both exporting firms and those with foreign affiliates.

A number of studies consider the effects of trade liberalisation (as opposed to trade) on productivity. Trade liberalisation is not a continuous or universal process but only occurs infrequently and in a specific location. In consequence these studies tend to focus on specific episodes of liberalisation in a specific country at a particular time. In some cases, they focus on industry level rather than firm level effects. For example, Tybout and Westbrook (1995) consider the effects of the liberalisation of Mexican import tariffs between 1984 and 1990. Nataraj (2011) examines the effects on productivity of trade liberalisation by India over the period 1989-1999. Topalova and Khandelwal (2011) also analyse the effects of Indian trade liberalisation on total factor productivity. Pavcnik (2002) found significant positive effects of trade liberalisation by Chile on productivity. Gustafsson and Segerstrom (2010) find evidence of spillover effects on R&D as a further source of gains in firm productivity arising from trade liberalisation.

Amongst the studies more explicitly linked to trade liberalisation, Bernard et al (2006) examined the effects of reductions in trade costs on productivity in US manufacturing between 1977 and 2001. They found that this contributed to gains in productivity at the industry, plant and intra-plant levels. Amiti and Konings (2007) analysed the effects of trade liberalisation on plant level productivity in Indonesia. Unusually, they considered the effects of liberalisation of trade in inputs on import competing firms as well as the effects of greater competition from liberalisation of trade in outputs, finding the effects of liberalisation of inputs to be very much greater. Tybout (2006) also argues in favour of the potential importance of liberalisation of trade in inputs. This literature is extensive, for example, Bernard et al (2007) provide a useful summary of the predictions of different trade theories. They also provide evidence from the US manufacturing sector to support the view that research at firm or plant level is important to better understand the consequences of trade liberalisation. Further, Wagner (2007) offers a useful review of the earlier literature linking exports and productivity.

Although the majority of liberalisation studies are of unilateral tariff reductions some do deal with regional trade liberalisation. For example, Bustos (2011) examines the effects on

Argentinian firms of membership of MERCOSUR. Melitz and Trefler (2012) identify gains in firm level productivity from the US-Canada free trade agreement.

This literature can be divided into two main areas. Firstly, we consider the literature which links exporting and trade liberalisation to firm or plant level effects on productivity and related issues such as sales growth and price-cost margins. Although not specifically related to economic integration, this provides the basis for most of the key propositions relating to the effects of EU membership. Secondly, we examine the existing literature relating specifically to the effects of EU membership on transitional countries.

However, this paper is also concerned with the issue of transitional economies that are now EU members and the trade and integration aspects are examined within this context. There are a number of papers that directly address the impact of EU entry on firm performance. Bakucs et al. (2010) use a stochastic frontier model to compare the efficiency of Hungarian farms before and after accession to the EU. They found contradictory effects. Although EU membership itself increased farm efficiency the higher rate of subsidies in the EU lowered the efficiency of these farms. Bojneca and Latruffe (2009) analyse the efficiency of Slovenian farms using both stochastic frontier and data envelopment analysis (DEA) techniques in the period leading up to EU accession. They find an increase in farm efficiency but attribute it to technological change. Afonso et al. (2010) use DEA to analyse public sector efficiency in new EU members compared to other emerging markets and find considerable variation amongst new EU members.

Using data on Bulgaria and Romania, Dimitrova and Buzogány (2014) found that the EU allowed these countries to promote more effective domestic policies by appealing to EU rules. In a rare paper dealing with the construction sector, Wagner and Lillie (2014) found that transnational sub-contracting allowed scope for more competition between regulatory regimes from different EU states. Epstein (2014, page 31) found that EU membership reduced the vulnerability of the new transitional members, stating that this is, in part, "…by applying the single market rules equally across new and old Member States". These papers lend support to the view that the changes in the regulatory regime involved in joining the EU are sufficient to have an impact on firm performance.

There also exists a significant literature on the effects of the single market and a number of studies focus on its effects on productivity. For example, Notaro (2011) found that the single market programme had significantly affected productivity in those sectors most affected by

the relevant policy changes. This study does not address the single market programme or its consequences, but nonetheless, the underlying theoretical arguments are essentially the same in the context of EU enlargement – that integration brings dynamic gains including productivity effects. This study shares the objective of modelling such effects.

A number of studies have used the *Business Environment and Enterprise Survey* (BEEPS) from the World Bank and EBRD to analyse efficiency and productivity in transition economies. Correa et al (2010) examine differences in technological diffusion between Central Asian and Eastern European countries using the 2002 and 2005 BEEPS surveys, and identify private ownership and inward investment as important determinants. De Rosa et al (2010) provide an econometric analysis of total factor productivity in Eastern European and Central Asian countries using the 2009 BEEPS survey, finding that corruption adversely affects productivity. The BEEPS survey is also closely related to other World Bank enterprise surveys. The questionnaires are built around the core of common sets of questions, which provide a degree of consistency across the surveys. Useful overviews of the literature using World Bank enterprise surveys to analyse firm performance, particularly with respect to governance and regulatory issues, are by Xu (2011) and Dethier et al (2011). Of particular note is Ma et al (2010), who conduct an econometric analysis of performance in international trade for a sample of 28 developing countries and find both relationship-specific investment and contract enforcement to be important. Furthermore, Clarke (2011) analyses the effects of corruption on firm level performance in African countries. The empirical analysis in this paper follows this practice and uses the BEEPS data.

Finally, there is a substantial body of research devoted to the empirical analysis of frontiers and firm level efficiency, many of which focus on the effects of both corruption and of cumbersome bureaucracy on firm performance. Méon and Weill (2010) use stochastic frontier models to estimate aggregate production functions on data from 69 countries, including some transition economies. They find that particularly where government is highly inefficient, corruption can improve efficiency. Lensink and Meesters (2012) use a similar method on data from a large sample of banks from 139 countries and find that institutional differences have a significant effect on bank efficiency. Wang and Wong (2012) also use stochastic frontier analysis to model R&D transfer in a sample of 77 countries and find that political stability has a positive and significant effect on efficiency. Finally, Faruq et al (2013) used data envelopment analysis to analyse a sample of 900 firms from three African

countries and find that both high levels of bureaucracy and corruption reduced firm productivity.

Based on the existing literature this study seeks to examine the evidence for three key propositions to be empirically tested.

Proposition 1: EU accession was related to greater firm efficiency in new members (compared to non-members).

Membership of the EU single market involves liberalisation of both tariff and non-tariff barriers. However, EU membership is more than just the single market. For example, EU membership also involves institutional change. The focus of this paper is on the effects of the liberalisation aspects on firm performance. That is, it also seeks to examine whether any observed effect of EU membership on firm performance was attributable, in part, to liberalisation of trade and investment (internationalisation). To more directly and precisely address the role of internationalisation two further propositions were tested.

Proposition 2: EU accession was related to greater internationalisation (exporting and foreign ownership) at the firm level.

Proposition 3: Greater internationalisation was associated with greater firm efficiency.

3. Methodology

This study uses three distinct techniques: stochastic frontier estimation, propensity score matching and Inverse Probability Weighted Regression Adjustment (IPWRA) estimator. The stochastic frontier model is used in a similar manner to estimation of total factor productivity in other studies. It is used to provide estimates of firm (in)efficiency and to identify determinants of this (in)efficiency. In so doing it tests our first proposition – that EU membership is associated with greater firm efficiency. Propensity score matching is used to further test whether EU membership is associated with higher labour productivity and higher profitability. To further check that any observed link between EU membership is at least partly attributable to internationalisation, propensity score matching is used to test whether EU membership is associated with (a) higher exports and (b) more foreign ownership. Finally, IPWRA is used to test whether, for transitional countries, higher exports and higher foreign ownership are associated individually and jointly with stronger firm performance.

Stochastic Frontier Models

The measurement of firm level technical efficiency has become commonplace with the development of frontier production functions. Thus, the impact of deregulation and the move to a competitive market system is modelled using a frontier approach and from this, firm level efficiency levels are constructed. The approach can be deterministic, where all deviations from the frontier are attributed to inefficiency, or stochastic, where it is possible to discriminate between random errors and differences in inefficiency. The stochastic frontier model was originally proposed by Aigner, Lovell and Schmidt (1977)[1], and extended to include the characteristics of the firm that explain the inefficiency, following the work of Battese and Coelli (1995). This approach allows the use of panel data and the technical inefficiency effects are specified as factors that interact with the input variables of the frontier function. Whereas ordinary least squares (OLS) estimation takes the average line of best fit through the observations (a mean response function) and tacitly assumes that all the firms are efficient, this can be misleading if there are considerable differences in efficiency levels. Tests show whether a production frontier is the appropriate model, and efficiency levels are estimated for each firm, in each year.

The frontier model identifies the firms that represent best practice, and the inefficiencies are explained. The method of maximum likelihood is used to estimate the unknown parameters, with the stochastic frontier and the inefficiency effects estimated simultaneously. The theory is described in full in Coelli (1995) and Coelli, Rao and Battese (1998) and many applications are discussed in Bravo-Ureta and Pinheiro (1993). The estimating equation is

$$y_{it} = f(x_{j,it}, t, \beta) + \varepsilon_{it} \quad where\ \varepsilon_i = V_{it} - U_{it}$$
$$with \quad U_{it} \sim |N(\mu_{it}, \sigma_U^2)| \quad and \quad V_{it} \sim N(0, \sigma_V^2) \qquad (1)$$

where f(.) is a suitable functional form, y_{it} is an output measure of firm *i* at time t, $x_{j,it}$ is the corresponding level of input *j* and β is a vector of parameters to be estimated. The V_{it}*'s* are independently and identically distributed random error terms and uncorrelated with the regressors, and the U_{it}'s are non-negative random variables associated with the technical inefficiency of the firm.[2] In the second part of the model, this inefficiency term, U_{it}, is made

[1] See Fried, Lovell and Schmidt (1993) for a comprehensive survey of methods and applications.
[2] If the residuals are negatively skewed, the maximum likelihood estimator for the stochastic frontier production function model is simply OLS (see Waldman, 1992). In this case, either the model is mis-specified or the data are not consistent with the functional form.

an explicit function of *k* explanatory variables, $z_{k,it}$, that represent the characteristics of the firms. The U_{it} are independently (but not identically) distributed as non-negative truncations of the normal distribution of the form

$$U_{it} \sim N\left[\delta_0 + \sum_{k=1}^{M} \delta_k z_{k,it}, \sigma^2\right] \quad (2)$$

The technical efficiency of an individual firm is defined in terms of the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by that firm. Thus, the technical efficiency of firm *i* at time t in the context of the stochastic frontier production function can be expressed in terms of the errors as

$$TE_{it} = E[\exp(-U_{it})|(V_{it} - U_{it})] \quad (3)$$

which is the expectation of the exponentiated technical inefficiencies, conditional on the error, ε_{it}. Since U_{it} is a non-negative random variable these technical efficiencies are between zero and unity, where unity indicates that this firm is technically efficient.

Propensity score matching

Propensity score matching techniques have been used previously in studies of the impact of trade and monetary integration, and of trade liberalisation more generally. Baier and Bergstrand (2009) used matching techniques to analyse the impact of two free trade areas, including the original six members of the European Economic Community. They examined the long run effects on trade and found a 100% increase in trade flows.

The core idea of a matching approach is simple. First it is necessary to define a *treatment*, in this case membership of the EU in 2004, and an *outcome*. In this paper several different propositions are considered and, hence, several different outcomes. These include changes in sales, labour productivity and price-cost margins. An immediately intuitive approach would be to assess whether the mean growth in sales is statistically significantly greater for firms in countries that joined the EU in 2004 than those that did not. The difficulty with such an approach is that to avoid selection bias, it is necessary to construct a control group (of non-

EU members) that matches the *treated* group (EU members) as closely possible in all key characteristics other than the treatment. The selection of a suitable control group is the process of *matching* and this is intended to replicate the process of random sampling using non-experimental observed data.

Detailed discussions of the matching methodology can be found in several sources, for example, Dehejia and Wahba (2002) and Deheja (2005). A number of studies involving economic applications also include useful explanations of this technique (see Sianesi, 2004; Blundell et al., 2005). The matching approach focuses on three key parameters:

- ATE – the average treatment effect in the population (defined as all treated and untreated firms or individuals).
- ATT – the average treatment effect for treated firms (from countries that joined the EU in 2004 or 2007)
- ATNT – the average treatment for those that were not treated (firms from non-EU member countries).

These are defined as:

$$ATE = E(Y_{1i} - Y_{0i}) \equiv E(\beta_i) \quad (4)$$

$$ATT = E(Y_{1i} - Y_{0i} | D_i = 1) \equiv E(\beta_i | D_i = 1) \quad (5)$$

$$ATNT = E(Y_{1i} - Y_{0i} | D_i = 0) \equiv E(\beta_i | D_i = 0) \quad (6)$$

where Y is the outcome, with subscript 1 for those firms that are *treated* and subscript 0 for those that are not. D is an indicator of the treatment received (by definition 1 for treated and 0 for non-treated).

The naïve estimator of the effects of treatment (EU membership) on any particular outcome is to simply compare the means of the treated (EU) firms. Such an approach is biased for two sets of reasons. The first is bias from selection on observables (comparing firms that are not comparable or weighting comparable individuals differently) and the second is bias from selection on unobservables. The latter is actually a version of the problem of possibly excluded confounding variables. As always, there is no guarantee that an important

confounding variable has been excluded, but steps can be taken to limit this possibility. A common approach, which is followed in this paper, is to use a sufficient number of potentially relevant variables in selecting from observables. For example, firm size is one of the selection variables on the grounds that larger firms may be more likely to experience greater sales from the opening of EU markets in the presence of economies of scale in exporting than small firms.

Reducing bias from selection on observables is more complex. To estimate ATT it is necessary to assume that all relevant differences are captured in the observed attributes of the treated and untreated firms (that is, no bias from selection on unobservables) and that both treated and untreated firms can be observed to have shared attributes (common support). Selection uses a propensity score p(x) where:

$$p(x) \equiv P(D=1|X=x) = E(D|X=x) \qquad (7)$$

A common approach is to use a probit model to define the propensity score and this adopted here. This probit model is not in itself a causal model but acts as a way of identifying and summarising the key characteristics of the *treated* (EU member) firms. The next step is to use the propensity score for matching, that is, to pair each *treated* (EU member) firm with a comparable *untreated* (non-EU) firm. There are several ways of conducting this matching process. The simplest and most common is *Nearest Neighbour* (NN) matching. For each treated firm this selects the untreated firm with the closest value of the propensity score. In this study matching by Nearest Neighbour with replacement is used. Other methods were tried, including several variants using kernel densities, but none produced results that were materially different. The final step in the matching process is to assess how effective the process of matching was in selecting a control group from the untreated (non-EU) firms that was comparable to the treated (EU) group. Checks on the adequacy of marching are reported in the appendices.

Generalised Propensity Score (GPS) Matching

Propensity-score analysis, used in the case of binary treatment assignment, has been extended by Hirano and Imbens (2004) in the context of continuous treatment, whereby the estimated propensity score is termed generalized propensity score (GPS). The estimated dose-response function represents a set of potential outcomes.

Similar to the propensity-score methodology, the estimation of GPS and the dose-response function rely on two assumptions. The first assumption is defined as weak unconfoundedness or ignorability, which states that each potential outcome is independent of the treatment, conditional on covariates *X*. Is it termed weak unconfoundedness because it does not require that all potential outcomes are jointly independent of the treatment assignment. The second assumption relies on the balancing property of the GPS, such that within strata with the same value of the estimated GPS, the probability of assignment treatment does not depend on covariates *X*. Jointly, both assumptions posit that the treatment assignment is unconfounded by the estimated GPS, thus the estimator can eliminate any overt bias arising from differences in the covariates (Hirano and Imbens, 2004).

After estimating the GPS, the next step is to evaluate whether the balancing property is satisfied. The balancing property refers to the characteristic of correctly specified GPS to render statistically insignificant mean difference of covariates *X*. Namely, the mean difference of covariates *X* before the estimation of GPS can be statistically significant, that is, unmatched firms that received different amounts of treatment can have different characteristics measured by covariates *X*. However, to create similar pairs of matched firms, the GPS needs to pair firms with similar characteristics. This implies that the mean differences of firm characteristics *X* are not statistically significant and that GPS has created pairs of similar firms with a single important difference- firms received different amounts of treatment.

After estimating the GPS and establishing that the balancing property of the GPS is satisfied, we proceed to estimate the dose-response function and the marginal effects. First, we estimate the conditional expectation of the outcome Y_i, as a quadratic function of the treatment level T_i and the estimated GPS (GPS_i).

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 T_i^2 + \beta_3 GPS_i + \beta_4 GPS_i^2 + \beta_5 T_i GPS_i \qquad (8)$$

It should be noted that the estimated coefficients do not have a direct causal interpretation, but rather their function is to enter the calculation of the dose-response function (Hirano and Imbens, 2004). Then we estimate the dose-response function at each specific treatment level, by averaging the conditional expectation function over the estimated GPS at that particular treatment level (Bia and Mattei, 2012).

Due to data limitations the results of the GPS analysis for the 2005 sample were unreliable and have not been reported. As with the IPWRA analysis only results for the 2013 sample have been reported. Details of the results are available on request from the authors.

Inverse Probability Weighted Regression Adjustment (IPWRA)

The IPWRA technique is set out in detail in Cattaneo (2010) and Cattaneo et al (2013). IPWRA can be seen as an extension of the matching approach. In propensity score matching there is a single treatment variable, e.g. foreign ownership. However, exports and foreign ownership could simultaneously affect firm performance.

To take into account that exporting and foreign ownership simultaneously influence firm performance, we estimate treatment effects in the multi-treatment context. A matching approach with multiple treatments is first introduced by Lechner (2001). We have M+1 treatments, whereby treatment equal to zero denotes the absence of exports and foreign ownership (see e.g. Czarnitzki et al., 2007). The average treatment effect on the treated (ATT) effect is then calculated as:

$$ATT = E(Y^m|T = m) - (Y^l|T = m) \quad (9)$$

Where m denotes the treatment level, l represents the comparison group (the treatment level to which m is compared, termed matched controls by Czarnitzki et al. 2007), and Y^m and Y^l denote outcomes in states m and l respectively.

We employ the Inverse Probability of Treatment Weighting Regression Adjustment (IPWRA) estimator. The IPWRA estimator belongs to a group of matching estimators that have the double-robust property. Double robustness implies that either the treatment model or the outcome model (or both) have to be correctly specified for the estimator to produce consistent treatment effects (Hirano et al. 2003). The main advantage of the IPWRA estimator is its double robust property. If either the propensity score model (the outcome model) or the treatment model is correctly specified, then this estimator will yield treatment effects with a lower bias than will other estimators that are not characterized by the double-robustness property. Busso et al. (2014) conducted a Monte Carlo simulation of the finite sample properties of a range of matching and reweighting estimators – which include the IPWRA – in the estimation of ATTs. Their findings support our use of the IPWRA: first, we use normalised reweighting, which exhibits overt bias of the same magnitude as pair matching but much smaller variance; second, their findings suggest that normalised

reweighting outperforms matching estimators when overlap is good, which is the case in our study.

The IPWRA estimator consists of three steps. First, the treatment model estimates, for each firm in the sample, the propensity score, which is the probability for each firm of treatment assignment. Given that we evaluate multiple treatment effects, the propensity scores are estimated by a multinomial logit model, incorporating all four treatment levels: neither exports nor foreign ownership; only exports; only foreign ownership; and both. The choice of the model is motivated by the nature of our treatment variable, which has more than two outcomes with no natural ordering. The propensity scores enable firms to be matched within each treatment level. Second, regressions are estimated in which the inverse of the estimated propensity scores are used as weights on covariates *X* and our treatment dummies. Third, from each of these regressions, the ATT effect is computed as the difference in the weighted averages of the predicted outcomes (for technical details see Wooldridge 2010). This three-step approach provides consistent estimates given the underlying assumption of the independence of the treatment from the predicted outcomes once covariates are modelled in steps 1 and 2. We report valid standard errors (of the Huber/White/sandwich type) which take into account that the estimates are computed in a three-step approach (Emsley et al. 2008).

Due to data limitations the results for the 2005 sample were inconclusive and unreliable. The results of the IPWRA analysis are reported only for the 2013 sample. The results for 2005 are available from the authors on request.

4. Data

The data are from the *Business Environment and Enterprise Survey* (BEEPS) produced by the World Bank and European Bank for Reconstruction and Development (EBRD). The data comprise two separate cross section samples from the 2005 survey and from the 2013 survey. The 2005 sample was intended to capture the impact and pre-accession effects of EU membership on the performance of firms in countries that joined the EU in 2004. That is, theory predicts changes to firm efficiency from trade liberalisation. Firms do not find themselves in the EU by surprise and it is likely they make efficiency improvements in advance of EU membership as well as in response to it. The 2005 data is intended to provide an insight into these impact and anticipatory effects.

The 2013 survey was intended to provide evidence on the longer term effects of EU membership on firm performance for firms in those countries which joined the EU in 2004 or 2007. The data from the 2013 survey were provided in local currency units. These were converted to US dollars using annual averages of official exchange rates (http://data.worldbank.org/indicator/PA.NUS.FCRF).

Details of the 2005 and 2013 samples are given in the first three appendices. Appendix 1 gives details of the countries included and the sample of firms for each. Appendix 2 gives details of the composition of the sample by sector and Appendix 3 by firm size class.

Stochastic Frontier Models

Variables included in the stochastic production frontier models for 2005 and 2013 comprised:

- Output (total sales), converted to US dollars (Q)
- Capital stock, replacement cost of machinery, equipment, vehicles, land and buildings, converted to US dollars (K).
- Labour, number of full-time permanent employees plus full time equivalent of temporary employees (L).

Firm level variables included in the efficiency model (all taken from the BEEPS surveys) were:

- *Size* – the firm size category. Firm size categories varied between the 2005 and 2013 surveys. Details are presented in Appendix 3.
- *Foreign* – the share of the firm that is foreign owned.
- *Export* – the share of exports in total sales
- *Age* – the age of the firm in years. A proxy variable for organisational experience.
- *Mgrexp* – the number of years of experience of the firm's top manager (not available in the 2005 BEEPS survey)
- *LnR* – log of rental of land, buildings and machinery. This variable is intended to capture the effects of those factor services that are rented rather than owned. It is only available for the 2013 survey.
- *Compet* – the number of direct competitors faced by the firm (not available for 2005)
- *Loan* – (0,1) variable, taking on the value of 1 if the firm received a loan

- *Local* – (0,1) variable, 1 if the firm supplies mainly local markets.
- *National* – (0,1), 1 if the firm supplies mainly national markets.
- *Degree* – the share of the firm's work force with a university education (not available for 2005)
- *Burcy* – A measure of perceived bureaucratic obstacles faced by the firm. The mean value of the firms' responses to separate questions on the degree (rated 0-4) to which customs, tax administration, business licensing and labour regulations pose constraints.

Country level variables included in the efficiency model were:

- *EU04*, a (0,1) variable taking on the value of 1 where the firm was from a country which joined the EU in 2004, used for the 2005 sample
- *EU07*, an alternative (0,1) variable taking on the value of 1 where the firm was from an EU member country in 2007, used for the 2013 sample
- *Regeff* , distance to frontier score (0=lowest performance to 100=frontier), a measure of regulatory effectiveness.(not available for 2005)
- *Legal,* strength of legal rights index (0=weak to 12=strong), not available for 2005.
- *Ruralpop,* the rural population (as a percentage of total population)
- *Totaltax,* the total tax rate (total taxes as a percentage of commercial profits)
- *Minrents,* mineral rents as a percentage of GDP.

Country level data (other than EU dummy variables) were taken from the *World Development Indicators* database (World Bank)

An important limitation of the stochastic frontier approach is that measures of output (total sales) and of capital are based on values rather than physical quantities, while labour is measured in terms of number of employees (full-time and full-time equivalents). As Katayama et al (2009) argue the use of value measures presents the risk that these are correlated with important omitted confounding variables. However, this approach follows the majority of the papers in this literature. In both the matching and stochastic frontier analysis as many relevant variables as the data would allow are included.

Propensity score matching, GPS and IPWRA

For the matching analysis the outcome (firm performance) variables were:

- Productivity (*spw*) – sales per worker, and
- Profitability (*ppw*) – profit per worker.

The variables *Export* (the share of exports in total sales) and *Foreign* (the share of the firm owned by foreign interests) are used as intermediate outcomes. That is, in the propensity score matching they are used as outcome variables to test whether EU membership resulted in greater internationalisation. In the Generalised Propensity Score (GPS) matching analysis they are used as continuous treatments to test whether internationalisation is related to better firm performance. The IPWRA analysis tests for a relationship between *Export* and *Foreign* (as treatments), jointly and individually on, firstly, productivity and, secondly, profitability. For the IPWRA analysis only both treatment variables were converted to (0,1), with a value of 1 assigned to 50% or higher.

The treatment variables for the propensity score matching were *EU04* (2005 sample) and *EU07* (2013 sample) as described earlier, for tests of the effects of EU membership on both final outcomes (productivity and profitability) and intermediate outcomes (*export* and *foreign*)

Firm level control variables (taken from the BEEPS surveys) used in the estimation of the propensity score comprised:

- Sector dummy variables
- *Size, age, burcy, mgrexp, local, national, degree* and *loan*, as described above.
- *Infra* – the mean value of the firms' responses to separate questions on the degree (rated 0-4) to which transport, electricity and telecommunications pose constraints.
- *Newprod* – a (0,1) variable, taking on the value of 1 if the firm had introduced a new product or service in the past three years, 2013 sample only.
- *Newprocess* – a (0,1) variable, taking on the value of 1 if the firm had introduced a new production process in the past three years, 2013 sample only.
- *Rdspend* - a (0,1) variable, taking on the value of 1 if the firm had spent on research and development in the past three years, 2013 sample only.

Country level control variables used in the matching analysis comprised:

- *regeff* and *legal*, as previously defined, and
- *gdpcap*, per capita GDP, measured in US dollars.

Table 1 presents a summary of relevant characteristics of the 2013 BEEPS sample. It provides descriptive statistics not just for EU members and other transitional countries across the whole of each sample, but also for broad economic sectors. In the full sample firms in countries that were EU members in 2007 exhibited a substantially higher mean percentage foreign ownership, almost three times the comparable mean for firms in non-EU countries. There was similarly substantial difference between firms in EU (2007) members and non-members with respect to exports, with the mean exports (as a percentage of total sales) being more than twice the value of the mean for firms in non-EU countries. Although not a formal test these findings do suggest that EU membership is of consequence on the internationalisation of firms (trade orientation and foreign ownership).

In the overall sample, we found very little difference in the mean value of perceived infrastructure constraints but a marginally higher score for perceived bureaucratic constraints for firms in EU (2007) members. The sample also suggests a noticeable difference with respect to perceive corruption, with firms in EU members perceiving it as a much less severe constraint.

As with the 2005 survey, there are important differences between sectors. Firms in construction, in particular, and in other services were very much more dependent on sales to the government than other sectors. An important feature of EU membership is the adoption of non-discriminatory EU procurement practices in place of discriminatory national regimes. These data suggest that such liberalisation would be likely to have more profound effects for these sectors. Both the construction and the hotels and restaurant sectors exhibit lower foreign ownership and lower exports than other sectors. Firms in hotels and restaurants were much less likely to have received a loan than in other sectors.

Table 2 presents the key characteristics for the 2005 BEEPS survey. Overall, the firms in the 2005 sample based in EU (2004) countries exhibited a higher share of exports in total sales than non-EU members, but only a marginally higher percentage of foreign ownership. There seems little difference between EU and non-EU firms with respect to the importance of either

infrastructure or bureaucratic constraints but firms in non-EU countries were more likely to perceive corruption as a serious problem. There was also a substantial difference between EU and non-EU firms with respect to the share of government in their total sales, with the mean for EU firms being about one half of that for non-EU.

In the 2005 sample, there were also important variations between one sector and another. For example, the mean percentage of foreign ownership was markedly higher in both EU and non-EU firms in manufacturing and in hotels and restaurants. Manufacturing and transport services exhibited a much larger share of exports in total sales than other sectors (both EU and non-EU). Government procurement was a much more important source of sales for the construction sector than any other sector, for firms in both EU and non-EU countries. Firms in the 2005 sample in hotels and restaurants and in other services were much less likely to have received a loan than other sectors.

Table 1. Selected characteristics of the 2013 BEEPS survey data.

Sector/measure	% foreign owned		Export intensity (% of sales)		Infrastructure constraints (0-4)		Administration constraints (0-4)		Perceived corruption scale (1-6)		% of firms bidding for government contracts		% of firms with a loan	
	EU (2007)	Non-EU	EU (2007)	Non-EU	EU (2007)	Non-EU	EU (2007)	Non-EU	EU (2007)	Non-EU	EU (2007)	Non-EU	EU (2007)	Non-EU
All sectors														
Mean	9.91%	3.83%	16.13%	5.98%	2.696	2.669	3.380	2.602	1.672	2.125	20.50%	21.88%	38.62%	31.56%
Standard deviation	28.40%	17.42%	30.57%	18.82%	3.202	2.996	3.134	2.764	1.049	1.265	40.37%	41.35%	48.70%	46.48%
No of obs.	2,698	8,305	2,671	8,257	2,698	8,305	2,698	8,305	2,433	7,706	2,664	8,213	2,698	8,305
Manufacturing														
Mean	11.82%	4.44%	30.74%	9.84%	2.909	2.798	3.303	2.641	1.617	2.150	17.70%	22.23%	41.55%	33.72%
Standard deviation	30.37%	18.54%	37.59%	23.44%	3.220	3.062	3.070	2.766	1.011	1.264	38.18%	41.58%	49.30%	47.28%
No of obs.	1,047	3,215	1,039	3,200	1,047	3,215	1,047	3,215	937	2,975	1,034	3,181	1,047	3,215
Transport														
Mean	14.34%	2.87%	33.92%	16.69%	2.432	2.477	3.470	2.637	1.744	2.068	15.91%	18.21%	43.94%	31.08%
Standard deviation	33.91%	15.33%	39.82%	31.39%	2.974	3.014	3.242	2.866	1.121	1.318	36.72%	38.65%	49.82%	46.35%
No of obs.	132	325	130	320	132	325	132	325	125	307	132	324	132	325
Construction														
Mean	4.07%	1.62%	4.03%	1.34%	2.242	2.275	3.358	2.663	1.823	2.284	43.92%	42.49%	35.00%	29.44%
Standard deviation	18.22%	10.84%	14.85%	8.80%	2.972	2.784	3.052	2.680	1.209	1.358	49.73%	49.47%	47.79%	45.61%
No of obs.	260	754	254	751	260	754	260	754	232	691	255	746	260	754
Hotels and restaurants														

Mean	7.25%	3.66%	3.18%	2.92%	2.385	2.805	3.527	2.064	1.738	1.956	12.09%	11.14%	26.37%	22.16%
Standard deviation	24.54%	16.40%	13.07%	13.18%	3.119	2.775	3.277	2380	0.920	1.172	32.78%	31.51%	44.31%	41.59%
No of obs.	95	751	95	747	95	751	95	751	88	686	96	746	96	752
Other services														
Mean	11.26%	4.75%	14.42%	6.10%	2.435	2.708	3.226	2.879	1.759	2.055	34.43%	37.40%	33.87%	18.68%
Standard deviation	29.85%	18.99%	30.36%	21.06%	3.060	3.042	2.978	2.873	1.113	1.283	47.91%	48.48%	47.71%	39.05%
No of obs.	62	257	59	255	62	257	62	257	58	238	61	254	62	257

Table 2. Selected characteristics of the 2005 BEEPS survey data.

Sector/measure	**% foreign owned**		**Export intensity (% of sales)**		**Infrastructure constraints (0-4)**		**Administration constraints (0-4)**		**Perceived corruption scale (1-6)**		**% of firms bidding for government contracts**		**% of firms with a loan**	
	EU (2007)	**Non-EU**	**EU (2007)**	**Non-EU**	**EU (2007)**	**Non-EU**	**EU (2007)**	**Non-EU**	**EU (2007)**	**Non-EU**	**EU (2007)**	**Non-EU**	**EU (2007)**	**Non-EU**
All sectors														
Mean	9.08%	8.98%	11.32%	9.35%	1.466	1.520	2.052	2.033	1.766	2.399	2.43%	5.72%	41.45%	44.78%
Standard deviation	27.12%	25.88%	24.47%	23.12%	2.247	2.212	3.163	3.235	1.324	1.638	10.39%	16.62%	49.28%	49.74%
No of obs.	2,065	2,327	2,065	2,327	2,065	2,327	2,065	2,327	2,065	2,327	1,987	2,250	2,065	2,327
Manufacturing														
Mean	11.38%	10.62%	18.87%	13.95%	1.492	1.574	2.122	2.184	1.654	2.337	1.01%	3.99%	46.42%	54.03%
Standard deviation	30.31%	27.22%	30.71%	27.52%	2.308	2.244	3.201	3.345	1.296	1.591	6.76%	12.44%	49.90%	49.86%
No of obs.	866	981	866	981	866	981	866	981	866	981	825	939	866	981

Transport														
Mean	3.87%	9.84%	15.38%	18.60%	1.420	1.395	2.094	1.994	1.949	2.622	2.45%	4.26%	43.48%	41.18%
Standard deviation	16.14%	26.65%	26.96%	29.52%	2.186	2.178	3.263	3.374	1.476	1.775	11.13%	15.38%	49.75%	49.42%
No of obs.	138	119	138	119	138	119	138	119	138	119	128	113	138	119
Construction														
Mean	2.04%	2.82%	2.51%	3.17%	1.458	1.382	2.033	2.006	2.018	2.801	6.88%	18.67%	43.78%	41.06%
Standard deviation	12.93%	15.26%	9.20%	12.05%	2.336	1.846	3.019	2.930	1.478	1.735	18.35%	30.59%	49.73%	49.29%
No of obs.	217	246	217	246	217	246	217	246	217	246	211	240	217	246
Hotels and restaurants														
Mean	10.59%	9.00%	5.53%	8.81%	1.405	1.645	2.112	1.764	1.864	2.065	1.71%	3.07%	27.18%	33.87%
Standard deviation	29.48%	26.33%	16.89%	23.05%	2.037	2.631	3.208	3.166	1.237	1.612	4.45%	9.59%	44.71%	47.52%
No of obs.	103	124	103	124	103	124	103	124	103	124	100	120	103	124
Other services														
Mean	10.41%	5.95%	5.04%	4.76%	1.416	1.514	1.843	1.789	1.808	2.137	4.63%	8.26%	31.37%	25.88%
Standard deviation	28.97%	22.87%	15.84%	15.74%	2.039	2.357	2.965	3.069	1.294	1.585	15.47%	20.44%	46.48%	43.88%
No of obs.	271	255	271	255	271	255	271	255	271	255	260	245	271	255

5. Stochastic Production Frontier Analysis

For both the 2005 and 2013 samples a translog production frontier of a common form was estimated such that:

$$\ln Q_i = c + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln^2.K_i + \beta_4 \ln^2 L_I + \beta_5(\ln K_i.\ln L_i) + u_i \quad (10)$$

Where lnQ_i is the log of firm i's output, lnK_i the log of firm i's capital stock and lnL_i the log of its labour. For both samples a Cobb Douglas frontier was also estimated (not reported here) and used to test the following hypothesis with a likelihood ratio (LR) test:

H_0: $\beta_3 = \beta_4 = \beta_5 = 0$, against

H_1: at least one of the above coefficients $\neq 0$.

Since a Cobb-Douglas specification in effect imposes the above restrictions on the translog model it is, in effect, a test of whether a Cobb-Douglas function can be justified by the data. In both cases the LR tests rejected the null hypothesis at 90% and higher confidence levels. For this reason, the Cobb-Douglas frontiers are not reported.

The specification of the determinants of the technical inefficiency term varied between the 2005 and the 2013 sample, mainly because of differences between the two survey questionnaires used. For the 2005 sample the technical efficiency specification was:

$$TE05_i = \alpha_0 + \alpha_1 EU04_i + \alpha_2 size_i + \alpha_3 foreign_i + \alpha_4 export_i + \alpha_5 age_i + \alpha_6 rdspend_i + \alpha_7 national_i + \alpha_8 ruralpop_i + \alpha_9 totaltax_i + \alpha_8 minrents_i + v_i \quad (11)$$

For the 2013 sample the technical efficiency specification was:

$$TE13_i = \pi_0 + \pi_1 EU07_i + \pi_2 size_i + \pi_3 foreign_i + \pi_4 export_i + \pi_5 age_i + \pi_6 mgrexp_i + \pi_7 lnR_i + \pi_8 rdspend_i + \pi_9 local_i + \pi_{10} burcy_i + \pi_{11} compet_i + \pi_{12} degree_i + \pi_{13} regeff_i + \pi_{11} ruralpop_i + \pi_{12} legal_i + \pi_{13} minrents_i + w_i \quad (12)$$

Table 3 presents the results for the 2013 sample. All coefficients in the estimated frontier for the 2013 sample were positive and statistically significant at 99%, with the exception of the cross product between lnK and LnL, which was negative and statistically significant at 99% and the square of ln(L) which was not statistically significant.

With respect to technical efficiency EU membership in 2007 was found to have a positive and statistically significant effect at 99% confidence. The value of the coefficient suggests a strong effect of EU membership in 2007 on firm efficiency (negative effect on inefficiency) in 2013. With respect to the control variables foreign ownership, age, managerial experience, R & D spending, the number of competitors and the efficiency of the regulatory environment were all found to have positive and statistically significant effects on firm efficiency (negative effects on inefficiency) at 90% confidence or higher. Rental payments, a focus on local markets, a large rural population, a high share of mineral rents in GDP and the strength of the legal system were all found to have an adverse effect on efficiency (positive effect on inefficiency) at 90% confidence or higher.

Table 3 also presents the results of the stochastic frontier estimation for the 2005 sample. It is, of course, the case that the results between the two samples cannot be directly compared. Very few firms were included in both samples (ruling out panel estimation) and the questionnaire used differed between the two.

For the 2005 frontier (deterministic component), all of the coefficients are positive and statistically significant at 95% or higher confidence levels. The results with respect to the impact of EU membership in 2004 on technical (in)efficiency do not support the view that the effect of EU membership had a statistically significant effect in 2005. However, it is worth noting that the 2005 survey asked firms to report their sales for 2004, the same year that eight of the countries in the sample became EU members. The results, therefore, suggest that the immediate impact effect was not then statistically significant. The 2007 sample includes the same countries who joined in 2004 plus Bulgaria and Romania, who joined in 2007. The 2013 BEEPS survey asked firms to report sales for the last fiscal year. This means that firms in every country that was an EU member in 2007 would have been reporting sales for at least five years after their country joined the EU. The 2013 data therefore capture a much longer term effect of EU membership than the 2005 survey.

Of the control variables foreign ownership, the age of the firm, a focus on national markets and a large rural population were all found to have a positive and statistically significant (at 95% or higher confidence) on efficiency (negative on inefficiency). Firm size category, total tax rates and the share of mineral rents in GDP were all found to have negative and

statistically significant (at 99% confidence) effects on efficiency (positive effects on inefficiency).

Table 3. Stochastic production frontier estimates; dependent variable – log of output.

	2005	2013		2005	2013
Deterministic Component			**Parameters in variance of u**		
Constant	3.18061***	9.31155***	Constant	-1.76353***	0.65823
	(0.07546)	(0.1844)		(0.35018)	(0.92852)
lnK	.10957***	0.00309	EU04 (for 2005)/EU07 (for 2013)	-7.27621	-2.40874***
	(0.02307)	(0.00208)		(7.32719)	(0.67414)
lnL	.90279***	.95047***	Size	.18409***	0.14077
	(0.03091)	(0.08253)		(0.03895)	(0.12715)
lnK(squared)	.00532**	.01183***	Foreign	-.00646***	-.00140**
	(0.00259)	(0.00064)		(0.00227)	(0.00062)
lnL(squared)	-.02109***	0.01115	Export	-0.19946	0.00023
	(0.00452)	(0.01035)		(0.26421)	(0.00107)
lnK.lnL	.01258**	-.01622***	Age	-.00791**	-.00111*
	(0.00525)	(0.0024)		(0.00381)	(0.00061)
Parameters in variance of v			Mgrexp		-.00125***
Constant	-.68593***	.15983***			(0.00038)
	(0.03068)	(0.02757)	lnR		.00067***
					(0.0002)
	2005	**2013**	Rdspend	0.04334	-.78715**
Observations	4392	2507		(0.02996)	(0.3217)
Log Likelihood	-5198.9381	-3933.5843	Local		.98668***
Gamma	0.52689	0.40492			(0.20439)
Likelihood Ratio Test for Stochastic Frontier versus OLS			National	-.43915***	
Chi squared (3 degrees of freedom)	1083.926	344.806		(0.13224)	
			Burcy		-0.07076
					(0.10998)
			Compet		-.00069***
					(0.00023)
			Degree		0.00025
					(0.00074)
			Regeff		-.05303***
					(0.013)
			Ruralpop	-.01723***	.01486**
				(0.00583)	(0.00698)
			Totaltax	.01146***	
				(0.00249)	
			Legal		.19449***
					(0.0464)
			Minrents	.24284***	.11385***
				(0.04598)	(0.02856)

Notes: Standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1. Gamma (γ) gives the ratio of variance of the inefficiency term over the total amount of variance.

6. Propensity Score Matching

This section presents propensity score matching estimates for both the 2013 and 2005 samples. Two sets of estimates are presented in Table 4. The first set of results test our proposition 1 that EU membership is associated with stronger firm performance. For these tests we use two different performance variables as outcomes: productivity (output per worker) and profitability (profit per worker). The second set of results in Table 4 test our proposition 2 that EU membership is associated with increased internationalisation. For the tests we use (a) the share of exports in the firm's total sales and (b) foreign ownership as outcome variables. Checks for bias on observables associated with Table 4 are presented in Appendix 4.

Table 4 shows a statistically significant (at 99% confidence) effect of EU membership (in 2007) on both output per worker and profit per worker at the firm level. Likewise, EU membership in 2004 exhibits a statistically significant (at 99% confidence) effect on both output per worker and profit per worker in 2005. The results strongly support proposition 1 that EU membership is associated with stronger firm performance.

Table 4. Results of kernel density matching; treatment variables – EU membership in 2004 and 2007.

Outcome variables	Treatment variables	
	EU membership in 2004 (using 2005 data)	EU membership in 2007 (using 2013 data)
Final outcomes: productivity and profitability		
Log of output per worker	0.9378***	0.3286***
	(0.0281)	(0.1119)
Log of profit per worker	0.9104***	0.3110*
	(0.0343)	(0.1662)
Intermediate outcomes (internationalisation)		
Export intensity	0.0353***	8.7319***
	(0.0098)	(1.9249)
Foreign ownership	-0.0033	6.0176***
	(0.0091)	(1.6393)

Notes: Bootstrapped standard errors (1000 replications) in parentheses. ***p<0.01, **p<0.05, *p<0.1.

As with much empirical analysis, association is not necessarily causality. Although the results presented in Table 4 suggest a strong association between EU membership and firm performance, it might, for example, be argued that the countries that joined the EU in 2004 or 2007 were the economically more advanced transitional countries. Against such arguments, it needs to be remembered that the analysis is at firm not country level and that the point of

matching is to compare firms in EU members with like firms in non-members. That is, firms in EU countries are only compared to firms with common characteristics in non-member nations.

It might also be argued that EU membership involves more than regional liberalisation of trade and investment. For example, it also includes institutional change. To test whether the effects on firm performance are at least partly attributable to trade and investment this study adopts a two stage approach. Firstly, Table 4 tests whether EU membership had a significant effect on exports and foreign ownership. This is followed by testing the effects of internationalisation on firm performance (using the IPWRA analysis). In effect, the approach is to break down proposition 1 (EU membership is associated with better firm performance) into two subsidiary elements – that EU membership is associated with greater internationalisation (proposition 2) and that this greater internationalisation is associated with better firm performance (proposition 3).

Table 4 shows that EU membership in 2007 was associated with statistically significantly (99% confidence) higher shares of exports in firm sales, for the 2013 BEEPS sample. The analysis of the 2013 sample also shows EU membership (2007) is associated with higher levels of foreign ownership. For the 2005 sample, the treatment effect of EU membership in 2004 was positive and statistically significantly (at 99%) for the share of exports in firm sales. However, there was no statistically significant effect of EU membership on foreign ownership in the 2005 sample.

7. Generalised Propensity Score Analysis

This section presents (graphically) our estimates of the dose response function for four different cases. Firstly, dose response functions are reported separately for productivity (log of output per worker) and profitability (log of profit per worker) as outcomes, both with foreign ownership as the (continuous) treatment variable. Secondly, they are reported for the same two outcomes (productivity and profitability) but with exports as the treatment variable. Estimates of the treatment (propensity score) model for each are presented in Appendix 5. For each model the balancing property was tested using a Bayes factor based test. In each of the four cases this concluded that there was only very slight evidence against the balancing property. Each model was initially estimated separately assuming a gamma and a normal distribution but tests rejected normality every time. The dose response functions presented assume a gamma distribution.

Figure 1: Dose Response Function for Productivity with Foreign Ownership as the Treatment

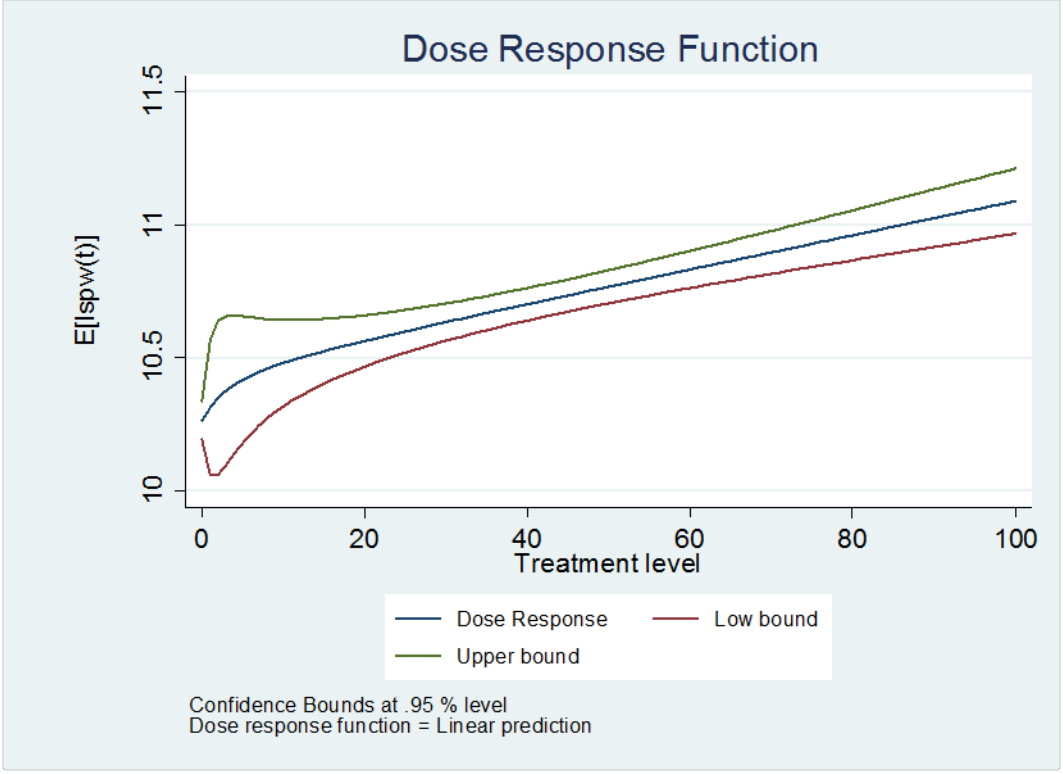


Figure 2: Dose Response Function for Profitability with Foreign Ownership as the Treatment

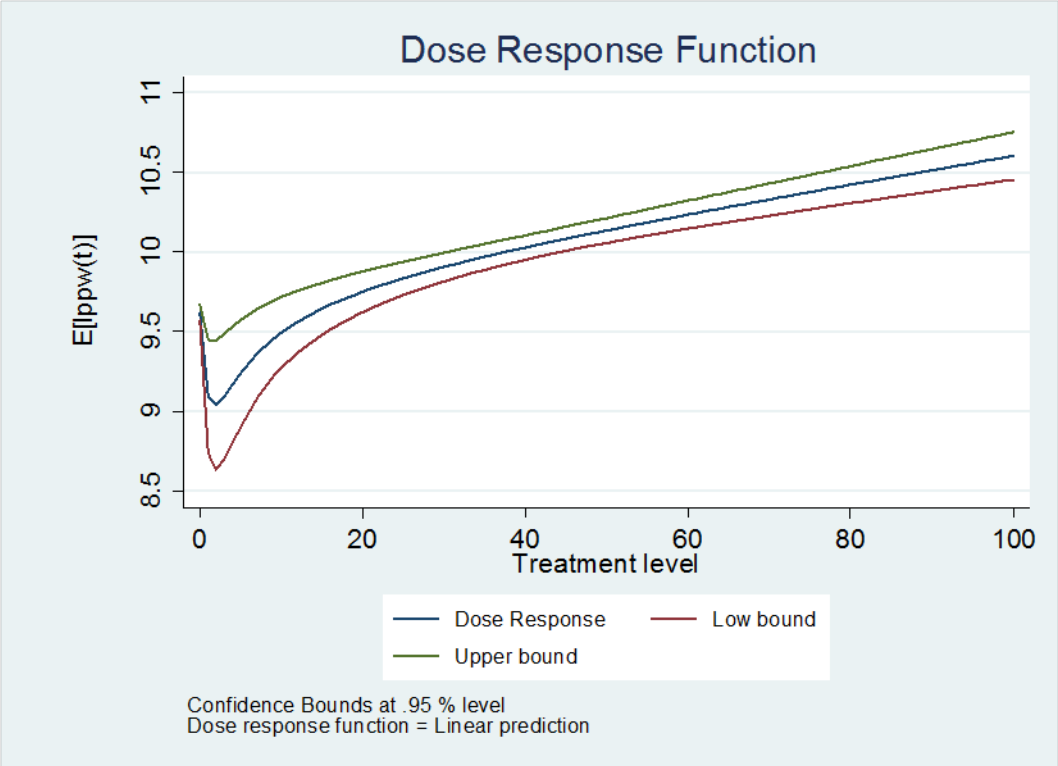


Figure 3: Dose Response Functon for Productivity Using Export Intensity as the Treatment

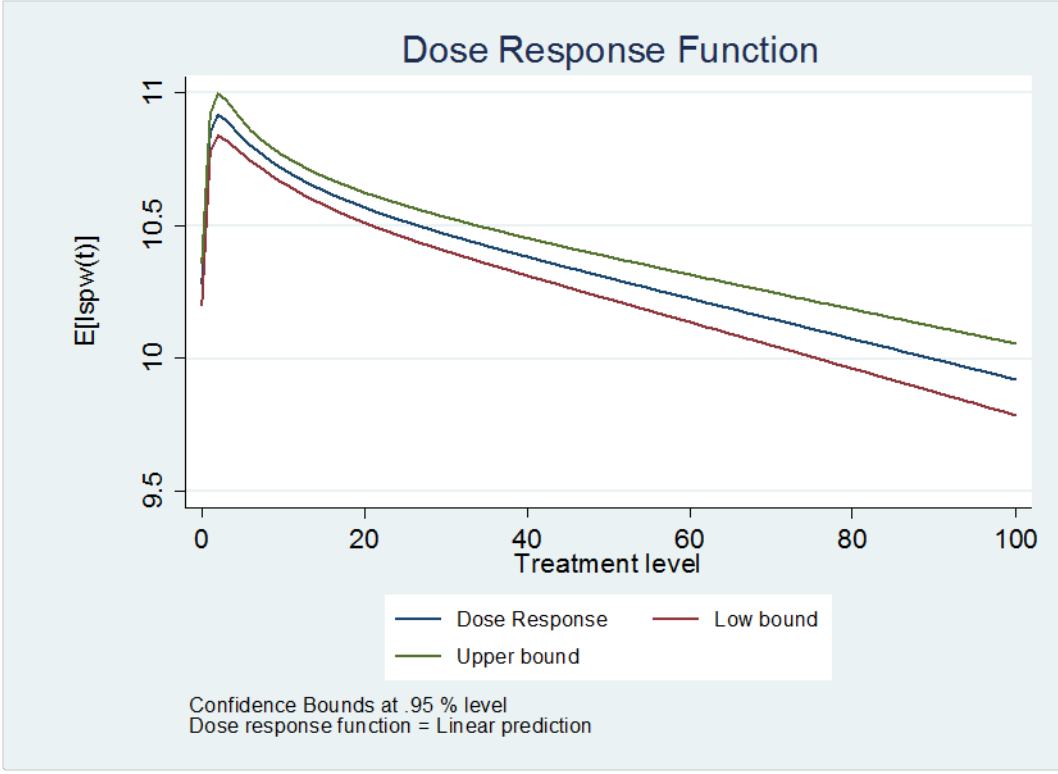
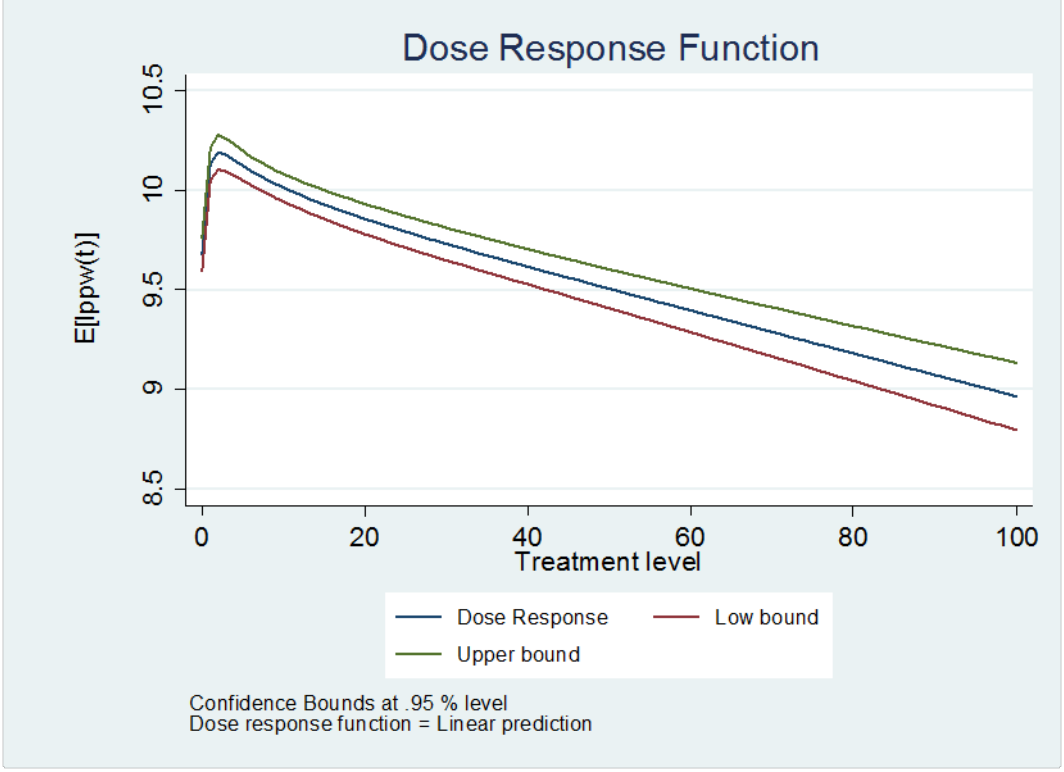


Figure 4: Dose Response Functon for Profitability Using Export Intensity as the Treatment



With foreign ownership as the treatment the dose response functions for both productivity and profitability show almost linear positive relationships between the percentage foreign ownership of the firm and firm performance. The higher the foreign owned share the greater the productivity or profitability of the firm.

The results for export intensity (the percentage of total sales) are a little more complex. The results show a strong increase in both productivity and profitability as export intensity increases from zero to modest levels. As export intensity is increased the gains in productivity and profitability are gradually reduced. This is consistent with our earlier finding (and with existing research) that, on balance, exporting firms are more efficient than non-exporters. The dose response function shows export intensity to yield better performance up to about 80% of total sales, which accounts for the great majority of exporting firms in our sample. It also needs to be remembered that – Tybout (2004) – the theory of trade predicts a fall in price as well as an increase in efficiency as a result of trade liberalisation. Since output is measured in terms of value it is consistent that gains in both productivity and profitability would decline with respect to falling prices the greater the resulting competition.

8. IPWRA Analysis

Table 5 presents IPWRA analysis using the 2013 BEEPS sample. As with the matching analysis, the performance (outcome) variables are output per worker and profit per worker. To capture the effects of internationalisation, there are two binary treatment variables – export and foreign ownership. Reading across the first row of Table 5 shows a statistically significant effect (at 99% confidence) on output per worker of exports and foreign ownership (individually) and of both treatments jointly, compared to a counter-factual where neither effect exists. Reading down the first column of Table 5 shows that removing exporting and foreign ownership (both individually and jointly) results in a statistically significant effect of lowering output per worker.

Table 5. Results of IPWRA estimator using the 2013 BEEPS survey.

Outcome variable: output per worker				
	Treatment Group			
Control Group	None	Export	Foreign Ownership	Both
None	-	0.09936**	0.3010697***	0.3253619***
		(0.0405256)	(0.075105)	(0.0787808)
Export	-0.1985036***	-	0.2089432**	0.2874666***
	(0.0536076)		(0.0860314)	(0.0807954)
Foreign Ownership	-0.2386026***	-0.2559592***	-	-0.1346961
	(0.0835998)	(0.1068244)		(0.129056)
Both	-0.4288132***	-0.2547884***	0.0241825	-
	(0.1622793)	(0.0916976)	(0.1336732)	
Outcome variable: profit per worker				
	Treatment Group			
Control Group	None	Export	Foreign Ownership	Both
None	-	-0.0564557	0.3267646***	0.1486679
		(0.060341)	(0.1013215)	(0.1195874)
Export	-0.2625243***	-	0.2395875**	0.2686353**
	(0.0769683)		(0.1189923)	(0.1208704)
Foreign Ownership	-0.1644141	-0.5267745***	-	-0.3819827**
	(0.1215956)	(0.1332508)		(0.1729291)
Both	-0.4831439**	-0.2925692**	0.0572431	-
	(0.2081582)	(0.1331656)	(0.1756691)	

Notes: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1.

Similar results apply to the relationship between both treatment (internationalisation) variables and profit per worker. At 99% confidence both exporting and foreign ownership (individually and jointly) are positive and statistically significant compared to no internationalisation (first row of the section). Likewise, removing both or either of these internationalisation treatments has a statistically significant effect of lowering profit per worker (first column). These provide further evidence that internationalisation (export intensity and foreign ownership) are linked to higher productivity and profitability.

8. Conclusions

Improving economic efficiency and, in particular, transferring resources from less efficient firms and industries to more efficient ones is of key interest to economic transition. The self-selection and learning by doing effects of trade liberalisation on firm level efficiency are, potentially, of considerable consequence for transitional countries. For those countries that joined the EU's single market in 2004 or in 2007, such effects are observed by this study. The EU single market did not just involve removal of tariff barriers but also non-tariff barriers.

This widened the scope for services to be affected by liberalisation. For example, the construction sector is disproportionately dependent on government contracts and liberalisation of government procurement within EU borders removed an important non-tariff barrier. The focus of this paper is on accession to the EU single market, but it is recognised that EU membership involves significantly more than the single market alone. For example, EU membership also involved institutional change. Our results also show that internationalisation was, at least, an important contributor to efficiency gains.

Methodologically, the first part of this study is in the tradition of those which estimate total factor productivity (TFP) effects of trade liberalisation. Unlike those studies, we use a stochastic frontier approach to identify differences between firms in productive efficiency and the role of trade liberalisation (EU membership). This was applied to a large sample of firms from 27 transitional countries in 2005 and 2013. The results of this analysis were clear for both the 2005 and 2013 cross-sections: EU accession had a statistically significant and substantial positive effect on the productive efficiency of firms in the new members.

Our next step was to adopt a propensity score matching approach, as has been undertaken in a number of studies examining the effects of exporting on firm productivity. Our propensity score matching analysis produced clear results which supported the findings of the stochastic frontier analysis. EU membership was found to have a positive effect on both labour productivity (output per worker) and profitability (profit per worker) compared to carefully matched firms from non-EU transitional economies. This applied to both the 2005 and 2013 cross-sections.

To support the link between EU membership and firm efficiency, this study undertook further matching analysis to test whether EU membership was linked to increased internationalisation (exporting and foreign ownership) at the firm level. Our results suggest that EU membership had a positive effect on the exports of firms in both the 2005 and 2013 samples. For foreign ownership, there was also a positive effect of EU membership in the 2013 sample but not for the 2005 cross-section. Next, using generalised propensity score (GPS) analysis we were able to show that both export intensity and foreign ownership are linked to improved firm performance.

The final step in our analysis was to test the proposition that exporting and foreign ownership at the firm level were associated with improved firm performance. Our IPWRA analysis showed that in both our 2013 and 2005 cross-sections internationalisation increased both

labour productivity and profitability. For both of these performance indicators, firm exports and foreign ownership were shown to be statistically significantly (individually and jointly) related to better firm performance.

The findings of this study show that EU membership is related to more efficient firms in transitional countries. Since EU membership involves more than just the single market, it might be argued that this is the result of something other than a trade liberalisation effect. This study finds that EU membership is also associated with the internationalisation of firms through exporting and foreign ownership. It also provides evidence that, for transitional countries in 2005 and 2013, internationalisation at the firm level was related to stronger firm performance.

REFERENCES

Amiti, M., & Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. *The American Economic Review*, 1611-1638.

Afonso, A., Schuknecht, L., & Tanzi, V. (2010). Public sector efficiency: evidence for new EU member states and emerging markets. *Applied Economics*, 42(17), 2147-2164.

Arnold, J. M., & Hussinger, K. (2010). Exports versus FDI in German manufacturing: firm performance and participation in international markets. *Review of International Economics*, *18*(4), 595-606.

Baier, S. L., & Bergstrand, J. H. (2009). Estimating the effects of free trade agreements on international trade flows using matching econometrics. *Journal of International Economics*, 77(1), 63-76.

Bakucs, L. Z., Latruffe, L., Fertő, I., & Fogarasi, J. (2010). The impact of EU accession on farms' technical efficiency in Hungary. *Post-communist economies*, 22(2), 165-175.

Bojnec, Š., & Latruffe, L. (2009). Determinants of technical efficiency of Slovenian farms. *Post-Communist Economies*, 21(1), 117-124.

Bernard, A. B., Jensen, J. B., & Schott, P. K. (2006). Trade costs, firms and productivity. *Journal of Monetary Economics*, 53(5), 917-937.

Bernard, A. B., Jensen, J. B., Redding, S. J., & Schott, P. K. (2007). Firms in international trade (No. w13054). National Bureau of Economic Research.

Bia, M. & Mattei, A. (2012). Assessing the effect of the amount of financial aids to Piedmont firms using the generalized propensity score. *Statistical Methods and Applications* 21(4), 485-516.

Blundell, R., Dearden, L., & Sianesi, B. (2005). Evaluating the effect of education on earnings: models, methods and results from the National Child Development Survey. *Journal of the Royal Statistical Society: Series A* (Statistics in Society), 168(3), 473-512.

Bolatto, S., & Sbracia, M. (2016). Deconstructing the Gains from Trade: Selection of Industries vs Reallocation of Workers. *Review of International Economics*, 24(2), 344-363.

Busso, M., DiNardo, J. & McCrary, J. (2014). New evidence on the finite sample properties of propensity score reweighting and matching estimators. *Review of Economics and Statistics*, 96(5), 885-897.

Bustos, P. (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinian firms. *The American Economic Review*, 101(1), 304-340.

Cattaneo, M. D. (2010). Efficient semiparametric estimation of multi-valued treatment effects under ignorability. *Journal of Econometrics*, 155(2), 138-154.

Cattaneo, M. D., Drukker, D. M., & Holland, A. D. (2013). Estimation of multivalued treatment effects under conditional independence. *Stata Journal*, 13(3), 407-450.

Clarke, George RG. (2011), How Petty is Petty Corruption? Evidence from Firm Surveys in Africa." *World Development* 39, 1122-1132.

Correa, Paulo G., Ana M. Fernandes, and Chris J. Uregian. (2010), Technology adoption and the investment climate: firm-level evidence for Eastern Europe and Central Asia., *The World Bank Economic Review,* 24, 121-147.

Czarnitzki, D., Ebersberger B. & Fier, A. (2007). The Relationship between R&D Collaboration, Subsidies and R&D Performance: Empirical Evidence from Finland and Germany. *Journal of Applied Econometrics,* 22(7), 1347–366.

Das, S., Roberts, M. J., & Tybout, J. R. (2007). Market entry costs, producer heterogeneity, and export dynamics. *Econometrica*, 75(3), 837-873.

De Jong, E., & Bogmans, C. (2011). Does corruption discourage international trade?. *European Journal of Political Economy*, 27(2), 385-398.

De Loecker, J. (2007). Do exports generate higher productivity? Evidence from Slovenia. *Journal of International Economics*, 73(1), 69-98.

De Rosa, Donato, Nishaal Gooroochurn, and Holger Gorg. (2010) Corruption and productivity: firm-level evidence from the BEEPS survey." World Bank Policy Research Working Paper Series.

Dehejia, R. H., & Wahba, S. (2002). Propensity score-matching methods for non-experimental causal studies. *Review of Economics and Statistics*, 84(1), 151-161.

Dehejia, R. (2005). Practical propensity score matching: a reply to Smith and Todd. *Journal of Econometrics*, 125(1), 355-364.

Dethier, Jean-Jacques, Maximilian Hirn, and Stéphane Straub. (20110, Explaining enterprise performance in developing countries with business climate survey data., The World Bank Research Observer 26: 258-309.

Dimitrova, A., & Buzogány, A. (2014). Post- Accession Policy- Making in Bulgaria and Romania: Can Non- state Actors Use EU Rules to Promote Better Governance?. *Journal of Common Market Studies*, 52(1), 139-156.

Emsley, R., Lunt, M., Pickles, A. & Dunn, G. (2008). Implementing double-robust estimators of causal effects. *Stata Journal*, 8(3), 334–353.

Epstein, R. A. (2014). Overcoming 'Economic Backwardness' in the European Union., *Journal of Common Market Studies*, 52(1), 17-34.

Faruq, H., Webb, M., & Yi, D. (2013). Corruption, Bureaucracy and Firm Productivity in Africa. *Review of Development Economics*, 17(1), 117-129.

Fried, HIO Lovell, CAK and SS Schmidt, eds., (1993) The measurement of productive efficiency: Techniques and applications (Oxford University Press, New York).

Greenaway, D., & Kneller, R. (2007). Firm heterogeneity, exporting and foreign direct investment. *The Economic Journal*, *117*(517), F134-F161.

Girma, S., Greenaway, A., & Kneller, R. (2004). Does exporting increase productivity? A microeconometric analysis of matched firms. *Review of International Economics*, *12*(5), 855-866.

Girma, S., Kneller, R., & Pisu, M. (2005). Exports versus FDI: an empirical test. *Review of World Economics*, *141*(2), 193-218.

Gustafsson, P., & Segerstrom, P. (2010). Trade liberalization and productivity growth. *Review of International Economics*, *18*(2), 207-228.

Hirano, K., & Imbens, G.W. (2004). The propensity score with continuous treatments. In *Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives,* ed. A. Gelman and X.-L. Meng, 73–84. Chichester, UK: Wiley.

Hirano, K., Imbens, G.W., & Ridder, G. (2003). Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica*, 71(4), 1161–1189.

Katayama, H., Lu, S., & Tybout, J. R. (2009). Firm-level productivity studies: illusions and a solution. *International Journal of Industrial Organization*, 27(3), 403-413.

Konings, J. (2001). The effects of foreign direct investment on domestic firms. *Economics of Transition*, *9*(3), 619-633.

Lechner M. (2001). Identification and estimation of causal effects of multiplie treatments under the conditional independence assumption, in: M. Lechner and F. Pfeiffer (eds.), *Econometric evaluation of active labor market policies*, Heidelberg, 43–58.

Lensink, R., & Meesters, A. (2014). Institutions and Bank Performance: A Stochastic Frontier Analysis. *Oxford Bulletin of Economics and Statistics*, 76(1), 67-92.

Levinsohn, J., & Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *The Review of Economic Studies*, *70*(2), 317-341.

Ma, Yue, Baozhi Qu, and Yifan Zhang (2010) Judicial quality, contract intensity and trade: Firm-level evidence from developing and transition countries." *Journal of Comparative Economics* 38, 146-159.

Mallick, S., & Yang, Y. (2013). Productivity performance of export market entry and exit: Evidence from Indian firms. *Review of International Economics*, *21*(4), 809-824.

Melitz, M. J., & Trefler, D. (2012). Gains from trade when firms matter. *The Journal of Economic Perspectives*, *26*(2), 91-118.

Méon, P. G., & Weill, L. (2010). Is corruption an efficient grease?. *World Development*, 38(3), 244-259.

Méndez, F., & Sepúlveda, F. (2006). Corruption, growth and political regimes: cross country evidence. *European Journal of Political Economy*, 22(1), 82-98.

Nataraj, S. (2011). The impact of trade liberalization on productivity: Evidence from India's formal and informal manufacturing sectors. *Journal of International Economics*, 85(2), 292-301.

Notaro, G. (2011). European Integration and Productivity: Exploring the Early Effects of Completing the Internal Market, *Journal of Common Market Studies*, 49(4), 845-869.

Olley, G. S., & Pakes, A. (1992). *The dynamics of productivity in the telecommunications equipment industry* (No. w3977). National Bureau of Economic Research.

Pavcnik, N. (2002). Trade liberalization, exit, and productivity improvements: Evidence from Chilean plants. *The Review of Economic Studies*, 69(1), 245-276.

Pitt, M., & L. Lee (1981). The Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry, *Journal of Development Economics*, 9, 43-64.

Sianesi, B. (2004). An evaluation of the Swedish system of active labor market programs in the 1990s. *Review of Economics and Statistics*, 86(1), 133-155.

Topalova, P. and Khandelwal, A., 2011. Trade liberalization and firm productivity: The case of India. *Review of Economics and Statistics*, 93(3), pp.995-1009.

Tybout, J. R. (2003). 'Plant-and Firm-level Evidence on the 'New' Trade Theories' in E. Kwan Choi and James Harrigan, ed., Handbook of International Trade.

Tybout, J. R. (2006). Comments on: Trade costs, firms and productivity by Bernard, Jensen and Schott. *Journal of Monetary Economics*, 53(5), 939-942.

Tybout, J. R., & Westbrook, M. D. (1995). Trade liberalization and the dimensions of efficiency change in Mexican manufacturing industries. *Journal of International Economics*, *39*(1), 53-78.

Van Biesebroeck, J. (2005). Exporting raises productivity in sub-Saharan African manufacturing firms. *Journal of International Economics*, 67(2), 373-391.

Wagner, J. (2007). Exports and productivity: A survey of the evidence from firm- level data. *The World Economy*, 30(1), 60-82.

Wagner, J. (2012). International trade and firm performance: a survey of empirical studies since 2006. *Review of World Economics*, *148*(2), 235-267.

Wagner, I., & Lillie, N. (2014). European integration and the disembedding of labour market regulation: transnational labour relations at the European Central Bank construction site, *Journal of Common Market Studies*, 52(2), 403-419.

Wang, M., & Wong, M. C. (2012). International R&D Transfer and Technical Efficiency: Evidence from Panel Study Using Stochastic Frontier Analysis. *World Development*, 40(10), 1982-1998.

Waldman, M. (1993). A new perspective on planned obsolescence. *The Quarterly Journal of Economics*, 273-283.

Wang, Y., & You, J. (2012). Corruption and firm growth: Evidence from China. *China Economic Review*, 23(2), 415-433.

Wooldridge, J.M. (2010). *Econometric Analysis of Cross Section and Panel Data.* (2nd edition). MIT Press.

Xu, Lixin Colin (2011), The effects of business environments on development: Surveying new firm-level evidence., *The World Bank Research Observer* 26: 310-340.

APPENDIX 1: 2005 AND 2013 SAMPLES BY COUNTRY

2005		2013	
Country	**Sample**	**Country**	**Sample**
Albania	121	Albania	343
Armenia	217	Armenia	243
		Azerbaijan	248
Belarus	111	Belarus	285
Bosnia	88	Bosnia-Herzegovina	297
Bulgaria	152	Bulgaria	273
Croatia	178	Croatia	322
Czech Republic	282	Czech Republic	215
Estonia	144	Estonia	243
FYR Macedonia	89	FYR Macedonia	343
Georgia	106	Georgia	289
Hungary	427	Hungary	193
Kazakhstan	114	Kazakhstan	430
		Kosovo	179
Kyrgyzstan	118	Kyrgyzstan	215
Latvia	137	Latvia	270
Lithuania	156	Lithuania	223
Moldova	91	Moldova	312
		Mongolia	324
		Montenegro	102
Poland	666	Poland	390
Romania	308	Romania	476
Russia	129	Russia	3021
Serbia and Montenegro	133	Serbia	333
Slovak Republic	121	Slovak Republic	172
Slovenia	132	Slovenia	243
Tajikistan	49	Tajikistan	252
Ukraine	263	Ukraine	767
Uzbekistan	60	Uzbekistan	365
Sample Total	**4392**	**Sample Total**	**11368**
Source: BEEPS surveys for 2005 and 2013			

APPENDIX 2: 2005 AND 2013 SAMPLES BY SECTOR (ISIC Rev. 3)

ISIC 2 Digit Sector		Sample	
Code	**Description**	**2005**	**2013**
10	Mining of coal and lignite; extraction of peat	11	1
13	Mining of metal ores	5	0
14	Other mining and quarrying	34	3
15	Manufacture of food products and beverages	492	761
16	Manufacture of tobacco products	5	4
17	Manufacture of textiles	54	153
18	Manufacture of wearing apparel; dressing and dyeing of fur	262	361
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and footwear	23	52
20	Manufacture of wood and of products of wood, straw and cork, except furniture.	50	256
21	Manufacture of paper and paper products	16	71
22	Publishing, printing and reproduction of recorded media	79	268
23	Manufacture of coke, refined petroleum products and nuclear fuel	5	6
24	Manufacture of chemicals and chemical products	45	199
25	Manufacture of rubber and plastics products	36	265
26	Manufacture of other non-metallic mineral products	59	419
27	Manufacture of basic metals	23	53
28	Manufacture of fabricated metal products, except machinery and equipment	357	398
29	Manufacture of machinery and equipment	178	401
30	Manufacture of office, accounting and computing machinery	8	8
31	Manufacture of electrical machinery and apparatus	30	161
32	Manufacture of radio, television and communication equipment and apparatus	6	38
33	Manufacture of medical, precision and optical instruments, watches and clocks	17	120
34	Manufacture of motor vehicles, trailers and semi-trailers	11	34
35	Manufacture of other transport equipment	8	37
36	Manufacture of furniture; manufacturing not elsewhere specified	81	241
37	Recycling	2	23
45	Construction	463	1037
50	Sale, maintenance, repair of motor vehicles and motorcycles; retail of automotive fuel	101	412
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	369	1617
52	Retail trade, except of motor vehicles and motorcycles; repair of household goods	549	2660
55	Hotels and restaurants	227	469
60	Land transport; transport via pipelines	153	297
61	Water transport	3	7
62	Air transport	2	4
63	Supporting and auxiliary transport activities; activities of travel agencies	79	166
64	Post and telecommunications	20	103
70	Real estate activities	67	37
71	Renting of machinery and equipment and household goods	19	6
72	Computer and related activities	41	188
73	Research and development	19	0
74	Other business activities	182	22
92	Recreational, cultural and sporting activities	88	1
93	Other service activities	110	2
	Other	3	7
	Sample Total	**4392**	11368
Source: BEEPS surveys for 2005 and 2013			

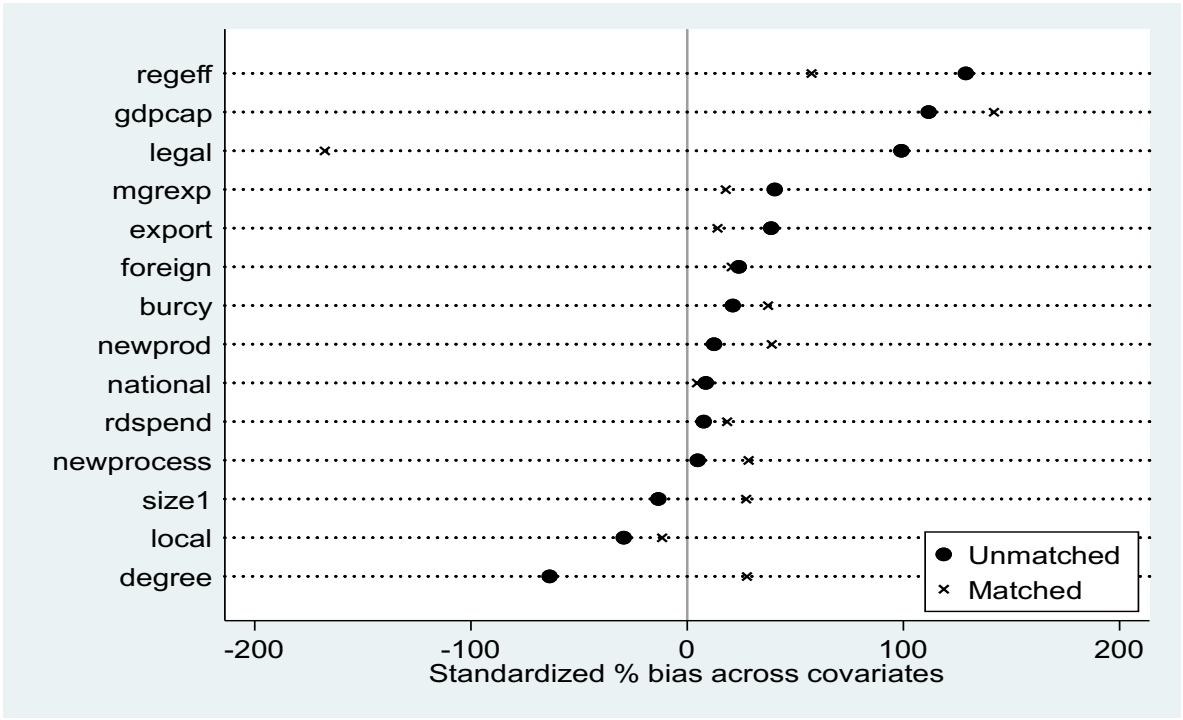
APPENDIX 3: 2005 AND 2013 SAMPLES BY FIRM SIZE CATEGORY

		2005			2013
Size Class		Sample	Size Class		Sample
1	2-10 employees	1687	Micro	less than 5 employees	425
2	11-49 employees	1349	Small	5-19 employees	5607
3	50-99 employees	493	Medium	20-99 employees	4039
4	100-249 employees	435	Large	100 or more employees	1297
5	250-499 employees	262			
6	500-999 employees	108		**Sample Total**	**11368**
7	1000-9999 employees	58			
Sample Total		**4392**			
Source: BEEPS surveys for 2005 and 2013					

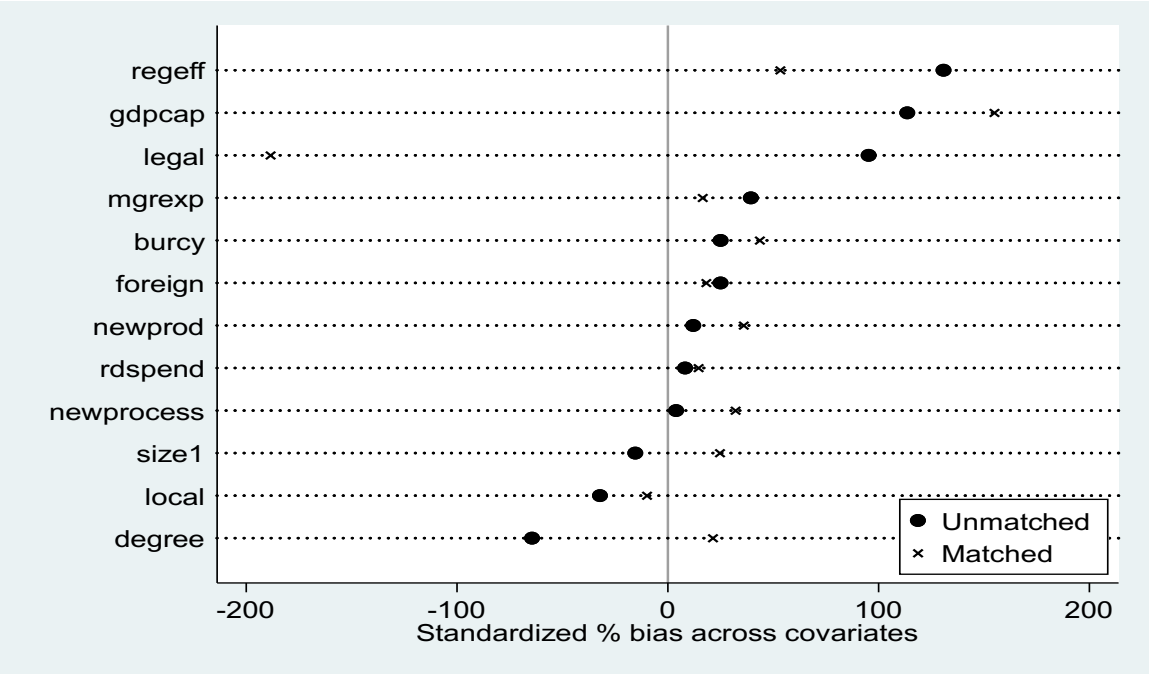
APPENDIX 4: PROPENSITY SCORE MATCHING - CHECKS FOR MATCHING ON OBSERVABLES

A. 2013 SAMPLE

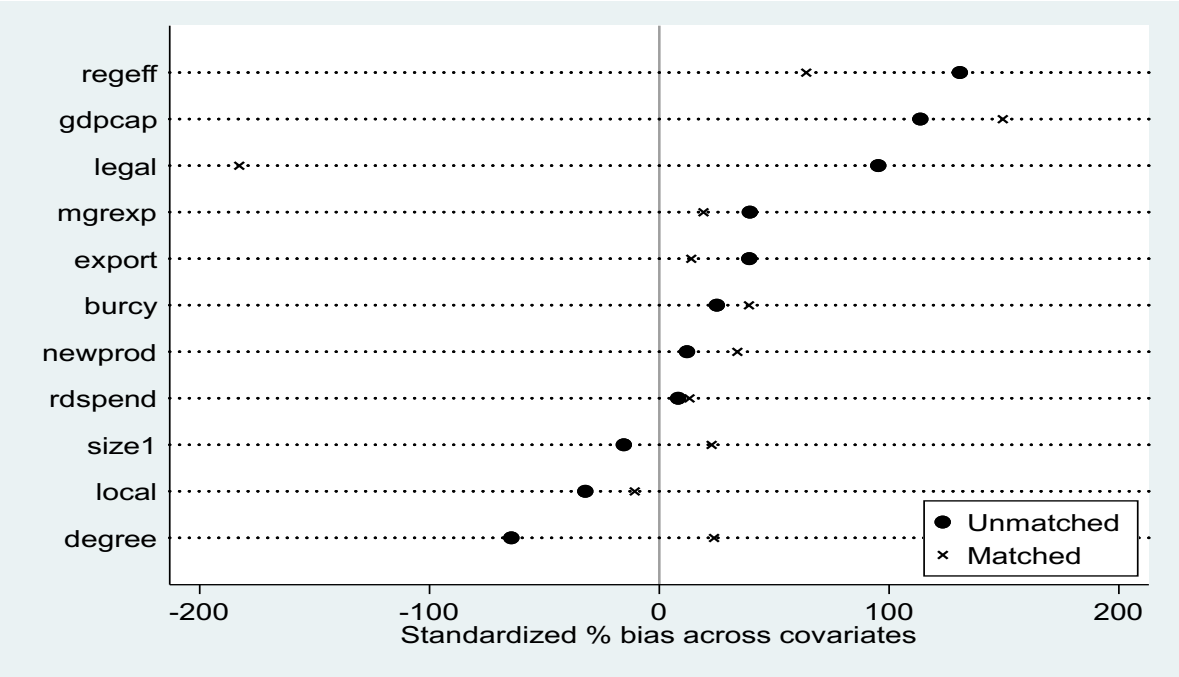
Treatment = EU Membership, Outcome = log of sales per worker and log of profit per worker



Treatment = EU Membership, Outcome = export intensity

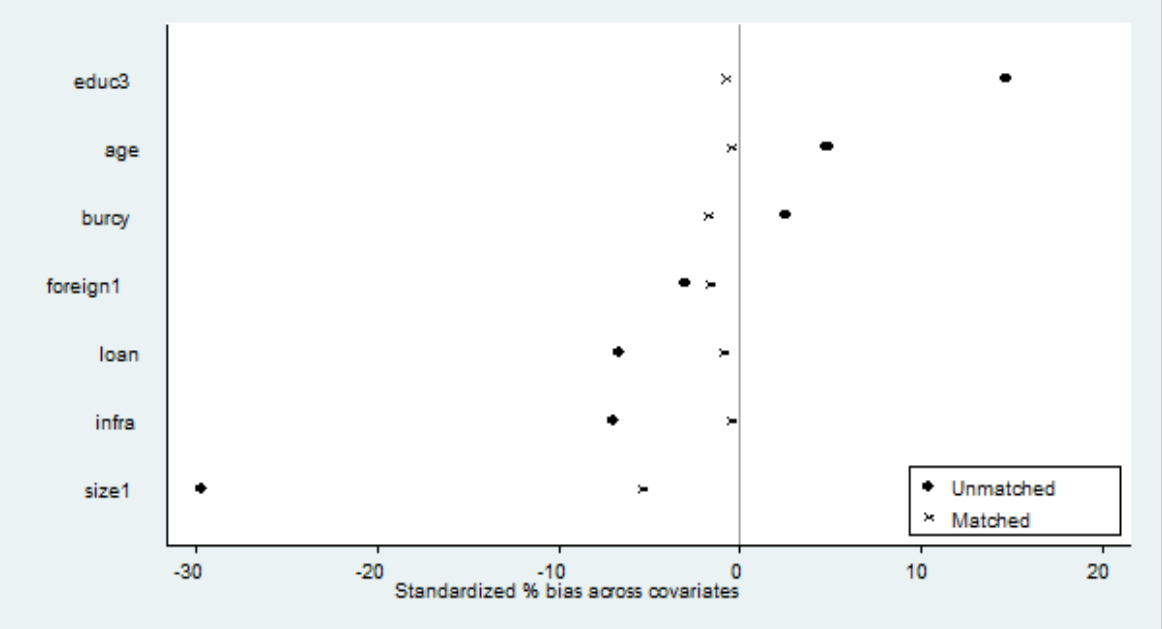


Treatment = EU Membership, Outcome = foreign ownership (%)

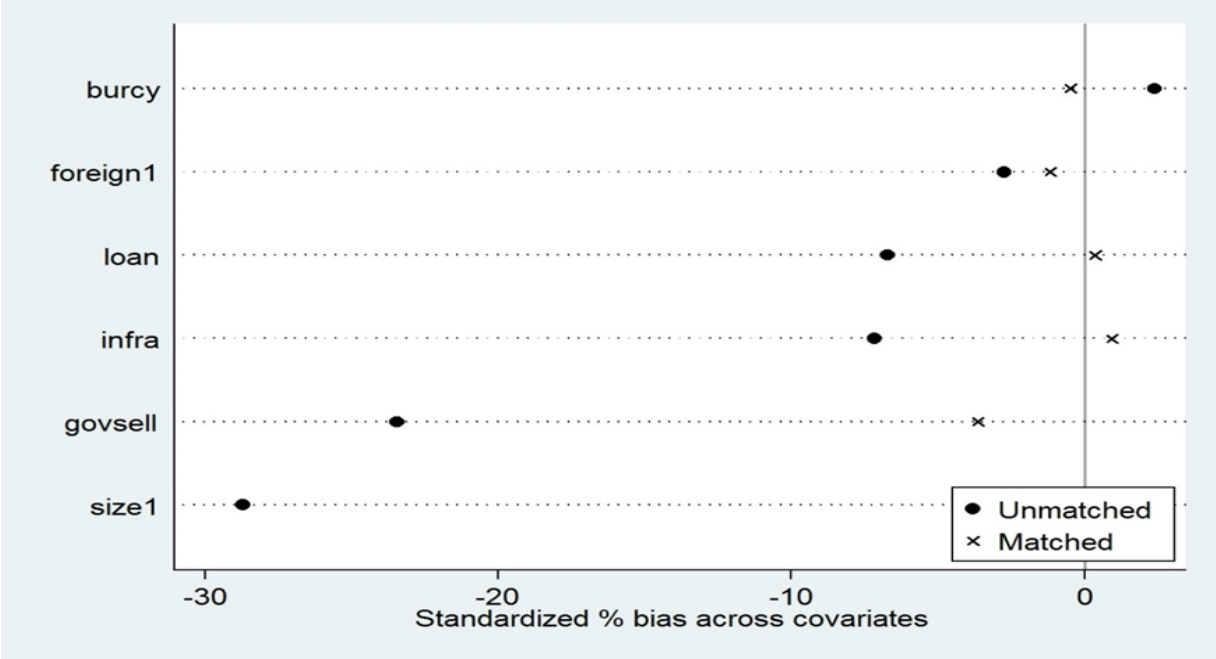


B. 2005 SAMPLE

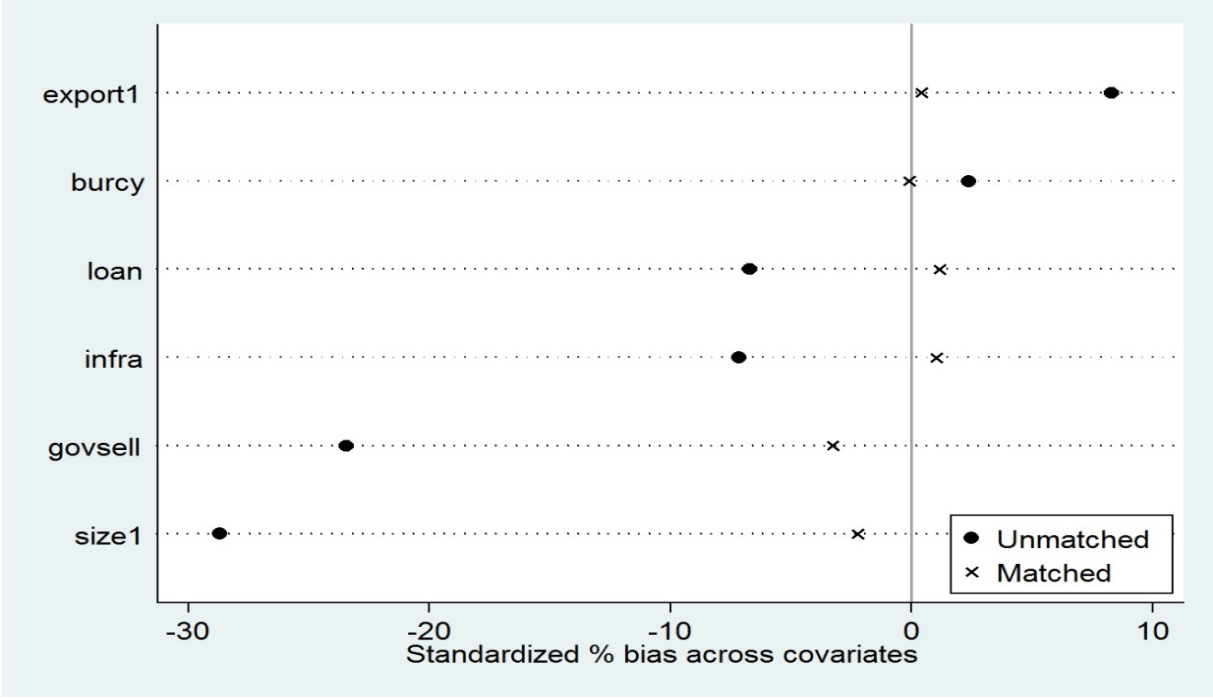
Treatment = EU Membership, Outcome = log of sales per worker and log of profit per worker



Treatment = EU Membership, Outcome = export intensity



Treatment = EU Membership, Outcome = foreign ownership (%)



APPENDIX 5: GPS Matching

Covariate	Coefficient Coef.	Robust S.E.	z
A. Treatment = foreign ownership (9731 observations)			
A.1 outcome = log of output per worker			
eu07	0.7966	0.1191	6.69
export	0.0112	0.0017	6.7
size1	0.4875	0.0782	6.23
burcy	-0.1074	0.0809	-1.33
loan2	-0.3550	0.1283	-2.77
age	-0.0053	0.0049	-1.08
mgrexp	-0.0283	0.0063	-4.52
local	-1.0483	0.1169	-8.97
degree	0.0030	0.0019	1.61
newprod	0.3771	0.1198	3.15
licensing	0.7822	0.1287	6.08
govbid	-0.2565	0.1454	-1.76
_cons	1.1678	0.2202	5.3
A.2 outcome = log of profit per worker			
eu07	0.7966	0.1191	6.69
export	0.0112	0.0017	6.7
size1	0.4875	0.0782	6.23
burcy	-0.1074	0.0809	-1.33
loan2	-0.3550	0.1283	-2.77
age	-0.0053	0.0049	-1.08
mgrexp	-0.0283	0.0063	-4.52
local	-1.0483	0.1169	-8.97
degree	0.0030	0.0019	1.61
newprod	0.3771	0.1198	3.15
licensing	0.7822	0.1287	6.08
govbid	-0.2565	0.1454	-1.76
_cons	1.1678	0.2202	5.3

Covariate	Coefficient Coef.	Robust S.E.	z
B. Treatment = export intensity (9722 observations)			
B.1 outcome = log of output per worker			
eu07	0.3564	0.1084	3.29
foreign	0.0060	0.0015	4.04
size1	0.1871	0.0684	2.74
infra	-0.0266	0.0557	-0.48
burcy	0.2262	0.0655	3.46
loan2	0.3346	0.0964	3.47
age	0.0093	0.0043	2.14
mgrexp	-0.0021	0.0056	-0.37
local	-3.6378	0.0874	-41.64
national	-2.4834	0.0629	-39.5
degree	-0.0041	0.0017	-2.47
newprod	0.4402	0.1109	3.97
newprocess	-0.1274	0.1108	-1.15
rdspend	0.3584	0.1129	3.17
licensing	0.4311	0.1023	4.22
govbid	-0.1138	0.1308	-0.87
_cons	3.1748	0.1878	16.9
B.2 outcome = log of profit per worker			
eu07	0.3564277	0.1084381	3.29
foreign	0.0059683	0.0014757	4.04
size1	0.1871201	0.0683893	2.74
infra	-0.0265509	0.0557211	-0.48
burcy	0.2262068	0.0654529	3.46
loan2	0.3346276	0.0963929	3.47
age	0.0093074	0.0043496	2.14
mgrexp	-0.0021056	0.0056405	-0.37
local	-3.637831	0.0873738	-41.64
national	-2.483403	0.0628733	-39.5
degree	-0.0041399	0.0016737	-2.47
newprod	0.4401783	0.1109482	3.97
newprocess	-0.1274013	0.1108195	-1.15
rdspend	0.3583703	0.1128927	3.17
licensing	0.4310922	0.1022548	4.22
govbid	-0.1138213	0.1308078	-0.87
_cons	3.174752	0.1878487	16.9