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**COMPETITION, OWNERSHIP AND PRODUCTIVITY:  
A Panel Analysis of Czech Firms**

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# Competition, Ownership and Productivity. A Panel Analysis of Czech Firms<sup>o</sup>

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## *Abstract*

This study empirically investigates if competition's impact on firm performance depends on the ownership structure. Our results show that an increase in import competition has a positive effect on firms with concentrated ownership and a negative effect on firms with dispersed ownership, regardless of the level of domestic competition. Given that the optimal level of ownership concentration with respect to firm productivity is high (low) if tariffs are low (high) in the case when import competition is high these results are consistent with theoretical findings that competition has positive effects in companies that are *a priori* efficient but not in unproductive firms. If tariffs are high, however, they support inferences based on the x-inefficiency literature. Contrary to what has been suggested by some theoretical results, the riskiness of a firm's environment does not seem to influence our results.

JEL: D24, F10

Keywords: Firm productivity; trade liberalization; competition; initial productivity.

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## 1. Introduction

The creation or the development of various economic agreements between countries, and the assiduous activity of the WTO during the last decades have lead to a decrease in the entry barriers into domestic and foreign markets. Faced with a continuously changing and increasingly competitive environment, companies have been forced to enhance their productivity to insure their survival. As suggested by the theoretical literature, firm characteristics such as the ownership structure may play an important role in determining the speed and the adequacy with which firms respond to changes in competition. Two concurrent views have emerged in this respect. According to one stream of literature, under increased competition companies close to the technology frontier are incentivized to innovate and to increase performance; the opposite holds for laggard companies that, regardless what they do, expect to loose market to more efficient entrants (Boone 2000, Aghion et al 2005). The corporate governance literature indicates that the efficiency level of a firm, at its turn, depends on the ownership structure (see the survey of Lawriwsky 1984). Consequently, firms with good ownership structure respond better to competitive pressure, raising their productivity and insuring their survival. There is, however, an alternative way to link competition and performance via ownership structure. According to the literature that analyzes x-inefficiencies, competition has a positive effect on managerial slack. When there are more competitors in the market: i. there are more opportunities for comparison, and thus better incentive schemes could be designed (Hart 1983);<sup>1</sup> ii. the threat of bankruptcy is higher and therefore managers have to work harder to avoid it (Aghion and Howitt 1997, Schmidt 1997, Aghion, Dewatripont and Rey 1999). The extent to which slack is an issue in a company and needs to be diminished by an increased competitive pressure depends on its ownership (see also Lawriwsky's 1984 survey of literature). Accordingly, when the competition intensifies, productivity increases more in companies with weak ownership structure.

This paper aims to provide empirical evidences regarding the extent to which the effect of competition on firm performance depends on firm ownership. The empirical literature provides significant evidences that competition and ownership, each at its turn, have an effect on firm and industry productivity. However, the fact that competition's effect on firm performance varies with the ownership structure is far less documented. We are aware of few papers that directly address this issue: Nickell, Nicolitsas and Dryden (1996), Grosfeld and Tressel (2002), and Konings et al. (2005). Finding out the direction in which the

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<sup>1</sup> See also Nalebuff and Stiglitz 1983, or Hermalin (1992) for explicit schemes or Holmstrom (1982), Meyer and Vickers (1995), and Nickell (1994) for the implicit schemes.

ownership structure influences the effect an increase in competition has on firm productivity is important in shedding light on the conditions under which privatization or reforms that promote competition yield the best results.

Our empirical analysis is done on a panel data of Czech firms for the period 1993-2005. Czech Republic's transition process offers an interesting case where the ownership structure has been quasi-exogenous during the period we study. This is due to the fact that the privatization of the formerly state owned enterprises has been done using different methods. Firm characteristics, apart from firm size, had little influence on the privatization method chosen by the government and on the resulting ownership structure. Once privatization has been completed, regulations have restricted the swapping of shares to avoid the concentration of financial capital. Moreover, the persistence of illiquid capital markets, underdeveloped entry and exit mechanisms, and soft budgets constraints during the first 7-10 years of the Czech transition process (Estrin 2002) have hold back further changes in ownership. Due to the quasi-exogenous ownership that emerged from this natural experiment, and due to the fact that there has been few changes in ownership following the privatization, causality between ownership and performance is less of an issue in our study than in related research. In addition, the fact that firms have been privatized using different methods has generated broad variations in ownership structures.

In our study we consider one aspect of ownership structure: the level of ownership concentration.<sup>2</sup> According to the theoretical literature, concentrated ownership aligns incentives and encourages monitoring (see Short 1994 for a survey). This is especially true when takeovers are not a threat (John and Kedia 2000) and the secondary markets do not perform their monitoring role (see the literature survey of Becht, Bolton and Röell 2003), as is the case in transition countries where market monitoring has been weak and the takeover market has been underdeveloped (Estrin 2002). Yet, dispersed ownership increases managers' incentives to acquire information (Aghion and Tirole 1997) and could serve as a commitment device that promotes managerial activism (Burkart et al 1997). Therefore when firms face high uncertainty managers' ability to react fast to changes might be crucial in ensuring good performance and concentrated ownership might not be the optimal structure with respect to firm performance. Conversely, Demsetz and Lehn (1985) argue that in uncertain

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<sup>2</sup> Foreign versus domestic ownership or private versus state ownership are issues that are often raised in the theoretical and empirical literature. In our dataset in many instances we did not have information on the country of origin for the owners. However, for those we had the fact that the foreign ownership prevails or not did not play a role for firm performance. Also, since in the Czech Republic almost all the companies have been privatized at the outset of the transition process, state owned enterprises are too weak represented in our sample to make any valuable inferences.

environments it is harder to distinguish managerial effort or ability from randomness and thus concentration should increase. These considerations suggest that good ownership is concentrated ownership unless a firm faces a highly risky environment. In the latter case it is less clear if ownership concentration is desirable.

Our results confirm that ownership characteristics and competition influence firm performance. Surprisingly, they show that the optimal level of ownership structure is dispersed ownership when import competition is weak and concentrated ownership when import competition is tough. Also, as conjectured, they show that the impact of an increase in competition on firm performance depends on the ownership structure. Thus, regardless of the level of domestic competition, if ownership is concentrated a decrease in tariff protection has a positive effect on firms with concentrated ownership and a negative effect on firms with dispersed ownership. These results are consistent with our conjectures based on the theoretical results of Boone (2000) and Aghion et al (2005) in the case when import competition is tough. On the contrary they support inferences based on the x-inefficiency literature when tariffs are high.

In our data risk does not influence ownership concentration which supports our initial assumption that the ownership structures in the Czech Republic have been rather exogenous. In addition the riskiness of a firm's environment does not seem to influence the impact of ownership concentration on firm performance.

Overall our results suggest that in an increasingly globalized world where the costs of trade decrease or when trade liberalization is envisaged, the companies with concentrated ownership structure will adapt better to increased competitive pressure from abroad. Yet, given that this recommendation is based on results obtained on the Czech data, it might only hold for economic environments similar to the one extant in the Czech Republic during the transition period, thus for economies in which market monitoring is weak and the takeover market is underdeveloped.

The remaining paper is organized in the following way. Section 2 briefly presents the economic reforms and the privatization process done by the Czech Republic. Section 3 discusses the main empirical evidences. Section 4 presents our data and methodology. The results are presented and discussed in Section 5. Section 6 concludes.

## **2. Short overview of economic reforms in the Czech Republic**

The economic transformation in the CEE has begun in the pre-transition period, while Michail

Gorbachov launched his program of economic reforms known as perestroika. In December 1988 the former Czechoslovakia<sup>3</sup> has launched a first generation of trade agreements with the Western Europe to lift restrictive quotas against their exports. The fall of the communist regimes of the CEE countries in the following year and the subsequent end of the CMEA, their economic agreement among them and Russia, had allowed Czechoslovakia to formally start its gradual process of EU integration. Thus, in December 1991 Czechoslovakia has signed a trade agreement with the European Community that set a gradual schedule of trade liberalization in industrial products between the EU and the Czech Republic over a 10 year period.<sup>4</sup> According to it, the EU had to abolish quotas on all industrial products (except textiles and coal) and custom duties on a substantial number of industrial products upon the entry into force of the agreement. The Czech Republic had to follow suit and by 2001 all the tariffs on manufacturing between the two trading partners had to be lifted.

In parallel, at the beginning of the 90s some of the former planned economies have decided to revive the trade among them. On December 21, 1992, the Central European Free Trade Agreement (CEFTA) was created by Czechoslovakia, Hungary and Poland. Later Slovenia (1996), Romania (1997), and Bulgaria (1999) have joined the agreement. However, the creation of CEFTA did not manage to bust the trade in the region to the same extent as the Europe Agreements did (Appendix, Table 1).

Trade reforms were also accompanied by other reforms that touched all the sectors of the economy. In January 1991, a far-reaching shock therapy has been started that apart from trade liberalization included privatization, price decontrol, drastic cuts in public subsidies to enterprises, a reform of the financial sector, and internal convertibility of the country's currency, the Koruna (Table 1).

Privatization has been completed by mid '90s. Among the firms that have not been restituted to former owners, most small firms were auctioned or sold in tenders, most medium firms were sold in tenders or to direct buyers, while large firms have participated in voucher privatization programs, have been sold in auctions or to strategic investors, or transferred to municipalities. The first two years after the voucher privatization has been completed (1995-1996) were characterized by extensive swapping of shares. The swaps were, however, restricted by legal requirements that aimed to prevent the excessive concentration of the financial capital. For example, the share of ownership held by privatization funds (IPFs) in a

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<sup>3</sup> The former Czechoslovakia existed until January 1, 1993 when it broke-up to form two different countries: the Czech Republic and the Slovak Republic.

<sup>4</sup> The Czech Republic is a member of the EU since May 1, 2004.

given company has been restricted to 20 percent or less and privatization funds were not allowed to purchase shares of other financial institutions.

The Czech legislation confers different rights to owners according to their ownership share. Large owners with stakes above 50% have the most rights, being allowed to change the board or the management, or alter firm's assets. Yet, their decisions could be blocked by blocking minority owners with shares between 33% and 50%. Further, legal minority owners that hold a 10% to 33% stake in the company may impede the implementation of unwanted decisions through lengthy court proceedings. In addition, the government may keep a golden share in a company that allows it to veto certain managerial decisions. The Czech government has retained golden shares in about 100 companies in food, telecommunications, pharmaceuticals and medical equipment, cinema, publishing, electricity and gas distribution and water and sewage sectors.

### **3. Relation to previous empirical research**

Empirical evidences on the relation between ownership concentration and firm performance are abundant (see for example the literature review of Denis and McConnell 2003). However, there is no consensus regarding the direction of this relationship. Among others, Mitton (2002) and Claessens and Djankov (1999) find a positive relationship while Demsetz and Lehn (1985), Kocenda (2003) and Lskavyan and Spatareanu (2006) do not find any significant relationship between concentration and performance.

The empirical evidence on the degree to which ownership concentration influences the relation between market competition and firm performance is scarce. We are only aware of the work by Nickell, Nicolitsas and Dryden (1996) on UK, and Grosfeld and Tressel (2002) on Poland. Using a panel data of 125 UK manufacturing companies over the period 1982-1994 Nickell, Nicolitsas and Dryden (1996) investigate if competitive pressure may serve as a substituting device to ownership structure in inducing good firm performance. They find that the impact of competition on firm productivity is lower when firms have a dominant external shareholder. The ownership data was available for only one of the years between 1983 and 1985. The very small sample used in the empirical analysis raises questions regarding sample representativeness and therefore the generality of these results. Grosfeld and Tressel (2002) have conducted a similar analysis on all non-financial companies listed on the Warsaw Stock Exchange (WSE) over the period 1991-1998. 153 companies were included in the analysis. Their results show that, unlike in Nickell, Nicolitsas and Dryden (1996), competition and

good corporate governance reinforce each other. In this study good corporate governance is defined based on their own empirical results to be either dispersed ownership or the existence of a controlling shareholder. This study includes only companies quoted in WSE, which constitutes a negligible share of all Polish companies. Given the small sample used in the analysis, the generality of these results may be questioned. Moreover, for firms that are quoted in stock exchanges the stock market monitoring is an alternative mechanism to ownership structure or to competition that plays a role in firm performance. In our case, most of the companies are not quoted in stock exchanges.

Also related to our research is the work of Konings et al. (2005) who study the impact of the privatization of manufacturing firms in Bulgaria and Romania on price markups. They find out that the higher the competitive pressure is the more positive is the impact of privatization on price-cost margins. Konings et al. (2005) interpret this result as being evidence that in highly competitive environments, privatized firms reduce costs rather than increase prices. Thus, much like in the case of Grosfeld and Tressel (2002), competition and better ownership structure resulted from privatization reinforce each other with respect to firm performance. In their study Konings et al (2005) only distinguish between domestic and private ownership, while we would like to emphasize another aspect of ownership structure: the ownership dispersion.

#### 4. Methodology and data description

Our empirical goal is to estimate changes in firm productivity that has accompanied increased competition and to relate these changes with ownership concentration. We assume that the amount of output produced by a firm depends on the level of capital, labor and on the effort employed by its manager. The managerial effort, at its turn, is affected by a firm's ownership structure, by the degree of competition it faces, as well as by the combined effect of ownership and competition. We consider a Cobb-Douglas production function. We estimate a dynamic model that uses a lagged dependent variable in order to take into account that it takes time until the output reaches its new long-run level when a factor of production changes. Therefore our empirical model is

$$y_{it} = \beta_i + \beta_t + \lambda y_{it-1} + (1-\lambda)\beta_k k_{it} + (1-\lambda)\beta_l l_{it} + \beta_o Ow_{it} + \beta_c c_{ind,t} + \beta_{c2} c_{ind,t}^2 + \beta_{oc} Ow_{it} c_{ind,t} + \beta_{oc2} Ow_{it} c_{ind,t}^2 + \varepsilon_{it} \quad (1)$$

where  $i$  is the firm subscript,  $t$  is the time subscript,  $y$  is log of real output (value added)<sup>5</sup>,  $k$  is log of capital stock,  $l$  is log of employment,  $Ow$  stands for ownership concentration,  $c$  for the degree of competition.  $\beta_i$  and  $\beta_t$  are unobserved firm and time effects. The lagged dependent variable takes into account persistent productivity shocks.  $\varepsilon$  are all other productivity shocks that are assumed to be serially uncorrelated. Our model bares similarities with Nickell (1996, 1997) and Grosfeld and Tressel (2002). We estimate it in first differences, using the generalized method of moments (GMM) for dynamic panels with lagged dependent variable developed by Arellano and Bond's (1991, 1998). We treat labor as endogenous while capital, which adjusts slower to changes in production, we treated as predetermined (e.g. state variable). To avoid possible endogeneity problems and to account for the fact that firms' adjustments to changes in competition may take time to materialize, we use lagged values of competition. For the former reason we also use lagged values of ownership concentration. Since prior theoretical and empirical results indicate that the impact of competition on firm productivity might be of an inverted U-shape we also use a square term for competition.

The empirical analysis is done on a panel dataset of Czech firms for the period 1993-2005 provided by Amadeus. We had access to the medium version of Amadeus database that contains information on medium and large firms (around 14000 firms), including sector classification, balance sheets, profit and loss accounts, number of employees, and detailed ownership information. To this data we further added industry level data, such as producer price indexes (PPI), tariffs, imports, and industrial output. Industry comes from the Czech Statistical Office, Eurostat, and UNIDO. These sources provide very detailed information and therefore most of the variables we used are at 4 or 3-digit level.

The competitive pressure faced by a firm in its market is captured by two measures. The first one, *Comp*, aims at proxying the competitive pressure arising from firms active in the domestic market. It is measured at 4-digit ISIC level using a Herfindal index where the sum of the squares of the market shares of the four largest firms in an industry was normalized by the industrial output, squared. We use our own dataset to identify these companies. The second one, *Tariff*, seeks to capture the effect of foreign competition and is the weighted average, by trade value, of effectively applied rates at 4-digit ISIC level. The ownership concentration variable,  $Ow$ , is also a Herfindal index and is defined as the sum of squared shares detained by the four owners with the highest shares in the company (see

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<sup>5</sup> To obtain firm level real output we deflate value added with industry price index. Therefore changes in our measure of real output could be driven by changes in productivity as well as by relative changes between a firm's prices and the price index.

Appendix 1).

Because, as we discussed before, it has been argued that the optimal level of ownership concentration for firm performance might be different for companies that act in highly risky environments than in stable conditions, we add to our Model (1) a variable *Risk* that aims to capture this aspect. It is computed at 4 digit NACE level as the standard deviation of return on assets of all the companies in an industry in a given year<sup>6</sup> (see Appendix 1). The natural way to introduce *Risk* in our estimation is as an instrumental variable. As we discussed, the riskiness of a firm's environment may determine the optimal level of ownership concentration. Given that firm performance may have at its turn an impact on ownership concentration, to deal with this endogeneity we could use *Risk* as an instrument when estimating (1). Yet, if the ownership structure in the Czech Republic has been fairly exogenous, as we argue in the introduction, *Risk* is not a valid instrument. In this case, since *Risk* should have an impact on the optimality of ownership concentration and therefore of the impact ownership has on firm productivity (directly or through its combined effect with competition) we add *Risk* as a regressor. We construct two additional models. First we add it as a simple regressor, and then we add its interaction term with ownership concentration.

$$y_{it} = \text{initial regressors} + \gamma_R Risk_{ind,t} \quad (2)$$

$$y_{it} = \text{initial regressors} + \gamma_R Risk_{ind,t} + \gamma_{Ro} Risk_{ind,t} Ow_{it} \quad (3)$$

Table 1 summarizes the main variables we use in our regressions.

Table 1. Summary statistics of main variables

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>y</i>	2551	6.580	1.213	0.900	11.058
<i>l</i>	2551	5.564	1.021	1.609	9.616
<i>k</i>	2551	6.653	1.566	0.118	12.192
<i>Ow</i> (lag)	2551	0.525	0.319	0.000	1
<i>Risk</i>	2551	13.787	8.006	0.163	86.76
<i>Tarif</i>	2551	6.427	4.422	0.060	27.53
<i>Comp</i>	2551	0.034	0.072	0.000	0.752

## 5. Results

We start by estimating Model (1) using Arellano and Bond's GMM method for dynamic

<sup>6</sup> We have also used two other alternative measures of *Risk* at the industry level (the standard deviation of return on assets of all the companies in an industry for all the period) and at firm level (the standard deviation of return on assets for all the period in a given firm). The results did not change.

panels. The results are given in Table 2.

Table 2. Regression results

	Main models (Nickell)			Robustness checks		
	M1	M2	M3	Nickell CRS	OP Prod	OP Prod & CRS
lag $y$	0.170*** (3.23)	0.171*** (3.23)	0.171*** (3.24)	0.194*** (3.78)		
$l$	0.300*** <sup>7</sup> (3.66)	0.305*** (3.71)	0.307*** (3.72)	0.455*** (6.36)		
$k$	0.235*** (2.76)	0.233*** (2.74)	0.235*** (2.77)	1.670*** (3.41)		
lag productivity					0.178*** (2.67)	0.192*** (3.08)
Ow	1.940*** (3.89)	1.942*** (3.88)	1.987*** (3.87)	0.194*** (3.78)	1.481** (2.33)	1.275** (2.08)
Comp	2.254*** (2.93)	2.257*** (2.93)	2.276*** (2.92)	1.980** (2.57)	2.384*** (2.70)	2.121** (2.43)
* $Ow$	-3.104*** (2.63)	-3.126*** (2.64)	-3.181*** (2.61)	-2.625** (-2.23)	-3.514*** (2.61)	-2.993** (2.25)
Comp <sup>2</sup>	-4.825*** (3.19)	-4.840*** (3.19)	-4.878*** (3.19)	-4.513*** (-2.97)	-5.043** (2.48)	-4.657** (2.32)
* $Ow$	6.080*** (3.15)	6.140*** (3.16)	6.258*** (3.12)	5.489*** (2.89)	6.681*** (2.68)	5.938** (2.42)
Tariff	0.211*** (3.50)	0.211*** (3.51)	0.214*** (3.53)	0.185*** (3.11)	0.144** (2.03)	0.143** (2.10)
* $Ow$	-0.413*** (3.90)	-0.413*** (3.89)	-0.418*** (3.91)	-0.352*** (-3.41)	-0.311** (2.35)	-0.266** (2.10)
Tariff <sup>2</sup>	-0.008*** (3.56)	-0.008*** (3.55)	-0.008*** (3.57)	-0.007*** (-3.22)	-0.006** (2.28)	-0.005** (2.30)
* $Ow$	0.016*** (3.91)	0.016*** (3.89)	0.016*** (3.90)	0.014*** (3.43)	0.012** (2.42)	0.010** (2.18)
Risk		-0.000 (0.40)	0.001 (0.36)			
* $Ow$			-0.002 (0.58)			
Serial correlation	-5.20	-5.20	-5.21	-5.49	-5.18	-5.11
Sargan test	$\chi^2(213) =$ 229.80	$\chi^2(213) =$ 203.26	$\chi^2(213) =$ 229.92	$\chi^2(213) =$ 226.25	$\chi^2(101) =$ 98.29	$\chi^2(100) =$ 102.23
	0.204	0.199	0.203	0.254	0.558	0.419
N firms	873	873	873	873	676	676
N observations	2551	2551	2551	2551	1857	1857

Note: We used one step GMM (xtabond2, Stata). Added value, capital and employment are expressed in logs.  $Ow$  stands for ownership concentration and is lagged once. Similarly,  $Comp$  and  $Tariff$  which respectively measure the intensity of domestic and foreign competition are lagged once. Control variables included in regressions but not reported: year dummies and industry dummies at 2 digit level.

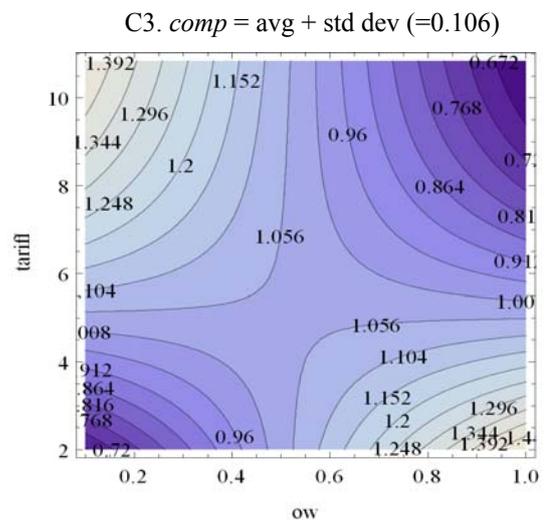
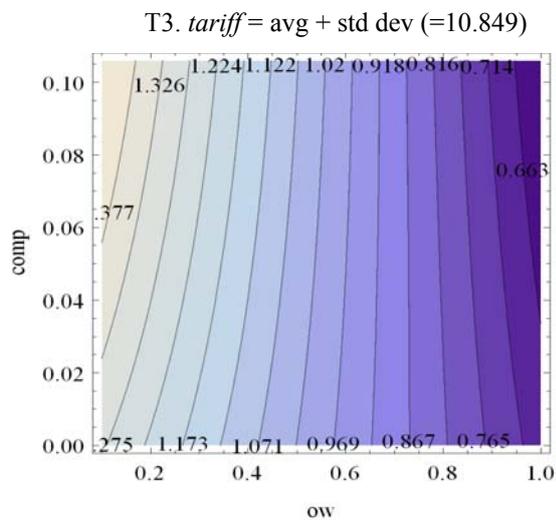
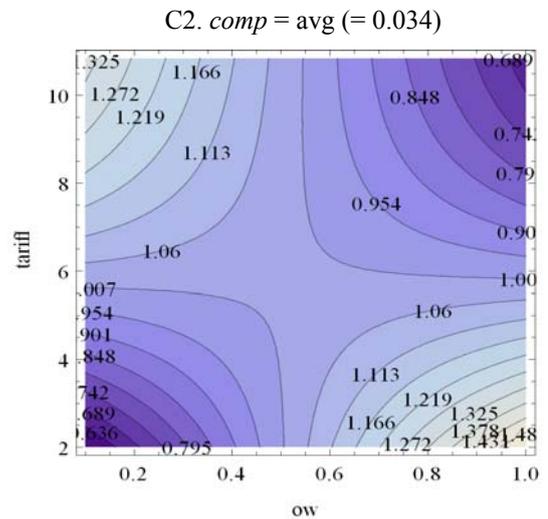
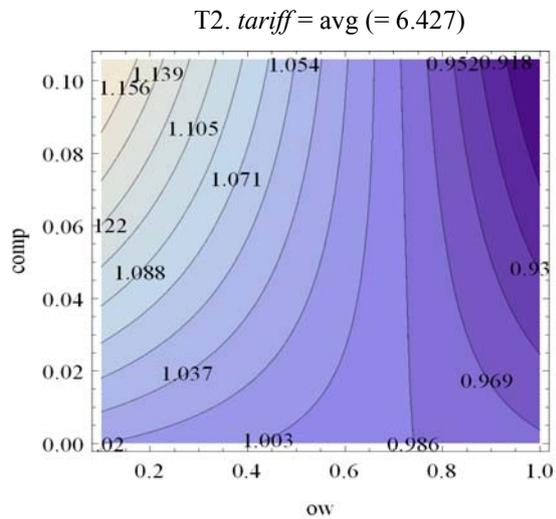
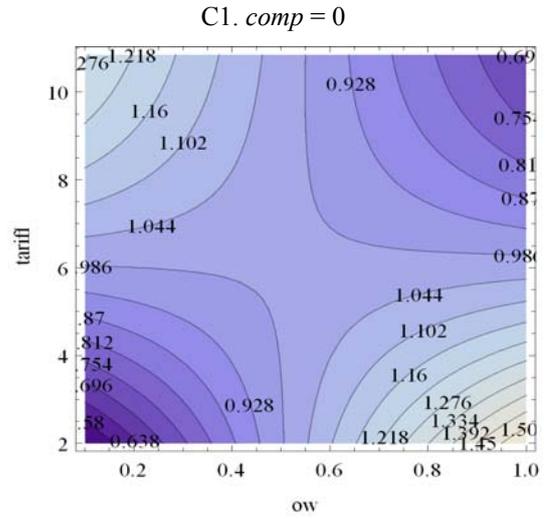
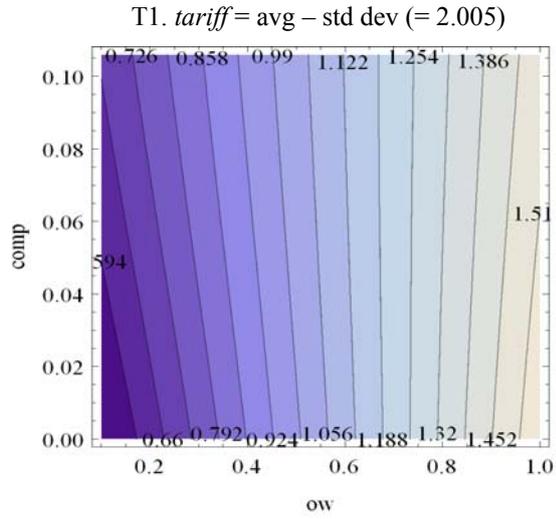
<sup>7</sup> This is the coefficient of employment we get when estimating our model. Given the way we specified it, in fact  $\beta_l$  is equal with  $0.3/(1-0.17) = 0.361$ . Similar calculations should be done to compute the elasticities of capital and labor in all the regressions.

They confirm that ownership characteristics and competition influence firm performance. Also, as we conjectured, they show that the impact of an increase in competition on firm performance depends on the level of ownership concentration. Thus, the direct effect of an increase in ownership on firm performance is significant and positive. Also if the level of domestic or foreign competition is not too high, the direct effect of a further increase is to induce higher productivity. If, however, competition is harsh, a further increase in it has a negative direct impact on firm performance. These findings are valid for both domestic and foreign competition.

The presence of many interaction terms between ownership concentration and competition renders difficult the inference of the total effect that changes in them, each at its turn, have on firm performance. To ease this interpretation Figures 1 draw the iso-productivity curves for ownership concentration and domestic competition keeping once tariff fixed at its mean value minus one standard deviation (fig T1), at the mean value (fig T2), and at one standard deviation above the mean value (fig T3). Similarly, fig C1, C2 and C3 draw the iso-productivity curves for *Ow* and *Tariff* fixing *Comp* respectively at 0, the mean value, the mean value plus one standard deviation. We allowed *Tariff* and *Comp* to vary only between their mean values minus/plus one standard deviation.

According to the iso-productivity curves shown in T1, when tariff is low, thus the competition from imports is high, concentrated ownership is optimal. If ownership is concentrated, an increase in competition (thus a decrease in *Comp*) moves the company on a higher iso-productivity curve; if ownership is dispersed, an increase in competition has an adverse effect on firm productivity. When tariff is average or high (fig T2 and T3), so import competition is weak, “good” ownership becomes dispersed ownership. Much like before an increase in competition has a positive effect on firms with concentrated ownership and a negative effect on firms with dispersed ownership. The results we get keeping tariff fixed are also confirmed looking the iso-productivity curves when the level of domestic competition is fixed (figures C). Regardless of the domestic competition level, if ownership is concentrated a decrease in tariff protection has a positive effect on firms with concentrated ownership and a negative effect on firms with dispersed ownership. However, when tariff is low, good ownership is concentrated ownership while when tariff is high dispersed ownership is optimal. The above results are consistent with our conjectures base on the theoretical results of Boone (2000) and Aghion et al (2005) in the case when import competition is high and thus concentrated ownership is optimal.

Figures 1. Iso-productivity curves



On the contrary they support inferences based on the x-inefficiency literature when tariffs are high and dispersed ownership is the best ownership structure.

Further on, we check if the stability of a firm's environment plays a role on the optimality of ownership concentration with respect to firm performance and thus should be used as an instrument for ownership concentration. Table 3 shows there is almost no relationship between *Risk* and *Ow* as their correlation is practically 0. As suggested in Wooldrige (2002) to further check if *Risk* is a valid instrument, we have also regressed ownership concentration on *Risk* and all the exogenous variables, including the instruments used by Arellano and Bond's GMM. Again, the fact that the coefficient of *Risk* is equal to zero cannot be rejected. These results indicate that *Risk* is not a valid instrument. In the case of the Czech Republic this could be due to the fact that the ownership structures resulted from privatisation have been exogenous and remained exogenous over most of the transition period due to rigidities in related markets and policy regulations.

Table 3. Correlation between *Risk* and *Ow*

Variable	Mean	Std. Dev.	Correlation with	
			Added value	Ow
Risk	13.787	8.01	0.079	0
* <i>Ow</i>	7.244	6.59	0.149	0.675
* <i>Comp</i> * <i>Ow</i>	0.281	1.03	0.083	0.200
* <i>Comp</i> <sup>2</sup> * <i>Ow</i>	0.057	0.62	0.014	0.079
* <i>Tariff</i> * <i>Ow</i>	44.950	56.62	0.066	0.426
* <i>Tariff</i> <sup>2</sup> * <i>Ow</i>	404.525	1035.90	0.015	0.159

Given that *Risk* is not a valid instrument, to further investigate if the optimality of ownership concentration varies with the level of stability of a firm's environment we estimate Models (2) and (3) where *Risk* is first introduced independently and then together with its interaction term with ownership concentration. The results are given in Table 2. Models (2) and (3) show that there is neither a direct effect of *Risk* on firm performance nor a combined effect of *Risk* and ownership concentration, further supporting our conjecture that ownership structure has been rather exogenous in the Czech Republic. The remaining effects, included in Model (1) are robust to the introduction of *Risk* remaining practically unchanged.

#### *Robustness checks*

Given that the effect that *Risk* does not seem to play a crucial role in this context, we favor Model (1) and do the robustness checks with respect to it.

It has been shown that measurement errors bias coefficients toward zero. Out of all the variables used in our estimation, we believe that the coefficient of capital is mostly affected by measurement errors. One way to deal with this bias is to introduce a constant return to scale (CRS) restriction in the estimates. To impose CRS in Model (1) we rewrite (1) as

$$y_{it} - k_{it} = \beta_i + \beta_l + \lambda(y_{it-1} - k_{it}) + (1 - \lambda)\beta_l(l_{it} - k_{it}) + \beta_o Ow_{it} + \beta_c c_{ind,t} + \beta_{oc} Ow_{it} c_{ind,t} + \varepsilon_{it} \quad (5)$$

When we estimated (5) we get the results in Table 2. They closely match the results we got before.

Given its attractive properties, one of the most popular methods in the empirical literature to estimate firm productivity is the Olley and Pakes (1996) semi-parametric method (from here on OP). In a first stage we estimate this productivity by industry at 2 digit level.<sup>8</sup> Herein lies the advantage of this method with the one used in our main model that impose the same production function to all firms in all industries. In the second stage we regress the predicted productivity on our repressors according to the following model

$$pr_{it} = \beta_i + \beta_l + \lambda pr_{it-1} + \beta_o Ow_{it} + \beta_c c_{ind,t} + \beta_{oc} Ow_{it} c_{ind,t} + \varepsilon_{it} \quad (6)$$

As before we estimate the equation (6) using Arellano-Bond's GMM method for dynamic panels. Further, we also estimate (6) imposing CRS in the productivity, assuming that OP provides an unbiased estimate of the labour coefficient and thus calculating the capital coefficient by subtracting from 1 the labour coefficient. In both cases, using the OP productivity without and with CRS, the estimated coefficients are highly significant and are similar in signs and magnitude with the coefficients we got for Model (1) (see results in Table 2). Using OP without CRS we get higher capital coefficients (even though they are not shown in the table) which is another reason to use (6) as an alternative to the main model.

## 6. Conclusions

In this empirical study that uses financial and industrial level data for a panel of Czech

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<sup>8</sup> As the Olley and Pakes method is widely used in the literature we will not spend time here to present it. In the end, to estimate productivity with this method taking into account the selectivity bias, we first estimated  $y_{it} = \beta_l l_{it} + (\beta_0 + \beta_k k_{it} + h(i_{it}, k_{it})) + v_{it}$ , where  $h(\cdot)$  is a function approximated in our case by a 3<sup>rd</sup> degree polynomial function, and  $v$  is a white noise. To further determine  $\beta_k$ , in a second stage we estimate  $y_{it} - \beta_l l_{it} = \beta_k k_{it} + \theta(\phi_{it-1} - \beta_k k_{it-1}) + \xi_{it} + v_{it}$ .  $\phi_{it-1}$  equals  $\hat{y}_{it-1} - \hat{\beta}_l l_{it-1}$  and  $\xi$  stands for unexpected productivity shocks. We used non-linear estimations where we used a 5<sup>th</sup> degree polynomial expansion to approximate the function  $\theta(\cdot)$ . Firm productivity is then  $pr_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it}$ .

companies we have in fact investigated two issues: i. which is the optimal level of ownership concentration, and ii. if the impact of an increase in competition (both foreign and domestic) on firm performance depends on the ownership structure. We have found out that the optimal level of ownership concentration varies with the level of import competition being highly concentrated ownership if tariffs are low and dispersed ownership when tariffs are high. Contrary to what has been suggested by some theoretical results, the riskiness of a firm's environment does not seem to influence this result. With respect to the impact of competition on firm productivity, our results show that for any level of domestic competition an increase import competition has a positive effect on firms with concentrated ownership and a negative effect on firms with dispersed ownership. The above results are consistent with our conjectures base on the theoretical results of Boone (2000) and Aghion et al (2005) in the case when import competition is high. If tariffs are high, however, they support inferences based on the x-inefficiency literature.

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Table 1. Main economic reforms

<i>Timing</i>	<i>Reforms</i>
July 1990	Cancellation of the negative turnover tax in Czechoslovakia
October 1990 – January 1991	Cumulative devaluation of the koruna by around 75% against convertible currencies
January 1991	A package of macroeconomic measures was launched. It included: <ul style="list-style-type: none"> <li>▪ price liberalization (except for some sensitive prices such as electricity, gas, heating, rents, postage, public transport, etc.)</li> <li>▪ trade liberalization</li> <li>▪ wage regulation</li> <li>▪ drastic cuts in subsidies to enterprises</li> <li>▪ restrictive monetary and fiscal policies</li> <li>▪ sharp devaluation and the introduction of partial convertibility of the currency, koruna</li> </ul>
December 16, 1991	The Association Agreement with the EU was signed
January 1, 1993	Dissolution of the Czech and Slovak Federal Republic
January 1993	Introduction of VAT.
February 8, 1993	Separate Czech and Slovak currencies were introduced
May 1993	The first wave of voucher privatisation
May and July 1994	Liberalization of coal and gasoline prices
March 1995	The second wave of voucher privatisation
July 1995	Abolition of general wage regulation
October 1995	Full current account convertibility of the Czech koruna
January 1996	Official application for EU membership
May 1, 2004	The country becomes a member of the EU
January 2002 – December 2005	Gradual liberalization of electricity prices
March 2003 – ...	Liberalization of rents
January 2005 – December 2006	Gradual liberalization of gas prices

## Appendix 1 – Data description

Firm level data are from Amadeus. Amadeus is a pan-European commercial database, provided by Bureau van Dijk, which contains financial information on public and private companies. We used data from all versions of the Amadeus database since 1996 with information on medium and large firms. Most of the Czech firms included in the database produce goods in several industries at 4 digit NACE level. We have classified firms according to their main activity.

We did the following modifications to the data:

- i. we excluded all companies that had less than 10 employees:
- ii. we excluded firms with non-positive investment levels when estimating firm productivity
- iii. since we did not have enough observations in three industries at 2-digit NACE level (16 – manufacture of tobacco, 23 – manufacture of coke, refined petroleum and nuclear fuel, 30 – manufacture of office machinery and computers) to estimate the production function we dropped companies from this sector.
- iv. we dropped 2 observations to exclude firms with market shares higher than 100.
- v. we dropped 6 observations to exclude firms with a productivity index less than -5 as they looked to be outliers (see Figure A1.4).

Table A1.1. Variables

<i>Variable</i>	<i>Definition</i>
<i>y</i> (log of output)	Added value deflated by the producer price index (PPI). For most of the industries, we have the PPI at 3-digit NACE; for the remaining we have used PPI at 2-digit NACE. <sup>9</sup> Sources: Added value is from Amadeus and Aspekt; PPI from the Czech Statistical Office. Coverage: 1993-2005
<i>k</i> (capital)	Tangible fixed assets deflated by the price index for gross fixed capital formation, at a slightly more aggregated level than 2-digit NACE. Sources: Tangible fixed assets are from Amadeus and Aspekt; price index for gross fixed capital formation from AMECO. Coverage: 1993-2005
<i>l</i> (log of labour)	Number of employees. Sources: Amadeus and Aspekt Coverage: 1994-2005
<i>i</i> (investment)	Computed as $i_{it} = k_{it+1} - (1 - \delta)k_{it}$ , where $\delta = 15\%$ . Coverage: 1993-2004
Tariff	Weighted average (by trade value) of effectively applied rates, taking into consideration applicable (and available) preferential duties. Source: WTO Coverage: 1994-2004
Comp	The ratio of the sum of the squares of the sales the 4 companies with the biggest sales of the four largest firms in an industry (according to our data) and the square of the industrial output, at 4-digit ISIC level. Sources: Firm sales are from Amadeus and Aspekt; industrial output is from UNIDO

<sup>9</sup>Mairesse and Jaumandreu (2005) show that deflating value added with PPI rather than a firm specific price index leads to very similar estimates of the coefficients in the production function.

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	via Campus Solutions. Coverage: 1995-2003
Ow	The sum of squared shares detained by the 4 owners with the highest shares in the company. Sources: Ownership information from Amadeus and Aspekt. Coverage: 1997-2003
Risk	The standard deviation of return on assets of all the companies in an industry in a given year, at 4 digit NACE level Sources: Amadeus and Aspekt Coverage: 1994-2005

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