Financial Liberalization, Competition and Productivity

Liliana Varela *

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Abstract

Recent cross-country studies associate financial liberalization episodes with increases in aggregate TFP. In addition, new evidence at industry-level illustrates that capital openness deepens market competition. This paper presents firm-level evidence showing that the increase in competition explains a major part of the expansion of aggregate productivity. To guide empirical work, I construct a simple endogenous growth, where firms have heterogenous access to external finance, which conditions their production and innovation activities. In the model, asymmetries in the access to credit limit competition and distort innovation activities. Removing heterogenous access to credit markets, financial openness reduces unconstrained firms' markups, and encourages innovation efforts of both constrained and unconstrained firms. The expansion is, however, heterogeneous: constrained firms rise their innovation efforts the most. As a result, I show that the increase in competition modifies the industry configuration, and affects the aggregate productivity growth rate. Using the deregulation of the financial account in Hungary in 2001, I present firm-level evidence for this mechanism. On the aggregate, I find that within firm productivity growth accounts for more than 80% of the RTFP enhancement in the post-reform period.

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1 Introduction

The relationship between international capital flows and productivity is a long-standing line of research in economics. A textbook theory states that capital opening should have no impact on total factor productivity (TFP). However, cross-country studies provide suggestive evidence of a positive impact of capital openness on aggregate productivity (Bekaert, Harvey, and Lundblad 2005 and 2011, and Bonfiglioli 2008). In the last years, new theoretical literature emerged focusing on the interaction between domestic financial imperfections and aggregate TFP during capital account liberalization episodes. This approach argues that it is the reallocation of market shares among heterogenous producers what drives movements in aggregate TFP (Aoki, Benigno, and Kiyotaki 2010; Buera and Shin 2009; Martin and Ventura 2012).

However, in this paper I present firm-level evidence, for a middle-income economy, illustrating that increases in *within* firm productivity are a major determinant of the expansion of aggregate TFP following capital account deregulations. In particular, in an environment were firms' technology is endogenous, the relaxation of credit conditions encourages firms' innovation efforts and deepens market competition. More specifically, I consider an economy in financial autarky, where firms' differential access to external finance generates monopolistic market power. The monopolistic rents distort firms' innovation incentives, which reduces aggregate TFP growth rate. Offering homogeneous access to credit markets, capital openness enables financially disadvantaged firms to undertake R&D activities and to challenge their industry rivals' market power. Thus, tighter competition and reduction in markups encourage all firms to rise their innovation expenditures. As a result, capital openness not only raises the level of aggregate TFP, but also accelerates its growth rate.

To investigate the impact of international financial integration on market competition and TFP, I identify and use the effect of a particular reform: the deregulation of the international financial flows in Hungary in 2001. An extensive dataset covering the population of manufacturing firms enables me to compute accurately the aggregate productivity growth and its reallocation and within-firm effects. Confirming cross-country studies, in Hungary the financial liberalization was accompanied by an increase of revenue TFP growth rate (RTFP henceforth). The deregulation of financial flows attracted large capital inflows to the economy, and remarkably to financial institutions.[1] The top chart in figure 1 plots the net inflows of the financial account of the balance of payments to financial institutions. It shows that net flows passed from 0.6 billions of US dollars yearly to 3.9 billions within the three years prior and following of the reform. The graph below depicts the rise in the cumulative RTFP growth rate in the manufacturing sector, and points out that the growth rate accelerated by 2.5% in the period.[2] Notably, after 2001 both capital inflows and RTFP evolved in parallel in Hungary.

Opposite to the view that the increase in aggregate productivity should be driven by

[1] I will explain the financial reform with further detail in the next section.

[2] A Perron's test of structural breaks confirms the breaking point around 2001, and the acceleration of the RTFP growth rate. See results in section 5.

reallocation across firms, firm' productivity improvements seem to be responsible for the bulk of the expansion of the RTFP. Table 1 decomposes the increase in RTFP into reallocation and within-firm effects. It shows that reallocation effects accounted for more than 60% of productivity growth between 1999 and 2000[3], whereas they only explained 12% in the three years following the deregulation. Conversely, within-firm productivity growth accounted for 88% of total RTFP enhancement in the post- reform period. Importantly, the liberalization of capital flows seems to have affected principally small firms' innovation activities. Columns 4 and 5 in table 1 illustrate that their average productivity growth accelerated by 4% within the three years following the reform.

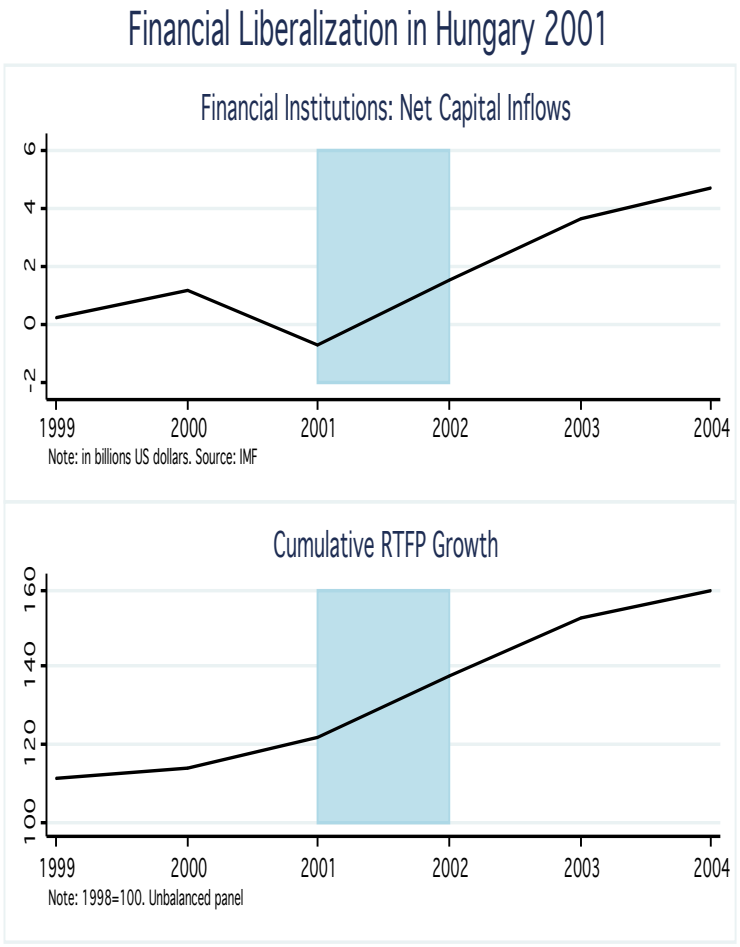


Figure 1: Net Capital Inflows and TFP

To study the effect of capital openness on firms' innovation incentives and their effect on market competition and the aggregate productivity, I construct an endogenous growth

[3]Since the reform took place in mid-2001, I remove 2001 to avoid misleading the impact of the reform.

Table 1: RTFP, Reallocation and Within-Firm Effects

	Revenue TFP Growth				
	RTFP	Reallocation	Within Firm	Within Firm	
				Large (L>100)	Small (L<100)
Before	6.4	5.0	1.4	4.1	4.5
After	9.7	1.6	8.1	0.9	6.5

model in the Shumpeterian tradition close to the spirit of the contributions in Aghion, Harris, and Vickers (1997) and Peters (2012). In my setup, heterogenous access to international financial markets offers an additional source of market power for incumbent firms which distorts their innovation incentives. In financial autarky, the low expenditures in R&D lead to high markup and productivity dispersion within sectors, and a low aggregate TFP growth rate. The openness to international financial markets decreases leader firms monopoly rents, inducing them to raise their innovation efforts. As well, it enables laggard firms to start undertaking R&D activities. Hence, the model predicts that both laggard and leader firms should realize more technology improvements than in autarky. The change in markup and productivity dispersion within sectors denotes the pro-competitive effects involved during capital opening episodes. On the aggregate productivity accelerates, and it is the within-firms' technical improvement which triggers it.

The model offers precise predictions that I test in the data. Employing an extensive database covering the population of manufacturing firms in Hungary, I proceed to investigate the implications of the theory in three steps. First, I use reduced-form regressions to study the change in firms' productivity. I present evidence illustrating that both leader and laggard firms increase their innovation efforts, showing the latests the larger expansion. Second, I estimate the markups and productivity dispersion within sectors. Data illustrate that process of technological catch up takes place, particularly in more technological dispersed sectors. Neck-and-neck sectors reveal the inverse effect. As firms gained access to credit, escape competition effect dominates and some firms increase their technology gap over their rivals. Third, I present evidence that physical TFP substantially after the reform. I also show that sectors where TFP dispersion was the largest contribute most to aggregate productivity growth after the liberalization.

This paper is mainly related to the literature investigating the effect of financial development on aggregate productivity. Aoki, Benigno, and Kiyotaki (2010) and Martin and Ventura (2012) include financial frictions to heterogenous agents model and show that the fraction of productive and unproductive agents determines whether the aggregate productivity expands or shrinks after the deregulation. Focusing on the allocation of capital and

entrepreneurial talents across firms, Buera, Kaboski, and Shin (2011) highlight the role of the external margin in the level of aggregate TFP. In a similar vein, Jeong and Townsend (2007), and Midrigan and Xu (2012) remark that credit market imperfections are particularly important when considering firms' technology adoption decisions. Differently from these studies focused on the aggregate level of TFP, this paper explores how changes in firms' innovation incentives and market structure affect the aggregate TFP growth rate.

Another branch of macroeconomic studies study empirically the relationship between income per capita, investment and productivity following capital openness (among others, Henry and Sasson 2008; Bekaert, Harvey, and Lundblad 2005 and 2011 and Bonfiglioli 2008; Gupta and Yuan 2009).[4] These cross-country panel regressions offer an extensive overview about the effects of financial market globalization, but provides little evidence about the forces at play in these episodes.[5] Levchenko, Rancière, and Thoenig (2009) advance this point and present evidence of pro-competitive forces following the deregulation episodes. In a cross-industry and -country study, their estimations suggest that credit market integration tightens competition by inducing firms' entry and reducing markups, particularly in more financially dependent sectors. This paper is close to Levchenko, Rancière, and Thoenig (2009) in the sense that the relaxation of credit conditions deepens product market competition. Yet, it advances their approach by using firm-level data and focusing on productivity.

This paper is also related to the literature stressing the pro-competitive effects of trade liberalization. This view broadly argues that reductions in trade costs deepens market competition and decreases distortions in input choices. Stronger competition impels reallocation of market shares toward more productive units, which raises the aggregate productivity level (see for example Bernard, Eaton, Jensen, and Kortum 2003; Melitz and Ottaviano 2008; and Edmond, Midrigan, and Xu 2011). My paper is related to these studies in the sense that a decrease in trade (financial) costs deepens competition and changes the industry configuration. However, it differs from them in firms' technology choices, which instead are endogenously determined.

In terms of the model, I build a Shumpeterian model where technology evolves in a quality ladder as in Grossman and Helpman (1991) and Aghion and Howitt (1992). My model is close to Peter's (2012), where the growth rate of aggregate TFP and the static distribu-

[4]For comprehensive studies on the impact of financial liberalization on growth see Henry 2007, Kose, Prasad, Rogoff, and Wei 2009, and Quinn and Toyoda 2008.

[5]This macro approach also deals with the difficulty of accurately identifying the timing and extension of financial deregulation episodes. More precisely, the two common used indexes of capital openness *de jure* and *de facto* tend to misrepresent the real level of financial integration. The *de jure* indexes of financial liberalization include a wide variety of international transactions from stock market openness to capital account transactions and banking deregulation. The difficulty in using these aggregate indexes stems not only from the particular effect of each of the components of financial liberalization, but also from the complexity of disentangling the effects of overlapping reforms. The *de facto* measure of financial openness may confound the actual level of financial integration. Since the country's gross external position also includes sovereign debt, this measure may overstate the private sector's financial integration with the rest of the world.

tion of markups are jointly determined in equilibrium. As in his model, the distribution of markups is endogenously determined by firms' innovation efforts. Differently from Peter's model, it is the access to external finance which determines firms' innovation efforts, and hence the markup distribution, and the aggregate productivity growth rate. Similar to Aghion, Harris, and Vickers (1997) and Acemoglu and Akcigit (2011), I analyze competition among leader and laggard firms within sectors. The characterization of these firms' R&D efforts follows the stylized facts presented in Klette and Kortum (2004). I further study the effect of the reform in neck-and-neck and technology dispersed sectors. I find evidence of escape competition effect in neck-and- neck sectors, and technological catching up in technology dispersed sectors. Reductions in mark-ups dispersion are consistent with this pattern. The model also accounts for the acceleration in RTFP growth rate observed in the data.

The remainder of the paper is structured as follows. In the next section, I present the main features of the deregulation of the financial account in Hungary and its impact on the domestic credit supply. In section three, I develop an endogenous growth model, where firms' heterogenous access to financial markets distorts innovation incentives. I show that the removal of barriers to international markets decreases markups distortions, which raises firms' innovation efforts. The model provides testable predictions that I turn to study in section four. In the reduced form analysis, I assess whether the deregulation of the financial account increased firms' investment and productivity, and decreased mark-ups. Then I study the sectoral RTFP and mark-ups dispersion, and show that their dispersion declined the most in sectors where the initial dispersion was the largest. Finally, I estimate the contribution of neck-and-neck and leaders firms to the acceleration of the RTFP growth rate. Section 5 explores the impact of the capital openness on entry and exit. It shows that the easing of credit conditions allowed smaller firms to join market, but the stronger competition rose the the productivity threshold for producing firms. Section 6 concludes.

2 Model

This section develops a simple model where distortions in the access to international borrowing affect firms' innovation efforts. The economy is composed by a continuum of intermediate sectors. Within each sector, firms compete à la Bertrand supplying a homogenous good, and invest in R&D activities, as in Aghion, Bloom, Blundell, Griffith, and Howitt (2005) and Acemoglu and Akcigit (2011). There are restrictions on capital flows as in Farhi and Werning (2012) that affect firms' borrowing costs and their incentives to undertake R&D activities.

2.1 Setup

Consider a one period small open economy, where the representative household maximizes its present utility from current consumption. The country is endowed with L units of labor and K units of capital. Let labor be immobile across countries. The capital is internationally mobile, but there are capital controls for domestic agents.

Final Sector
The economy is composed by a single final good Y produced by a representative firm in a perfectly competitive final output market. The price of the final good is taken as a numeraire. This firm combines the output y_j of a continuum of j intermediate industries using a Cobb Douglas production function with unitary elasticity of substitution for each industry. In particular, there is a measure of one of intermediate industries, indexed by $j \in [0, 1]$. In each intermediate industry, there are s firms that compete à la Bertrand supplying a homogenous good. Formally, $Y_{(t)} = exp\left(\int_0^1 ln\left(\sum_{s \in S} y_{(j,t)} \right) dj \right)$, where y_s is the quantity produced by firm s in the intermediate industry j. Given the final good production, the optimal demand for each sector is $y_{(j,t)} = \frac{Y_{(t)}}{p_{(j,t)}}$ where $p_{(j,t)} \equiv min_{s \in S_{(j,t)}} \{p_{(s,j,t)}\}$ is the minimum price in sector j.

Intermediate Sector
The production of the intermediate good requires capital and labor. Being a capital scarce economy, it imports capital from the rest of the world. Capital imports can take two forms: foreign direct investment and international borrowing. For simplicity, let each intermediate sector be composed by two firms: foreign and home firms (F and H). These firms differ in the access to credit market. In addition to their production activities, firms can innovate to increase their initial efficiency level. The timing is as follows: at the beginning of the period, firms choose their innovation efforts so as to maximize their expected profits net of innovation costs. After learning if the innovation was successful, they decide whether to produce. Firms take factor prices as given. For expositional purposes, I assume a partial equilibrium, and show in the appendix that the model's predictions hold under a general equilibrium setting.

-Access to Capital Markets. There are restrictions on capital inflows for domestic agents. In particular, domestic agents pay tax for each unit of foreign currency they borrow from abroad, $\tilde{\tau}$.[6] At the end of the period, the tax is transferred in lump sum fashion to the household. The no-arbitrage condition for domestic firms is then as follows,

$$R_{(t)} = (1 + \tilde{\tau})\, R^*_{(t)} \tag{1}$$

where R^* and R are the rental rate paid by foreign and domestically owned firms, respec-

[6]This treatment of restrictions on financial flows is similar to Farhi and Werning (2012) on capital controls. Notice as well that the tax on capital imports for domestic firms is analog to the distortion $(1 + \tau_{Ksi})$ modeled by Hsieh and Klenow (2009).

tively. In this framework, capital openness can be seen as a decrease in the tax rate, $\tilde{\tau}$. In perfectly integrated capital markets, i.e. $\tilde{\tau} = 0$, and the domestic and the foreign rental rates equalize.

-*Production.* To produce, intermediate firms use a Cobb-Douglas function,

$$f(q, k, l) = q_{(s,j,t)}\, k^{\alpha}_{(s,j,t)} l^{1-\alpha}_{(s,j,t)}$$

where q, k, and l represent each firm's physical productivity, capital and labor, respectively. For simplicity, I assume that at the beginning of the period foreign firms have an equal or higher productivity that home firms, i.e. $q_{(F,j,t)} \geq q_{(H,j,t)}$.[7]

-*Technology and Innovation.* Let firms' productivity evolve in a quality-ladder.[8] In particular, productivity is determined by $q = \lambda^{n_s}$, where $\lambda > 1$, and n_s denotes firm's s productivity level. In this economy, innovations stem from two sources: either F firms improve the existing technology, or H firms overtake the leader's technology.[9] If a F firm succeeds in improving its technology, it reaches the next step in the quality ladder and its technology increases by $\lambda\, q$. If a H firm produces an innovation, it obtains a new state-of-the-art technology, $\lambda\, q_{(j,t)}$.[10] Under this specification, in industry j the technological gap between firms can be expressed as a function of the difference in the productivity level of foreign and home firms: $\Delta_{(j)} \equiv n_{(F,j,t)} - n_{(H,j,t)} \geq 0$.

The innovation cost function is such that by employing C units of labor a firm can move ahead in the technological frontier with an independent probability determined by R&D investments. The innovation costs for F and H firms are given by,

$$C(x_{(F,j,t)}, \Delta) = \lambda^{-\Delta}\, \frac{1}{\phi} \frac{x^2_{(F,j,t)}}{2} \quad \text{and} \quad C(x_{(H,j,t)}) = \frac{1}{\phi} \frac{x^2_{(H,j,t)}}{2} \tag{2}$$

where ϕ denotes the efficiency of the innovation technology, and $x_{(F,j,t)}$ and $x_{(H,j,t)}$ denotes firm F and H in sector j innovation efforts. Notice that the efficiency of the innovation is equal for both F and H firms (ϕ), but foreign firms might enjoy lower innovation costs. Similarly to Klette and Kortum (2004), Atkeson and Burstein (2010) and Peters (2012), I assume that larger firms enjoy lower innovation costs. In particular, I follow Peters (2012) and assume that for F firms innovations are easier the greater the technology advantage, i.e. $\lambda^{-\Delta}$. This assumption guarantees that firm's growth is independent of its size, i.e. Gibrat's Law, and accounts for the empirical finding that R&D intensity is constant for

[7] This assumption is not crucial, but it simplifies substantially the exposition. Furthermore, it is in line with the empirical patterns observed in Hungary prior to the reform, and presented in section 7.3.

[8] As in Grossman and Helpman (1991) and Aghion and Howitt (1992), for example.

[9] In a one-period Bertrand competition model, a laggard firm would not invest to simple catchup its rival technology, in that case it would get zero profits. A detailed discussion can be found in Grossman and Helpman (1991).

[10] Remark that this race for the state-of-the-art technology assumes infinitely-lived patent protection, but H firms can learn enough about the existing knowledge so as to develop a new technology without infringing the patents law.

large firms (Crepon, Duguet, and Mairesse 1998; Klette and Kortum 2004). I show below that these functional forms are also appealing because they ensure that firms' innovation efforts solely differ on their asymmetric access to credit markets, i.e. if F and H firms had the same access to credit, their innovation efforts would be equal.[11]

2.2 Firm Behavior

At the beginning of the period, firms chose their innovation efforts so as to maximize their expected profits net of innovation costs (equations in (2)). In particular, firm F maximizes its net expected profits from climbing one step ahead in quality-ladder ($\lambda^{n_{(F,j,t)}+1}$) with an endogenous probability $x_{(F,t)}$, or remain at the same technology level ($\lambda^{n_{(F,j,t)}}$) with a probability $1-x_{(F,t)}-x_{(H,t)}$. Firm H chooses the innovation efforts $x_{(H,t)}$ so as to go one step ahead of the F firm's technology: λ, and to become the industry leader.

Given the market structure and the demand function, only firm s with the lowest unitary cost of production will be active in equilibrium and its profits will be given by: $\Pi_{(s,j,t)} = (1-\xi^{-1}_{(s,j,t)})Y_{(t)}$, where $\xi_{(s,j,t)}$ denotes its markup. In this setup, the pricing rule is such that, to prevent entry, the industry leader sets its price equal to its rival's marginal costs. Therefore, if F firm in sector j is active in equilibrium its markup will be given by:

$$\xi_{(F,j,t)} \equiv \frac{p_{(j,t)}}{MC_{(F,j,t)}} = \tau \frac{q_{(F,j,t)}}{q_{(H,j,t)}} \tag{3}$$

where $\tau = (\frac{R_t}{R^*_t})^{\alpha} = (1+\tilde{\tau})^{\alpha}$, and represents the differential in the rental rates of capital in the domestic and the world economies. As $\tilde{\tau} > 1$, $R > R^*$, and $\tau > 1$. Equation (3) illustrates that besides any difference in technology, F firms can obtain higher markups arising from their preferential access to financial markets.[12] If H firm succeeds in climbing ahead of the F firm productivity level, its markup will be

$$\xi_{(H,j,t)} \equiv \frac{p_{(j,t)}}{MC_{(H,j,t)}} = \frac{1}{\tau} \frac{q_{(H,j,t)}}{q_{(F,j,t)}} \tag{4}$$

[11] If innovation costs were not scaled by the foreign firm's productivity advantage, proposition 1-3 would still hold. The direction of the change in the productivity growth in proposition 4 would be, however, more ambiguous. To see this, note that the change in the growth rate of physical productivity depends on the changes due to firm's technical efficiency (within firm) and reallocation effects: $\frac{\partial g^e}{\partial \tau} = \frac{\partial g_{TE}}{\partial \tau} + \frac{\partial g_{RE}}{\partial \tau}$.The term $\frac{\partial g_{TE}}{\partial \tau}$ is always negative, which implies that a reduction in the asymmetries in the access to financial market increases firms' physical productivity. The sign of the reallocation term is more difficult to determine as it depends on how the distribution of sectors changes. If innovation efforts are not constant across sectors, numerical simulations are necessary to establish the sign of the reallocation term. Intuitively, if the fraction of sectors with low productivity growth rates increases as much to offset the technical efficiency growth, the growth rate of aggregate physical productivity growth could decrease.

[12] Equation (3) illustrates the negative impact of heterogenous access to credit on competition. To see this, consider a sector where F and H share the same productivity level ($q_{(F,j,t)} = q_{(H,j,t)}$). In absence of financial asymmetries, this would be a perfectly competitive market, and the price would be equal to firms' marginal costs. Instead, in presence of credit asymmetries, the firm enjoying the lowest rental rate would capture the entire market, and earn positive profits. As more asymmetric the access to credit markets is, larger is the difference between the rental rates, and larger is the distortion.

Equation (4) shows that home firms' markups of becoming an industry leader are reduced by the greater borrowing costs.

For the innovation activities to be profitable for H firms, the productivity gain that firm H will obtain from becoming an industry leader should exceed the difference in the cost of borrowing: $\lambda > \tau$.[13] In that case, innovation activities are profitable for both H and F firms, and they both will undertake innovation activities. Otherwise, innovation activities are only profitable for the F firms, and only these firms will undertake R&D activities.[14] To illustrate how distortions in the access to external finance affect firms' innovation incentives, I assume that innovation is profitable for both types of firms, i.e. $\lambda > \tau$, and analyze how R&D efforts respond to changes in the access to external finance.

Firms' optimal innovation intensities after maximizing their expected profits net of innovation costs are given by:

$$x^e_{(F,t)} = \frac{1}{\tau}\,\frac{\phi(1-\lambda^{-1})}{\omega_{(t)}} \qquad x^e_{(H,t)} = \frac{\phi(1-\tau\,\lambda^{-1})}{\omega_{(t)}} \tag{5}$$

where ω is the labor share in the economy. Equations in (5) illustrate that the difference in the rental rates of capital reduces both F and H firms innovation intensities. However, the origin of this decrease differs for F and H firms. In the former case, the preferential access to credit markets offers a source of extra rents. When this rent increases, the F firm's incentives to undertake innovation activities decreases. In the H firm case, the larger rental rate in the domestic market reduces their post-innovation profits from becoming a industry leader, and thus their incentives to innovate. As mentioned before, in the limit if the domestic rental rate is large enough, it would be unprofitable for the H to undertake R&D activities. Notice that, as mentioned above, in the absence of heterogeneity in the

[13] To see this, note that a necessary condition for a H firm to undertake innovation activities is to reach lower marginal costs than its rival so as to capture the market,

$$MC'_{(H,j,t)} < MC_{(F,j,t)} \Leftrightarrow \frac{\left(\frac{w_{(t)}}{1-\alpha}\right)^{1-\alpha}\left(\frac{R_{(t)}}{\alpha}\right)^{\alpha}}{q_{(H,j,t)}} < \frac{\left(\frac{w_{(t)}}{1-\alpha}\right)^{1-\alpha}\left(\frac{R^*_{(t)}}{\alpha}\right)^{\alpha}}{q_{(F,j,t)}}$$

If a H firm succeeds to overtake its F competitor, it will obtain a technology advantage of $\Delta \equiv n'_H - n_F = 1$. Hence, $\frac{q'_{(H,j,t)}}{q_{(F,j,t)}} = \lambda$. Then, $\tau < \lambda$ for H firms to undertake R&D activities. Thus, the gains from the technology improvement should exceed the greater borrowing costs that the H firms face in the local credit market. If the interest rate differential τ exceeds the productivity gain than a H firm would obtain by overtaking the leader, H firms' innovations are unprofitable and only F firms innovate.

[14] If $\lambda \leq \tau$, even if H firms overtake their rival's technology, they would obtain negative profits from producing. Therefore, F firms always lead the industry, and H firms only restrict F firms' price setting behavior. As only F firms undertake R&D activities, the technology gap between F and H firms would be increasing in time. In this scenario, F firms' optimal innovation efforts are given by equation (5). It is straightforward to see that the larger is the difference between the domestic and the world rental rates of capital, the lower is F firms innovation efforts. In the limit, when $\tau \to \infty$ as neither H nor F firms would realize R&D activities, and the economy would experience zero growth, $Lim_{\tau\to\infty}\, g_{q_{(t)}} \to 0$.

access to credit markets, firms would share equal innovation efforts. Given firms' optimal innovation efforts, the growth rate of the physical productivity growth is $Q_{(t)}$,

$$g_{q_{(t)}} = ln(\lambda)\ (x^e_{(F,t)}\ +\ x^e_{(H,t)}) \tag{6}$$

2.3 Model Qualitative Predictions

In the model, financial liberalization can be seen a reduction in the barriers to international credit markets for domestically owned firms, i.e. a decrease in the tax rate $\tilde{\tau}$. In particular, this implies a decrease in the difference between the rental rates of capital, τ. As I show below, facilitating access to financial markets, capital openness deepens market competition in two senses: it allows firms having the same productivity level to share the market, and increases firms' R&D activities. Propositions 1-4 state the effect of financial liberalization on firms' innovation efforts, markups, productivity gap, and aggregate productivity growth.

Proposition 1: Firms' investment in technology *. Reducing asymmetries in the access to financial markets (decrease in τ), increases all firms' innovation efforts. Importantly, innovation efforts increase more for domestically owned firms.*

Proof: In equilibrium, from equations in (5), $\frac{\partial x^e_{(F,t)}}{\partial \tau} < 0$ and $\frac{\partial x^e_{(H,t)}}{\partial \tau} < 0$. Furthermore, $|\frac{\partial x^e_{(F,t)}}{\partial \tau}| < |\frac{\partial x^e_{(H,t)}}{\partial \tau}|$.

Although, proposition 1 states that innovation efforts raise for both foreign and domestically owned firms, the causes of this increase differ. The decrease in the distortion reduces foreign firms' advantage in the cost of borrowing, and hence a source of extra rents. It is the reduction in their market power which leads them to undertake greater innovation efforts. Inversely, the removal of the distortion in financial markets increases domestic firms' post-innovation rents and, by this mean, their incentives to undertake R&D activities. Since the distortion discourages domestic firms' innovation efforts the most, its reduction induces a larger expansion of their innovation activities.

Proposition 2: Foreign firms' markups*. A decrease in τ reduces foreign owned firms markups.*

Proof: In equilibrium, from equation (3), $\frac{\partial \xi_{(F,j,t)}}{\partial \tau} < 0$.

The reduction in foreign firms' markups stems from two sources: the decrease in their advantage in the cost of borrowing, and the decline in the productivity gap (proposition 3).

Proposition 3: Productivity gap within sectors*. A reduction in the asymmetry in the access to capital markets, reduces the productivity gap in highly dispersed sectors, and increases it in sectors where firms were technologically similar.*

$$\Delta_{(t+dt)} = \begin{cases} < 0 & \text{if} \quad \Delta > 1 \\ > 0 & \text{if} \quad otherwise \end{cases} \tag{7}$$

Proof: The law of motion of productivity gaps can be expressed as,

$$\Delta_{(t+dt)} = \begin{cases} \Delta + 1 & x_{(F,t)} \\ 1 & x_{(H,t)} \\ \Delta & 1 - x_{(F,t)} - x_{(H,t)} \end{cases}$$

Since there are infinite sectors by each level of productivity gap, the law of large numbers guarantees that for each Δ the expected change in the productivity gap is,

$$\Delta_{(t+dt)} = \Delta + x_{(F,t)} - (\Delta - 1)x_{(H,t)} \tag{8}$$

The partial derivatives of equation (8) with respect to τ prove this lemma ($\frac{\partial \Delta_{(t+dt)}}{\partial \tau} > 0 \quad \text{if}\, \Delta > 1$, and $\frac{\partial \Delta_{(t+dt)}}{\partial \tau} < 0$ otherwise). The intuition about the decline in the productivity gap in high dispersed sectors arises from the larger innovation efforts undertaken by domestic firms following the reform. The increase in the probability of innovation being greater for home firms, the expected productivity gap decreases in sectors where $\Delta > 1$. Likewise, the expected productivity gap increases in sectors with low initial dispersion ($\Delta \leq 1$).

Proposition 4: Aggregate productivity growth. *Declines in τ accelerate the aggregate productivity growth rate.*

Proof: In equilibrium, from equation (6), $\frac{\partial g^e}{\partial \tau} < 0$.

The intuition for this is simple: as both firms increase their R&D activities, the innovation flows increase, and hence the aggregate growth rate of the physical productivity.

3 The Deregulation of Financial Flows in Hungary

3.1 Reform

The process of transition toward a market economy started early in Hungary. Such that by the time of the collapse of the soviet block, the economy already enjoyed FDI, the presence of foreign banks and an incipient stock market. Hence, the reforms undertaken in the early 1990s just accelerated the deregulation pace started in the previous decades.[15] By the end of the nineties, the deregulation process had advanced very far and the Hungarian economy was largely integrated with Western countries. Nevertheless, to shield the economy from the volatility of international financial markets, the authorities had held some restrictions on the financial flows of the Balance of Payment. In June 2001, in view of a vote about the transition economies' accession to the European Union, these restrictions were liberalized.

The cornerstone of the liberalization was the deregulation of the derivative and the foreign exchange (FX) markets. Prior to the reform, all derivative transactions between residents and non-residents were banned. The controls in the FX market included the ban on transactions between the Hungarian forint (HUF) and foreign currencies for non-residents; and severe controls for these transactions among residents. Essentially, these regulations bounded the development of the foreign exchange market in Hungary, which only operated for minor transactions.[16] Regulations on the derivative and FX markets are two pillar elements to determine the degree of capital account openness.[17] They jointly fence the extent to which agents are able to hedge the exchange rate risk, and therefore to borrow in international financial markets. In this way, the removal of capital controls in 2001 is considered as a further deregulation of the financial account.[18]

Importantly, the regulations on the foreign exchange transactions did not affect all firms similarly. As mentioned above, Hungary already enjoyed the presence of foreign direct investment. Foreign owned companies enjoyed access to international funds, and thus were less affected by these regulations. Conversely, in the absence of an foreign exchange

[15] These reforms included the privatization of the remaining public companies, the full deregulation of the banking sector (which complete privatization ended in 1997), and the complete liberalization of trade and FDI. The current account liberalization was fully achieved in 1996, when the country adopted the obligations of Article VIII of the IMF's Articles of Agreement. This process was complemented with the deregulation of the foreign direct investment inflows required by the accession to the OECD in May 1996.

[16] Notice as well that, by 2001, the international market between the HUF and foreign currencies was practically illiquid. Thus, both the restrictions in the domestic market and the lack of liquidity in the international financial market made that hedging the exchange rate risk was highly difficult and costly.

[17] From a regulatory point of view, derivatives and foreign exchange restrictions are two key lines reported IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) to account for restrictions in the Financial Account of the Balance of Payments. Notice that several of the *de jure* index of financial liberalization used in research studies are based in the AREAER report. See for example, Quinn and Toyoda (2008), and Schindler (2009).

[18] This reform is also captured by the aggregate indexes of financial liberalization. For example, in the Chinn and Ito (2008)'s index the degree of capital account openness passes from 1.4 to 1.7 between 2000 and 2001, in Abiad, Detragiache, and Tressel (2010) it raises to 20.25, on a total of 21, and declines from 0.83 to 0 (complete openness) in Schindler (2009).

market, domestic agents were impeded to hedge the exchange rate risk, and hence to access to international borrowing.[19] In the next sections, I exploit the heterogeneity in the access to international funds prior to the reform to investigate the effect of the financial deregulation among firms.

3.2 Impact on the Financial Sector

I now assess the effect of the liberalization on the financial sector, and the domestic credit supply. The regulations on derivatives and the FX market had significantly fenced the development of the banking sector. Prior to the liberalization banks used mainly domestic deposits to operate in the local market. Rising international obligations was a tricky and risky task. To take international debt, banks had to ensure that they could recover their domestic loans in the same currency and maturity that the funds they had risen. The liberalization offered banks more flexibility in the management of their liquidities. Banks no longer needed to match one-to-one their assets and liabilities, thereafter they could borrow from abroad, purchase financial instruments to hedge the exchange rate risk, and increase their credit supply.

The deregulation deepened the integration of the Hungarian financial sector with international markets. This could be seen through the financial account of the Balance of Payments, which reports financial transactions between residents and non-residents by institutional sectors. Figure 2 illustrates the significant upsurge of derivatives of financial institutions after 2001. These transactions passed from 0.3 billions of US dollars in 2000 to 3.5 billions in 2005.[20] As explained above, the rise in the cross-border derivative transactions expanded in parallel to the development of the FX market. To illustrate this point, figure (5, in the appendix) presents the daily turnover of the FX market, and shows that it was driven by the boost of swaps transactions. At the same time, the possibility of hedging exchange rate risk led banks to raise funds from international market at lower interest rates. Figure 3 presents the aggregate impact of the liberalization on financial institutions' capital inflows. The left chart plots the net inflows of the financial account toward these agents. The impact of the liberalization seems clear: in the years preceding the reform net capital inflows reached 0.6 billions of US dollars per year; whilst in the four years following the reform the net capital inflows soared to 3.9 billions per year. More conclusive is its impact on banks' external debt. Their foreign indebtedness soared from 5.7 billions of US dollars in 2000 to 22.5 billions in 2005 (right chart).

The increase in banks' liquidity turned into an expansion of the credit supply. Table 2 reports the main characteristics of the credit market before and after the liberalization. Between 2000 and 2005, the credit-to-deposit ratio rose 44%. By 2005, the granted credit

[19] In section 5, I show that domestic exporters and non-exporters present similar patterns of growth after the reform, which suggests that both types of firms were similarly affected by the restrictions in the foreign exchange market.

[20] By 2008 they had already exceeded the 10 billions of US dollars.

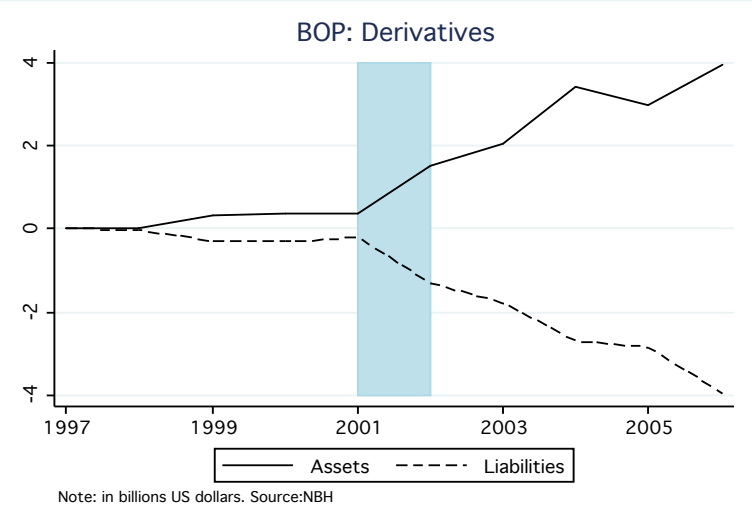


Figure 2: Impact on Financial Derivatives

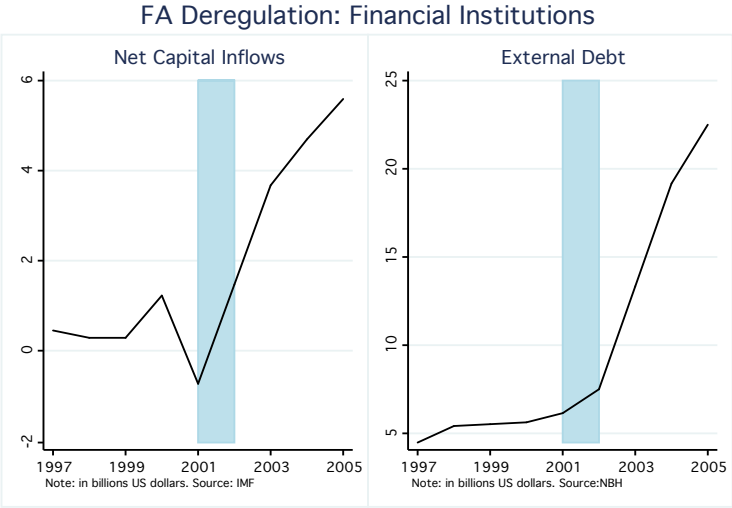


Figure 3: Impact on Financial Institutions International Borrowing

exceeded the sum of domestic deposits, confirming that banks were using others sources of funding than the domestic deposits (i.e. international borrowing). The decrease in the lending interest rate also suggests the expansion of funds in the economy. In the manufacturing sector, the credit supply expanded even faster than total output, leading to a substantial increase in the credit-to-output ratio. Remarkably, the growth in total credit was driven by the rise in credits in foreign currency, and especially by the upsurge of long-term credit in foreign currency (lines 4 and 5).

Prior to the liberalization the credit market was highly concentrated in large firms. Accordingly with data from the National Bank of Hungary, in 2000, only 50 firms re-

Table 2: Credit Market Before and After the Liberalization

Aggregate Economy	Before	After
Credit-to-Deposit Ratio	0.75	1.08
Lending interest rate	12.8	7.45
Manufacturing Sector		
Credit-to-Output Ratio	1.05	1.31
Long-term credit over total credit	0.41	0.50
Long-term credits in FX over total credit	0.25	0.37
Firms		
Interest rate differential b. Domestic and Foreign	2.50	0.86
Differential in collateral b. Domestic and Foreign	58.34	11.30
Credits to SME	0.34	0.51
SME debt in FX	0.00	0.33

Notes: For rows 1-5 and 8-9 the source is the National Bank of Hungary, and data corresponds to the period December 2000 and December 2005. Rows 6-7 come from Business Environment and Enterprise Performance Survey, 2002 and 2005 of the World Bank and EBRD.

ceived 30% of total credits, and half of firms did not use banking as a source of funding (Financial Stability Report, 2000). Importantly, the local credit market was highly differentiated between domestic and foreign firms (lines 6-7). Data from Business Environment and Enterprise Performance Survey (EBRD and World Bank) reveals that, in 2002, the value of the collateral required was 58% higher for domestic than for foreign firms, and the interest paid exceeded 2.5% for the formers (notice that this was already one year after the deregulation). The liberalization have substantially improved credit conditions for domestic firms, which on average became similar to those of foreign firms (lines 6 and 7).[21] In the same line, the expansion of the credit supply seems to have favored small and medium enterprises. The octave line of table 2 reports a larger participation of those agents in granted credits. The last line reflects that small and medium enterprises gained access to foreign currency debt after the liberalization. By 2005, one third of their total credit was denominated in foreign currency.

Beyond its effects on the banking sector, the reform produced a major impact on the Hungarian economy. In the four years following the liberalization, the financial account presented a surplus close to 9 billions of US dollars per year (figure 6 in the appendix). In addition, the Hungarian economy became more integrated to the international financial

[21] More generally, the difference between domestic and foreign firms' credit market conditions has been deeply analyzed by Gorodnichenko and Schnitzer (2010). They provide firm-level evidence for Eastern European Countries and Commonwealth of Independent States that domestic firms tend to be more credit constrained than foreign corporations.

markets. The deterioration of the net foreign asset position reflects this fact: it passed from -70% to GDP in 2001 to more than -100% to GDP five years later. Capital inflows also fostered investment and output. In the three years after the reform, the mean output growth rate in the manufacturing sector rose more than one percentage point, passing from 4.3 to 5.7 percentage points between the three years before and after the financial openness.

4 Data

The data I analyze are provided by the Statistical Department of the National Bank of Hungary (NBH) and come from firms' balance sheets reported to tax authorities. Data coverage represents the population of manufacturing firms and spans over the period 1992 and 2008. Firms' size vary significantly in the database, spanning from unipersonal firms to corporations employing thousands of workers. The database is mainly populated by small firms, over a total of 25,286 firms, only 30% reported ten or more employees in 2001.

In section 5.3, I focus my analysis on a balanced panel of 5,548 firms present over the period 1998-2004, and for which there is information on output, employment, materials and capital so as to compute the RTFP measure. The balanced panel accounts for 77% of value added and 70% of employment in the manufacturing sector.

The database contains information on value added, sales, output, stock of capital, employment, wages, materials, exports, and ownership structure. I use these variables to construct firms' RTFP, labor productivity, capital intensity, markups, and export and ownership status. Since the database does not provide any information on firm's prices, I am unable to compute physical total factor productivity. Instead, I focus on RTFP, and deflate each of its component with the corresponding industry price index. Information on prices indexes is disaggregated at four-digit NACE industries for materials, investment, value added, and production. I construct real values using this information. The database provides none information on firms' spending in R&D, I then confine the analysis to the evolution of RTFP and labor productivity as proxies for investment in technology upgrading. The RTFP measure is computed using the Olley and Pakes (1996) method to estimate the parameters of the production function. My results are robust to using other methodologies as Petrin and Levinsohn (2011) and De Loecker and Warzynski (2012).[22] A detailed description of the definition of each variable is contained in the Appendix.

In section 5.3, I also use controls for sector characteristics to account for pre-existing trends at four-digit NACE industries. I compute the average industry growth for capital intensity, RTFP and value added between 1996 and 1997 in Hungary. To control for global trends in productivity, I use capital intensity and industry RTFP growth in the United States between 1998 and 2004. Both variables are aggregated at four-digit NACE industry level.

In sections 5.4, 5.5 and 5.3.7, I analyze the impact of the financial deregulation using the entire population of firms. I use the years prior and following the reform to control for pre-exiting trends, and to test for structural break in 2001.

[22] See the Appendix for a comparison of the different RTFP measures.

5 Empirics

Throughout this section, I test the predictions of the theoretical model. In section 5.1, I present the identification strategy and test whether the firms' characteristics predicted by the model are consistent with the observed characteristics before the reform. Section 5.2 describes the statistical model.

In section 5.3.1, I use reduced-form regressions to evaluate the impact of the reform in firms' capital intensity and productivity (labor productivity and RTFP) (proposition 1). I show that results are robust to controlling for a full set of initial conditions at the firm level, and to using a large set of sectoral controls. Results are also robust to using different definitions of ownership structure, types of foreign firms, export status, and methodologies to estimate RTFP. To investigate whether the reform deepened competition, I study in section 5.3.2 changes in foreign firms' markups (proposition 2). In section 5.3.4, I exploit sector heterogeneity in terms of dependence on external finance to study how firms' investment profiles change in accordance to their financial needs. Section 5.3.5 uses sector heterogenous financial needs to analyze changes in markups.

In section 5.4, I investigate whether capital openness affects productivity dispersion within sectors (proposition 3). In addition, I examine whether the observed patterns in RTFP are consistent with changes in markup dispersion and competition. Finally, I show that results are not driven by pre-existing trends.

Section 5.5 studies the implications of the reform for aggregate productivity growth. In particular, I investigate whether capital openness accelerates productivity growth, and test a for structural break in the year of the reform (proposition 4).

To explore the contribution to aggregate productivity growth by the mechanism proposed in this paper, in section 5.6, I follow a decomposition exercise and disaggregate aggregate productivity growth into reallocation effects and within firm growth. Results suggest that, following the liberalization, aggregate productivity growth is mainly driven by increases in within firm RTFP growth.

Finally, section 5.3.7 shows that the reform affected the characteristics of entering and exiting firms.

5.1 Firm-Level Analysis: Identification Strategy

In the model, capital openness fosters firms' investments in technology. However, as stated in prediction 1, this effect is heterogenous: firms gaining access to international credits increase their innovation efforts the most. To test this prediction, I classify firms according with their access to international credit prior to the reform, and study changes in investment and productivity. As explained above, the regulations in force led to that only foreign companies got access to international credit. Thereby, the baseline empirical strategy consists in estimating the impact of the reform on investment and productivity of foreign and domestically owned companies.

To identify the effect of the reform, it is important to determine whether foreign and domestically owned firms "looked similar" or differed in characteristics that could involve heterogeneous patterns of investment and productivity growth. If these differences

Table 3: Mean Characteristics of Domestically and Foreign Owned Firms (1998)

	Foreign	Home	Difference in Means
		(In logs)	
Value Added	10.6549	9.0769	1.5779***
	(0.0525)	(0.0226)	(0.0500)
Employment	3.8952	2.8602	1.0349***
	(0.0429)	(0.0191)	(0.0418)
Labor productivity	6.7596	6.2167	0.5429***
	(0.0263)	(0.0131)	(0.0278)
RTFP	1.4093	1.1959	0.2133***
	(0.0267)	(0.0139)	(0.0291)
Markup	0.2391	0.1774	0.0617***
	(0.0159)	(0.0098)	(0.0197)
Age	1.6167	1.4777	0.1390***
	(0.0136)	(0.0090)	(0.0179)
Quantity of firms	1,283	4,165	5,448

Notes: Std errors in parenthesis. *, **, ***significant at 10, 5, and 1 percent.

were not accounted for, the estimated coefficients could suffer from omitted variable bias. Following the standard literature, I define a firm as foreign owned if more than 10% of their shares belong to foreign owners.[23] Table 3 disaggregates the data into domestically and foreign owned firms for the balanced panel of 5,548 firms, and presents sample means in the initial year by type of firm (1998). Prior to the reform, foreign owned firms were larger both in terms of value added and employment. In addition, as in the model, the difference in firms' size is positive correlated with firms' productivity. The third and fourth lines illustrate the gap both in terms of labor productivity and RTFP. In line with these characteristics, foreign owned firms also had on average higher markups (line 5).[24] Despite the average age of foreign and home firms was similar in the initial year: 5.38 and 4.92 years, their difference in means is statistically significant.[25] In sum, on average domestic owned firms were smaller, younger, less productive and enjoyed lower markups than foreign owned firms. The difference in these variables is significant at one percent level suggesting that these firms characteristics should be controlled for.

A main assumption underlying the analysis of the impact of a reform is that, prior to it, agents should share similar growth trends. To test whether pre-existing growth trends of domestically and foreign owned firms were alike, for each variable under analysis I regress its growth rate on a dummy for domestically owned firm and four-digit industry fixed effects over the five years preceding the reform (1996 and 2000). Results are presented in table 17 in the appendix, and illustrate that neither for capital intensity, labor productivity,

[23] I show below that results are robust to different structures of ownership status.

[24] See section 5.3.2 for a further discussion about this measure.

[25] This feature is important as it goes against the argument that results could be driven by the expansion of new foreign investments in Hungary. On average, foreign-owned firms had joined the market in the mid 1990s.

RTFP and markups, differences in growth rates were statistically significant prior to the reform. This suggests that domestically and foreign owned firms were on similar growth trends within sectors.

The last paragraph discussed the concern about firms' pre-existing growth trends within sectors. Nevertheless, if domestically owned firms were correlated with some industry characteristics, it would be necessary to control for them so as to rule out possible sources of bias. I estimate the equations in first differences, so that time-invariant industry characteristics are differenced out. However, if sectors with different initial characteristics are on different trends, the estimated coefficient for the foreign owned firms could be capturing some omitted industry-level time-varying variable. I tackle this issue in two different manners. To account for sectoral pre-existing growth trends, I include the average capital intensity and productivity growth at the four-digit NACE industries in Hungary before the reform (1996-1997). Since sectors' productivity might be growing at different pace in the global economy, I also control for capital intensity and productivity growth rate in the United States. As a robustness test, I consider as well sector fixed effects at four-digit NACE industries.

The general context about the deregulation of financial flows in 2001 and its timing make it likely to be exogenous with respect to the main outcomes analyzed, i.e. changes in home firms' investment and productivity between 2001 and 2004. First, the reform was driven by the accession of the transition economies to the European Union. The accession process lasted for more than a decade and was followed for fourteen economies (from which only ten joined the EU in 2004).[26] The requirements to join the EU were predetermined by the Copenhagen Criteria in 1993, and then equal for all accessing countries since then. In this sense, the content of the reform was exogenous to the country political choice. Second, the agenda was jointly determined by the European Council and the fourteen countries, and then it is unlikely to have been driven by political pressure of hungarian firms. Third, given the speed of the reform, it is unlikely that firms have anticipated it, and have undertaken investments in advanced.[27] Finally, it is implausible that the reform has been encouraged by local economic needs, as Hungary was already growing at a steady pace of 5% yearly.

Even though the preceding points address the reverse causality problem, any event occurring in the years of the reform, and that could affect firms' investment choices could be a source of bias. To accurately identify the effect of the financial deregulation, I restrict the analysis to the three years preceding and following the reform. In addition, it is worth mentioning that during this period no other significant event that could affect firms' investment or productivity growth occurred in the Hungary. First, as mentioned above the economy was growing at a steady pace, and no significant shock hit the economy during that period. Notably, real external flows, as trade and foreign direct investment, remain constant during the period under analysis (1998-2004).[28] Second, main reforms, as

[26]Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovakia and Slovenia.

[27]In December 2000, the European Council defined the timing for the accession vote, and the last requirements to be met by each candidate. The reform had to take place before the accession vote in December 2002. Soon after the European Council meeting, in March 2001, Hungary deregulated the remaining controls on financial flows.

[28]During the period preceding and following the reform, foreign direct investment remained constant,

privatization of public companies or bank deregulation, had already taken place during the 1990s. Furthermore, the EU did not require any reform, that could affect the development of the manufacturing sector, other than the complete deregulation of the financial account of the Balance of Payment. Third, the accession to the EU did not pursue a major economic integration with the EU. By 2001, the Hungarian economy was already deeply integrated with the EU; particularly, the manufacturing sector, which exports to the EU accounted for 80% of total exports (see figure 4 in the Appendix).

Finally, the liberalization of financial flows could affect firms' outcomes differently if they face heterogenous financial needs. With this idea in mind, I explore changes in firms' investment and productivity in accordance with the industry's exposure to external finance. More precisely, I investigate whether domestic owned firms in more financially dependent sectors benefited the most from the liberalization of the capital account. To avoid endogeneity problems, I use the Rajan and Zingales index of external finance at four-digit NACE industries contracted for the United States.

5.2 Firm-Level Analysis: Statistical Model

I analyze the effect of liberalization of the financial account in firms' investment in capital and productivity using the following model:

$$y_{ijt} = \beta_0 + \beta_1 H_i + \delta_0 T_t + \delta_1 (H_i \,\mathrm{x}\, T_t) + \delta_2 \psi_{jt} + \delta_3 Z_{ij} + \varepsilon_{ijt} \tag{9}$$

where i, j, t index firm, four-digit NACE industry, and t before and after the reform. H_i is a dummy variable for domestically owned firms, and captures differences between home and foreign owned firms prior to the reform. The dummy variable for post-reform period, T_t, captures the effect of the reform on foreign owned firms, after controlling for a full set of covariates that could cause changes in the dependent variable even in the absence of the reform. These set of covariates seek to account for ongoing trends at industry level in the world economy. I call this set of covariates *global trends*, and are captured at four-digit industry level by the term ψ_{jt}. The term $H_i \,\mathrm{x}\, T_t$ captures the effect of the reform on domestically owned firms. Since the domestically owned firms can be systematically related to other factors affecting the outcome variable, unbiasedness of the estimate requires to control for a full set of firm and sector characteristics at the initial year. These effects are taken in by the vector Z_{ij}.

The model in equation (9) uses yearly firm-level data. A potential pitfall of this regression is that their residuals might be serially correlated across time within firms, and across firms within sectors for a given year. Serial correlation in the error term might understate the OLS standard errors, and induce to commit type II error, i.e. failing erroneously to reject the null hypothesis. To account for this source of bias of the OLS standard errors, I use one of the solutions proposed by Bertrand, Duflo, and Mullainathan (2004), and remove the times series dimension of the data. More precisely, I aggregate the

and even showed a small slowdown in the years following the deregulation (see figure 7 in the appendix). Moreover, Hungarian external trade did not seem to have specially suffered from the world recession in 2001. As it is shown in figure 8 in the appendix, the volume of exports and imports continued growing during that period.

data into the pre- and post-reform periods, defined as the three years before and after the deregulation.[29] The dependent variable is computed as the average value between 1998 and 2000, and between 2002 and 2004,

$$\Delta\, y_{ij} = log(\frac{1}{3}\sum_{2002}^{2004} y_{ijt}) - log(\frac{1}{3}\sum_{1998}^{2000} y_{ijt})$$

where y is a vector of {capital intensity, labor productivity, RTFP, and markups}.[30] Thus, I estimate equation (9) in first differences:

$$\Delta y_{ij} = \delta_0 + \delta_1 H_i + \delta_2 \Delta\psi_j + \Delta\varepsilon_{ij} \tag{10}$$

In regression (10), I cluster the OLS standard errors at four-digit NACE industries to take into account correlation across firms within sectors. The model predicts that a reduction of asymmetries in the access to external finance should encourage investment of both domestic and foreign owned firms, being the increase larger for the former. This prediction can be tested in using equation (10): δ_0 captures the impact of the reform on foreign owned firms, and H captures the differential effect on domestic firms. The vector ψ_j captures global trends at four-digit industry level that could be correlated with the dependent variable. I use capital intensity and TFP growth rate at four-digit NACE industries in the United States to control for possible unobserved trends.[31]

Regression (10), in first differences, removes the firm- and sector-fixed effects, and therefore controls for time unvarying unobserved characteristics at firm and industry level. However, the fixed effects do not take into account firm and industry characteristics that might explain why firms benefited in different ways from the introduction of the reform. For example, as shown in table 3, domestically owned firms tend to be smaller than foreign companies. If the reform were to affect small and large differently, the estimated coefficient would suffer omitted variable bias. When estimating equation (10), therefore, I add a set of initial conditions at firm and four-digit NACE industries, Z_{ij}. At firm level, I control for: firms' size (employment), productivity (RTFP), and age at the initial year (1998). At industry level, I add RTFP and capital intensity (capital per worker) growth rate at four-digit NACE industries between 1996 and 1997 to account for possible pre-existing trends in Hungary.[32] Therefore, the final statistical model I estimate is:

$$\Delta y_{ij} = \delta_0 + \delta_1 H_i + \delta_2 \Delta\psi_j + \delta_3 Z_{ij} + \Delta\varepsilon_{ij} \tag{11}$$

[29]Since the reform took place during 2001, I omit this year from the analysis to avoid misleading the estimations.

[30]Unfortunately, the lack of records on R&D activities does not allow to directly observe firms' innovation efforts. Instead, I use firms' productivity as a proxy for R&D activities. This treatment is in line with the empirical evidence on the relationship between firms' productivity and R&D activities. For example, Crepon, Duguet, and Mairesse (1998) find that firms' productivity positively correlates with innovation output, and that the latter raises with research effort.

[31]I also use as proxy for productivity: output per worker at four-digit level in the United States. Since results remain unchanged, I only present regressions controlled for TFP.

[32]Econometric results are robust to consider longer pre-growth trends in Hungary, i.e. the period 1992-1997. Results are also robust to use value added and labor productivity pre-growth trends.

5.3 Firm-Level Analysis: Results

5.3.1 Baseline Results on Investment and Productivity

The estimation of equation (11) by OLS is reported in table 4, where the standard errors are clustered at the four-digit NACE industries. The coefficient for capital intensity estimated in the baseline specification of column 1, where only the dummy for the domestically owned firm is included as a regressor, implies that home firms' capital intensity grew 0.239 log points (t=10.24) beyond the expansion of foreign owned firms, 0.112 log points (t=6.18). The estimated coefficient for domestically owned firms is not affected by the inclusion of firm-level controls in column 2 nor by the inclusion of local and global trends in column 3. Albeit, the omission of firm-level controls has a non-negligible effect on the constant term, i.e. the average expansion of foreign owned firms in the post-reform period. This is because the negative effect of the firm-level omitted covariates on growth is absorbed by the error term, and transferred to the constant. The coefficients in the regressions including all controls in column 3 imply a raise of 0.213 log points (t = 4.08) for foreign owned companies, and 0.465 log points for domestically owned firms.

Column 4 presents the estimated coefficients of a regression of labor productivity on a dummy for home firms. Results suggest that being a domestic firm had a positive and significant effect over the overall increase in labor productivity: the estimated coefficient highlights a differential effect of 0.074 log points (t = 4.35). The inclusion of firm level controls reduces the estimated coefficient on the change in labor productivity of domestic firms, suggesting a negative correlation between the firm-level covariates and labor productivity growth. Regression in column 6, including all firm and industry controls, reports an average increase of labor productivity of 0.353 log points (t=8.84) for foreign owned companies, and an average expansion of 0.406 log points for domestically owned companies. The estimates for RTFP confirms the estimated changes in labor productivity (columns 7-9). After controlling for firm and sector characteristics, the regression in column 9 reports an average increase of 0.35 log points (t=8.29) for foreign companies, and 0.382 log points for domestically owned firms.

In table 18 (in the appendix), I present a full set of robustness tests. I show that these results are robust to controlling for: four-digit industry fixed effects (column 1), export status (column 2), foreign companies having more than 90% of foreign owned shares (column 3), foreign firms used as export platforms (column 4), top 1% of firms (column 5), and firms that change their ownership status between the pre- and post- reform periods (column 6). For robustness, I also compute the RTFP using the Petrin and Levinsohn (2011) and De Loecker and Warzynski (2012) methodologies to estimate the elasticities of the production function. Table 19 (in the appendix) confirms that results are robust to different estimates of RTFP.

Overall, these results confirm prediction 1 stating that firms' productivity should expand after the deregulation of financial flows. Furthermore, in line with the model's predictions, they also suggest a heterogenous pattern of growth: firms obtaining access to

international credits make larger efforts both in terms of capital and technology.

Table 4: Firms' investment decisions

	Capital Intensity			Labor Productivity			RTFP		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Domestic	0.239***	0.253***	0.252***	0.074***	0.051***	0.053***	0.098***	0.032**	0.032**
	(0.023)	(0.025)	(0.025)	(0.017)	(0.017)	(0.016)	(0.015)	(0.014)	(0.016)
Firm-level controls		yes	yes		yes	yes		yes	yes
Local trends			yes			yes			yes
Global trends			yes			yes			yes
Constant	0.112***	0.216***	0.213***	0.176***	0.386***	0.353***	0.038**	0.402***	0.350***
	(0.018)	(0.052)	(0.052)	(0.018)	(0.037)	(0.040)	(0.017)	(0.076)	(0.042)
R^2	0.019	0.030	0.030	0.004	0.027	0.040	0.008	0.075	0.088
N	5448	5448	5448	5448	5448	5448	5448	5448	5448

Notes: Std errors are clustered at time and 4-digit NACE industry level. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and RTFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998).

5.3.2 Baseline Results on Markups

As shown in the model, the ease of credit conditions deepens market competition by two means: first, it reduces asymmetries in the access to external finance and, to the same technology level, equalizes firms' marginal costs of production; second, it encourages firms' investment in technology. One way to investigate changes in market competition is by analyzing firms' markups. In this section, I investigate the evolution of the average markup by type of firm. Similar to De Loecker and Warzynski (2012), Peters (2012) and others, I derive markups from the firm's optimal labor demand equation,

$$w_{(t)}\, l_{(i,j,t)} = \beta_j\, y_{(i,j,t)} \frac{\left(\frac{w_{(t)}}{\beta}\right)^{\beta} \left(\frac{R_{(t)}}{\alpha}\right)^{\alpha}}{q_{(i,j,t)}}$$

$$\xi_{(i,j,t)} = \frac{1}{\theta_{(i,j,t)}}\, \beta_j \tag{12}$$

where l is the firms' optimal labor demand and y is its production; β_j is the estimated labor elasticity of the production function in sector j[33] [34]; w denotes the wage and R the interest rate; q expresses firm's productivity; and θ represents firm's labor share. As shown in equation (12), markups ξ are defined as a function of firms' labor share and the labor elasticity of production.

[33]Recall that in the model, $\beta = 1 - \alpha$.

[34]See details on the appendix on the estimation of the elasticities of the production function.

Table 5: Markups

	Markups		
	(1)	(2)	(3)
Foreign	-0.017*	-0.025**	-0.026**
	(0.009)	(0.011)	(0.012)
Constant	-0.098***	-0.101***	-0.101***
	(0.006)	(0.025)	(0.030)
Firm-level Controls		yes	yes
Global trend			yes
Local trend			yes
R^2	0.000	0.023	0.024
N	5376	5376	5376

Notes: Std errors are clustered at time and 4-digit NACE industry level. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and RTFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998).

Prediction 2 states that foreign firms' markups should decrease after the deregulation of financial flows. To see this, recall that in the model the markups depended on both the difference in the borrowing costs and the technology gap between competition firms ($\xi = \tau\,\lambda^{\Delta}$, equation (3)). Then, foreign firms' markups decrease due to the reduction in the interest rate differential and, possibly, to the reduction in their technology advantage. To account for this differential effect of foreign firms' markups, I study the following model,

$$\Delta\xi_{ij} = \delta_0 + \delta_1 F_i + \delta_2 \Delta\psi_j + \delta_3 Z_{ij} + \Delta\varepsilon_{ij} \tag{13}$$

where F_i is a dummy for foreign owned firms. Equation (13) is the analogous of equation (10) for foreign firms. In equation (13) δ_0 captures the impact of the reform on domestically owned firms, and F captures the differential effect on foreign owned firms.

Column 1 in table 5 regresses changes in markups on a dummy for a foreign firm. The estimated coefficient illustrates a decrease in markups of domestically owned firms by 0.098 log points (t=16.48), and a slightly larger reduction for foreign owned firms, 0.017 (t=1.9). The inclusion of firm-level and industry controls (local and global trends) do not affect significantly the results: on average, markups decrease 0.101 log points (t= 3.43) for domestically owned firms, and 0.026 log points (t=2.26) more for foreign owned companies. For robustness, I also compute markups using the elasticities of the production function estimated with the Petrin and Levinsohn (2011) and De Loecker and Warzynski (2012) methodologies. Table 19 (in the appendix) confirms these patterns. Results are also robust to use the price-cost margin as a proxy for markups (see column 3 in table 19 in the appendix).

Table 6: Debt /Sales

	Debt/Sales		
	(1)	(2)	(3)
Domestic	0.160**	0.239***	0.230***
	(0.073)	(0.085)	(0.088)
Constant	0.393***	0.085	0.105
	(0.064)	(0.150)	(0.161)
Firm-level Controls		yes	yes
Global trend			yes
Local trend			yes
R^2	0.002	0.006	0.007
N	2742	2742	2742

Notes: Std errors are clustered at time and 4-digit NACE industry level. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and RTFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998).

5.3.3 Baseline Results on Debt

5.3.4 Results on Financial Dependence: Investment and Productivity

The model states that access to external finance is a key determinant of firms' investments in capital and technology. As it was broadly analyzed in previous studies, financial needs vary significantly across sectors (see for example Rajan and Zingales 1998; Raddatz 2006; and Braun 2003). In this section, I exploit this sector heterogeneity to investigate whether firms' investment respond to the mechanism emphasized by the model. More precisely, I test whether domestic owned firms in more financially dependent sectors benefited the most from the ease of credit market conditions.

With this end, I interact the dummy variable for home firms (H_i) with sector's financial needs. To avoid endogeneity problems, I use the financial dependence index at four-digit industry level for the United States computed by Rajan and Zingales (1998). The empirical model is as follows,

$$\Delta y_{ij} = \delta_0 + \delta_1 H_i + \delta_2 FD_j + \delta_3 (H_i \,\mathrm{x}\, FD_j) + \delta_4 \Delta\psi_j + \delta_5 Z_{ij} + \Delta\varepsilon_{ij} \qquad (14)$$

where FD_j is the financial dependence index at four-digit NACE industries. The term $H_i \,\mathrm{x}\, FD_j$ captures the differential effect of the reform on domestically owned firms, i.e. whether domestic firms in more financial dependent sectors invested more following the reform.

Column 1-3 in table 7 presents the main results on capital intensity. The coefficient of domestic owned firms is positive and significant in all specifications. However, the coefficient on the interaction term becomes significant after controlling for firm's main characteristics (column 2). Specification in column 2 is robust to the inclusion of local and global trends (column 3). After including all controls, the estimated coefficients for

Table 7: Financial Dependence: Investment

	Capital Intensity			Labor Productivity			RTFP		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Domestic	0.216***	0.221***	0.219***	0.060***	0.017	0.015	0.083***	-0.010	-0.016
	(0.023)	(0.024)	(0.024)	(0.017)	(0.015)	(0.017)	(0.018)	(0.021)	(0.023)
Fin. Dep.	-0.068	-0.061	-0.053	0.279**	0.320**	0.334**	0.162	0.222	0.277***
	(0.061)	(0.070)	(0.077)	(0.101)	(0.124)	(0.134)	(0.107)	(0.156)	(0.092)
Domes.* Fin. Dep.	0.120	0.156*	0.155*	0.086	0.155***	0.147***	0.087	0.181**	0.167**
	(0.082)	(0.076)	(0.077)	(0.051)	(0.045)	(0.046)	(0.072)	(0.080)	(0.067)
Constant	0.120***	0.217***	0.211***	0.108**	0.334***	0.299***	0.001	0.373***	0.332***
	(0.021)	(0.039)	(0.044)	(0.050)	(0.076)	(0.089)	(0.046)	(0.082)	(0.050)
Firm-level controls		yes	yes		yes	yes		yes	yes
Local trends			yes			yes			yes
Global trends			yes			yes			yes
R^2	0.020	0.031	0.031	0.035	0.074	0.081	0.022	0.111	0.120
N	5143	5143	5143	5143	5143	5143	5143	5143	5143

Notes: Std errors are clustered at time and 4-digit NACE industry level. Financial Dependence is the Rajan and Zingales (1998) index. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and RTFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998).

the domestic firms in the average external financial sector, i.e. machinery and equipments (corresponding to an index of 0.27), implies an increase of 0.252 log points on top of the expansion of foreign firms. Consistent with the results reported in the previous section, estimations suggest an increase of the capital intensity of 0.211 log points for foreign firms (t=4.83) (column 3).

Columns 4-6 reports the results for labor productivity. The estimated coefficients are consistent with the results presented in the previous section. After the inclusion of all controls, the coefficient of the interaction term implies that domestic firms in the average financially dependent sector (i.e. machinery and equipments) rose their labor productivity 0.04 log points more than foreign owned firms, whose expansion was 0.299 log points (t=3.35).

Results on RTFP are presented in columns 7-9. After considering firms' initial characteristics, and sectoral pre-trends and global trends, the estimated coefficients suggest a larger expansion of domestic firms in more financial dependent sectors (column 9). For the average financially dependent sector, the interaction term estimates an expansion of 0.38 log points for domestic firms. In sum, results in this section confirm the mechanism implied by the model: domestic firms with high financial needs seem to have benefited the most from the ease of credit conditions. Along the different specifications, they report larger expansions in capital intensity, labor productivity and RTFP.

5.3.5 Results on Financial Dependence: Markups

The mechanism implied by the model highlights that asymmetric access to external finance becomes a source of market power of firms that enjoy better credit conditions, i.e. foreign firms (equation (3)). The ease of credit conditions should then decrease their market power, specially in sectors with high financial needs. In this section, I extend the analysis of section 5.3.2, and investigate whether foreign firms' markups change in accordance with sectors' financial dependence. With this end, I estimate the following model,

$$\Delta\xi_{ij} = \delta_0 + \delta_1 F_i + \delta_2 FD_j + \delta_3 (F_i \,\mathrm{x}\, FD_j) + \delta_4 \Delta\psi_j + \delta_5 Z_{ij} + \Delta\varepsilon_{ij} \tag{15}$$

Under specification (15), the change in markup for foreign owned companies is absorbed by F_i and the interaction term $F_i \,\mathrm{x}\, FD_j$. The average change in markups for domestic firms is captured by the constant term, as in equation (13).

Coefficients in table 8 report a negative effect of the reform on average markups in all specifications. Column 1 indicates a reduction of home firms' markups by 0.116 log points (t=8.63). The reform seems to have a larger impact on markups of foreign firms in more financially dependent sectors: in the average financially dependent sector (machinery and equipments) markups depressed 0.045 log points more. The estimated coefficient of the interaction term is sensitive to the inclusion of firm-level controls in column 2, changing from -0.155 (t=3.12) to -0.213 (t=4.6). This is possible due to a negative correlation between firms initial characteristics and the financial dependent index (i.e. firms in more financially dependent sectors being smaller and less productive). The estimated coefficient in column 2 implies reductions of foreign firms' markups of 16.6 log points. The coefficient is of similar magnitude when including the sectoral trends (column 3).

5.3.6 Results on Financial Dependence: Debt

5.3.7 Firm Survival, Entry and Exit

Firm Survival

Entry and Exit

The ease of credit conditions caused by the financial openness might affect the characteristics of entering and exiting firms. Regarding entry, easier access to external finance might facilitate smaller firms to join the market. The effect on exiting firms is, however, more ambiguous, and depends on which of the two counterbalancing forces dominates: the ease of credit condition or the tightness of competition. On the one hand, more favorable credit conditions might enable smaller firms to gain access to credit and join the market. On the other hand, if competition were tighter, to the same firm's size it would be more likely to exit the market. To study whether entering and exiting firms' characteristic changed after the reform, I use the following model,

$$log\,(y_{ijt}) = \beta X_{ijt} + \mu_j + \varepsilon_{ijt} \tag{16}$$

where y_{ijt} is a vector of {value added, capital intensity, labor productivity}; X_{ijt} is a dummy for entering (exiting) firm in the year of the entry (exit); μ_j are four-digit sector

Table 8: Financial Dependence: Markups

	Mark-ups		
	(1)	(2)	(3)
Foreign	0.020	0.030**	0.030*
	(0.013)	(0.014)	(0.016)
Fin. Dep.	0.077*	0.205**	0.212***
	(0.041)	(0.072)	(0.069)
Foreign* Fin. Dep.	-0.155***	-0.213***	-0.205***
	(0.050)	(0.046)	(0.043)
Constant	-0.116***	-0.108**	-0.115**
	(0.013)	(0.045)	(0.049)
Firm-level Controls		yes	yes
Global trend			yes
Local trend			yes
R^2	0.002	0.056	0.057
N	5087	5087	5087

Notes: Std errors are clustered at time and 4-digit NACE industry level. Financial Dependence is the Rajan and Zingales (1998) index. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and RTFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998).

Table 9: Financial Dependence: Debt /Sales

	Debt/Sales		
	(1)	(2)	(3)
Domestic	0.176*	0.247**	0.238**
	(0.097)	(0.100)	(0.100)
Domes.* Fin. Dep.	0.523**	0.505*	0.526**
	(0.263)	(0.264)	(0.266)
Financial Dependence	-0.601***	-0.567**	-0.595**
	(0.226)	(0.226)	(0.234)
Constant	0.235***	-0.018	-0.007
	(0.083)	(0.141)	(0.146)
Firm-level Controls		yes	yes
Global trend			yes
Local trend			yes
R^2	0.011	0.015	0.015
N	2458	2458	2458

Notes: Std errors are clustered at time and 4-digit NACE industry level. Financial Dependence is the Rajan and Zingales (1998) index. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and RTFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998).

Table 10: Firm Survival

	Firm Survival		
	Home	Foreign	Difference in Means
Exit	0.1328	0.1420	-0.0092
	(0.0026)	(0.0060)	(0.0064)
N	16,826	3,323	20,149

Notes: Std errors in parenthesis. The table reports the mean of a dummy variable on exit after the reform. In particular, for all existing firms prior the reform (in 2000), $exit = 1$ if the firm exit within the 3 years following the reform (2004), and 0 otherwise.

Table 11: Firm Survival

	Unbalanced and Balanced Panel Comparison		
	Unbalanced Panel	Balanced Panel	Difference in Means
Value Added	7.5285	9.6780	-2.1494***
	(0.0162)	(0.0220)	(0.0296)
Employment	1.7471	3.2182	-1.4711***
	(0.0126)	(0.0177)	(0.0226)
Labor Productivity	5.9570	6.4597	-0.5026***
	(0.0109)	(0.0115)	(0.0183)
RTFP	0.9814	1.3003	-0.3188***
	(0.0108)	(0.0118)	(0.0180)
Age	1.0841	1.8948	-0.8106***
	(0.0068)	(0.0047)	(0.0115)
N	20,149	5,448	

Notes: Std errors in parenthesis. All variables are in logs. The table reports the mean of a variable for the unbalanced and balanced panel in the year prior to the reform (2000).

fixed-effect. The sample spans all entering and exiting of firms between the period 1998-2004. The term X_{ijt} captures whether main characteristics of entering (exiting) firms changed after the deregulation. Using sector fixed-effects, I am comparing whether firms' main characteristic changed within four-digit industry.

Table 12 reports that on average entering firms where 0.392 log points (t=10.10) smaller in terms of value added, and less capital intensive, 0.302 log points (t = 8.40) after the reform (columns 1 and 2). Inversely, entering firms seem to be more productive: the estimated coefficient for labor productivity is 0.215 log points (t = 8.23). Columns 4-6 report the estimated coefficients for exiting firms after the reform. The coefficient on value added and productivity are positive and significant: 0.166 log points (t = 3.55), and 0.198 log points (t = 5.63), suggesting that exiting firms were larger and more productive after 2001. Interestingly, firms do not seem to differ in terms of their capital intensity. In sum, these results suggest that the easing of credit condition enables smaller firms to join the market, but these firms are more productive.

In sum, these results imply that the ease of credit conditions enables smaller firms to join the market. The increase in the labor productivity of entering firms, and the size and productivity of exiting firms suggest a deepening of market competition. In other words, the reform might have made more affordable to enter, but more difficult to survive in the market.

Table 12: Entry and Exit

	Entry			Exit		
	Value Added	Capital Intensity	Labor Productivity	Value Added	Capital Intensity	Labor Productivity
	(1)	(2)	(3)	(4)	(5)	(6)
Reform	-0.392***	-0.302***	0.215***	0.166***	0.033	0.198***
	(0.039)	(0.036)	(0.026)	(0.047)	(0.049)	(0.035)
Sector FE	yes	yes	yes	yes	yes	yes
R^2	0.111	0.111	0.148	0.111	0.120	0.163
N	14004	14004	14004	8408	8408	8408

Notes: Std errors are clustered at 4-digit NACE industries. Reform is a dummy for entering (exiting) firms after the reform. Sector fixed effect are 4-digit NACE industries.

5.4 Industry-Level Analysis: Competition

The paper argues that heterogeneous access to external finance affects market competition by two means: first, to the same technology level, firms with access to international credit markets enjoy lower marginal costs, which enables them to capture larger market shares; second, the interest rate differential distorts firms' innovation incentives. In this section, I study whether the reduction in the asymmetries in the access to credit markets changes competition within sectors.

First, I take prediction 3 to the data, and analyze changes in the productivity gap within sectors for the entire population of firms. In addition, I test whether the estimated patterns are also reflected in changes in markup dispersion, and competition within sectors. Then, I show that the reported patterns are not driven by pre-existing trends. Finally, I provide evidence that the presence of foreign owned firms is related with larger RTFP and markup dispersion within sectors, and with deeper industry concentration.

5.4.1 Competition, RTFP and Markup Dispersions

The model states that the reduction in the asymmetries in the access to credit markets affects the industry configuration. More precisely, it suggests that the higher innovation efforts undertaken by domestic firms induce reductions of the productivity gap in technologically dispersed sectors, and increases of it in sectors where firms shared similar productivity levels. This result was stated in prediction 3, equation (7).

This prediction refers to the gap in physical productivity between competing firms. Unfortunately, the lack of information on firms' prices does not allow to estimate the physical productivity. However, as RTFP is proportional to firms' physical productivity ($RTFP_{ijt} = p_{jt}\, q_{ijt}$, equation (**??**)), it is possible to use RTFP as a proxy for it. Like this, I use the dispersion in RTFP as a proxy of the physical productivity gap. I define the dispersion of RTFP as the difference in levels of RTFP between the 90th percentile and the 50th percentile firm within each three-digit NACE industry. I estimate the change in dispersion as the difference between RTFP dispersion after and before the reform.[35] In this way, a positive change in RTFP dispersion suggests an increase in the productivity dispersion within competing firms, and a negative value suggests a reduction in the productivity gap.[36]

To assess the validity of prediction 3, i.e. whether the change in the RTFP dispersion is negatively related to the initial RTFP dispersion, I regress the change in RTFP dispersion on its level before the reform. The estimated equation is as follows,

$$\Delta\kappa_j = \alpha + \beta_1 \kappa_j + \varepsilon_j \tag{17}$$

where $\Delta\kappa_j$ represents the change in the RTFP dispersion at three-digit industry level, and κ_j is the level of RTFP dispersion in the pre-reform period. Results are presented in figure 5.4.1. Confirming the model's predictions, the figure depicts a negative and statistically significant correlation between the change in RTFP dispersion and its initial level (results are presented in column 2 of table 13, below). It suggests that in sectors where firms

[35] Similar to the previous section, the periods before and after are defined as the three years preceding and following the reform (1998-00 and 2002-04). See the Appendix for a more precise description of this measure.

[36] Since the quantity of firms at four-digit industry level is rather small for many of sectors, estimating dispersion within four-digit industries could be misleading. Therefore, I concentrate the analysis to the three-digit industry level.

shared similar technology levels, the productivity dispersion increased; whilst in highly dispersed sectors, the RTFP dispersion decreased.

In this model, markup arises from the difference in firms' physical productivity and access to international capital markets (equation (3)). Therefore, the change in the productivity gap between competing firms should also be reflected in changes in the dispersion of markups. In particular, the change in markup dispersion should follow a similar pattern that the change in the dispersion of RTFP; i.e. markup dispersion should decrease in sectors where the initial dispersion was the largest, and increase in sectors where the initial dispersion was low. To investigate the evolution of markup dispersion, I follow the same procedure than in equation (17), and regress the change in the post-reform period regarding the level of markup dispersion before the reform. Figure 5.4.1 reports this relationship (results are reported in column 2 of table 13). The negative correlation supports the theory presented in this paper: the reduction in mark-ups dispersion was the largest in initially more concentrated sectors. In those sectors, the decline of the productivity gap led to a reduction in the markups dispersion. Inversely, the technological advantage achieved by some neck-and-neck firms enabled them to increase their mark-ups. This resulted in an increase in markup dispersion in those sectors.

Finally, recall that the change in the productivity gap affects firms' market power, and then competition within sectors. To investigate this effect, I compute the level of competition in each three-digit industry, and regress equation (17). I define an index of competition as in Aghion, Bloom, Blundell, Griffith, and Howitt (2005) and Nickell (1996), as one minus the average of the Lerner Index across firms within the industry. The index approaches to one as the level of competition increases. Like this, a positive change in the index between before and after reflects a raise in competition, whilst a negative value denotes a reduction in competition. [37] The theory presented in this paper implies a negative relationship between the change in competition and its initial level; i.e. competition should increase in highly concentrated sectors, but might decrease in neck-and-neck sectors. Figure 5.4.1 confirms a negative relationship between the change in competition and its initial level.

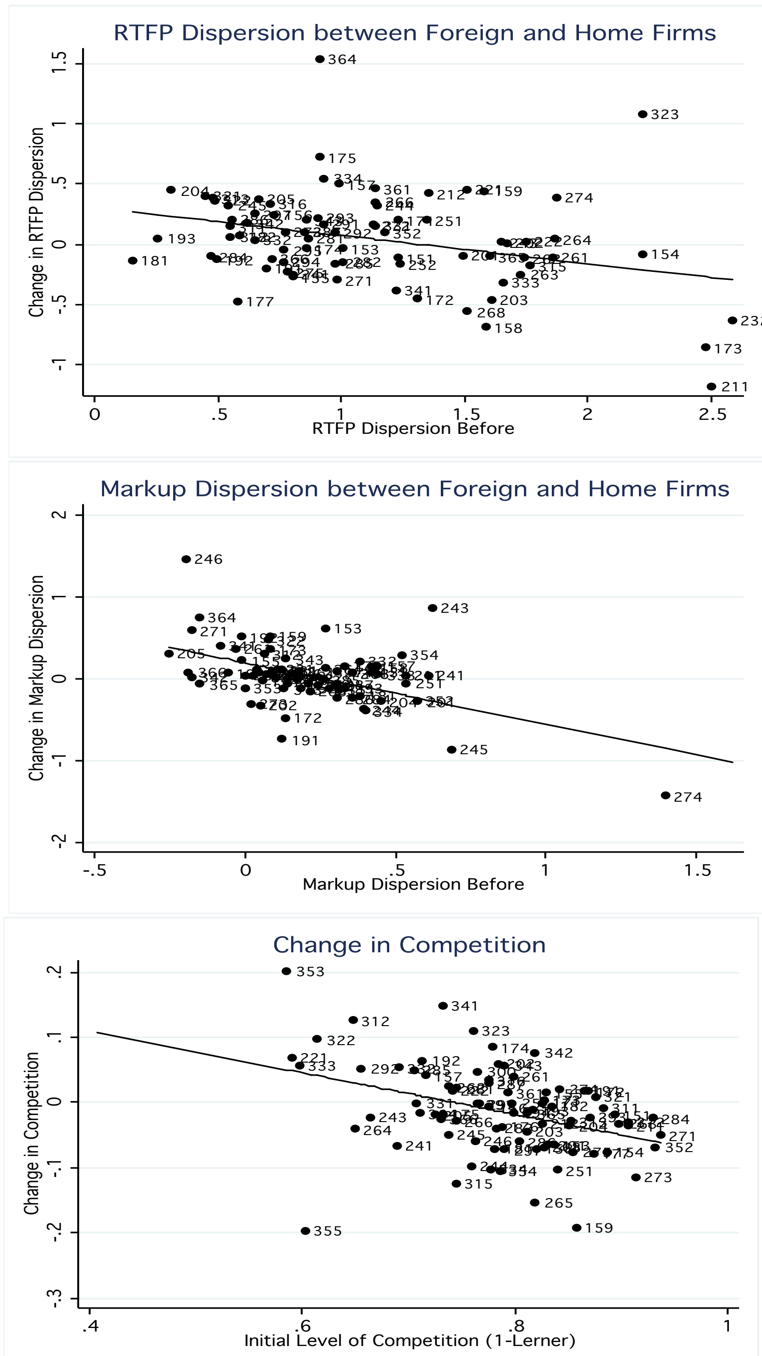
5.4.2 Testing for Pre-existing Trends

The sectoral patterns presented above considered changes in dispersion and competition within the three years before and after the reform. However, if there were pre-existing trends within sectors, the above correlations could be misleading the impact of the reform. In this section, I account for this possibility and show that results holds after controlling for pre-existing trends.

To account for preexisting trends in changes in the dispersion of RTFP and markups, and competition, I distinguish three periods: late nineties (1996-1997)[38], pre-reform (1998-

[37] See the Appendix for further details on this measure

[38] The period late nineties consists in the average of two years (1996-1997), instead of three. I exclude the


RTFP Dispersion between Foreign and Home Firms
Change in RTFP Dispersion
RTFP Dispersion Before
Markup Dispersion between Foreign and Home Firms
Change in Markup Dispersion
Markup Dispersion Before
Change in Competition
Change in Competition
Initial Level of Competition (1-Lerner)

2000), and post-reform (2002-2004), and estimate the following model:

$$\Delta\kappa_j = \alpha + \beta_1\kappa_{j,t} + \beta_2 T + \beta_3(\kappa_{j,t} * T) + \varepsilon_{j,t} \tag{18}$$

where $\kappa_{j,t}$ denotes the level at the beginning of each period (1996-97 and 1998-00), $\Delta\kappa_j$ represents the change in the variable between the period (1996-97 to 1998-00, and 1998-00 to 2002-04), T is a dummy indicating the reform period (1998-00 and 2002-04). The change after the reform once taking into account pre-existing trends is then captured by the coefficient β_3 of the interaction term.

Table 13 presents the estimated results for dispersion in RTFP and markups, and competition of equation (18). For comparison, I also present the results of separate regressions for each period as in equation (17). The coefficient of the change in the RTFP dispersion on the initial level of RTFP dispersion for the period 1996-1998 is indeed negative and significant, -0.163 points (t = 3.13). This confirms that laggard firms might have already been catching up technologically in high dispersed sectors. This pattern could be capturing the effect of the trade liberalization that occurred in 1996 in Hungary.[39] Column 2 presents the results on the effect of financial liberalization on the change in RTFP dispersion. The estimated coefficient confirms the negative relationship between the change in RTFP dispersion and its initial level following the reform; the coefficient is, however, significantly larger: -0.372 (t = 5.55). The change in RTFP dispersion after controlling for pre-existing trends is reported in column 3. The estimated coefficient of the interaction term β_3, -0.209 (t = 2.47), suggests that financial liberalization accelerated the previous trend.

Column 4 reports the estimated coefficient for the pre- reform period for the change in dispersion in markups. Similarly to RTFP, the coefficient is negative and significant -0.269 (t = 3.08), suggesting increases in competition in highly dispersed sectors. Column 5 presents the results for the period covering the financial liberalization. The estimated coefficient -0.636 (t = 7.23) is much larger than in the previous period. The interaction term reported in column 6 is negative and highly significant, -0.367 (t = 2.94), confirming the change in trend upon the reform.

The relationship between the change in competition and its initial level for the pre-reform period is presented in column 7. Albeit no significant, the coefficient suggests a negative relationship. Column 8 reports the estimated coefficient for the pre- and post-reform period, reported in figure 5.4.1. The estimated coefficient for interaction term is presented in column 9 is -0.239 (t=2.55), suggesting the change in pre-exiting trends after the reform. Overall, these figures confirms the model's prediction; i.e. en increase in competition in more concentrated sectors; and a decrease in it in neck-and-neck sectors.

year 1995 from the analysis, as an important downturn hit the Hungarian economy that year. Including that year could actually misinform about the actual level of dispersion and competition.

[39] See Bustos (2011) for the effect of trade liberalization of firms' technology adoption choices.

Table 13: Change in Dispersion and Competition

	Change in RTFP Dispersion			Change in Markup Dispersion			Change in Competition		
	Pre-trend	Reform	Accounting for Pre-trends	Pre-trend	Reform	Accounting for Pre-trends	Pre-trend	Reform	Accounting for Pre-trends
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Initial Value	-0.076	-0.202**	-0.076	-0.554***	-0.730***	-0.423***	-0.177***	-0.317***	-0.177***
	(0.064)	(0.079)	(0.077)	(0.153)	(0.135)	(0.079)	(0.054)	(0.085)	(0.060)
Initial Value *T			-0.222**			-0.307**			-0.245***
			(0.107)			(0.147)			(0.091)
T			0.186			0.120**			0.211***
			(0.128)			(0.057)			(0.072)
Constant	0.173**	0.274***	0.173*	0.163***	0.187***	0.067*	0.109**	0.236***	0.109**
	(0.076)	(0.101)	(0.092)	(0.046)	(0.045)	(0.039)	(0.044)	(0.067)	(0.048)
R^2	0.018	0.074	0.100	0.151	0.280	0.302	0.101	0.145	0.223
N	82	82	164	78	78	159	82	82	164

Notes: Std errors in parenthesis. 3-digit NACE industry correlations. *, **, ***significant at 10, 5, and 1 percent.

5.4.3 Competition, RTFP and Markup Dispersions Before the Reform

In this section, I explore whether sectors' characteristics before the reform were in line with the mechanism proposed in this paper. The model implies a positive relationship between the foreign firms' productivity advantage, and the level of markup and RTFP, i.e. more productive firms have higher RTFP and can charge larger markups (equations (3) and (**??**)). Empirically, these relationships could be thought as positive correlations between foreign owned firms' market share (as an indicator of firm's productivity advantage), and the dispersion of markups and RTFP within sectors. In the same token, foreign firms' market share should be negatively correlated with the level of competition. I turn now to test whether these correlations were present in the economy before the complete liberalization of the capital flows.

Table 14 reports industry correlations between foreign firms' market shares, the dispersions of RTFP and markups, and competition.[40] As implied by the theory, there is a positive and significant correlation between foreign firms' market share, and the dispersion of RTFP and markups in the industry (columns 1 and 2). In line with this evidence, figures in column 4 suggest that the larger the participation of foreign firms', the less competitive is the industry.

5.5 Aggregate Productivity Growth

Throughout the paper, I studied the role of capital openness on firms' innovation decisions. I turn now to evaluate the aggregate implications of firms' changes investment decisions. In particular, I take proposition 4 to the data and test whether aggregate RTFP growth accelerated after the liberalization of financial flows. To test this prediction, I compute the cumulative RTFP growth between 1992 and 2008, and test for structural break in

[40]Foreign firms' market shares are constructed as their value added in the three-digit industry value added.

Table 14: Competition, RTFP and Markup Dispersions Before the Reform

	RTFP Dispersion (1)	Markup Dispersion (2)	C=(1-Lerner Index) (3)
Share of Foreign Firms	0.3527***	0.2314**	-0.2003**
on Industry VA	(0.0008)	(0.0365)	(0.0351)
N	82	78	82

Notes: Std errors in parenthesis. 3-digit NACE industry correlations. *, **, ***significant at 10, 5, and 1 percent.

its trend. To compute the aggregate productivity growth, I follow Petrin and Levinsohn (2011) and Basu, Pascali, Schiantarelli, and Serven (2009) among others, and estimate aggregate RTFP growth as:

$$RTFPG_t = \sum_{i=1}^{N_t} dVA_{it} - \sum_{i=1}^{N_t} \sum_{k} W_{ikt}\, dX_{ikt}$$

where i, t denote firm and year; dVA represents the change in firms' value added; W_{ikt} is the price of the primary input (X_k, where k=labor, capital); $W_{ikt}\, dX_{ikt}$ is the change in the use of the primary input of firm i; and N is the total number of firms in the economy. To test for a structural break, I follow Perron and Zhu (2005) I estimate the statistical model,

$$CRTFPG_t = \alpha + \beta_1\, T_t + \beta_2\, SB_t + \varepsilon_t \tag{19}$$

where $CRTFPG$ denotes the RTFP cumulative growth, and T is a time-trend. SB represents the structural break in slope, and $SB = \text{year} - 2001$ if year ≥ 2002, $=0$ otherwise. Then, the coefficient β_1 absorbs the historical trend in productivity growth rate, and coefficient β_2 tests whether there is an acceleration in the RTFP growth rate upon the deregulation of capital markets. Column 1 in table 15 reports the results for a regression on the trend in productivity growth. The estimation of equation (19) is presented in column 2. The coefficient β_2 is positive and statistically significant at one percentage point, confirming the acceleration in the RTFP growth rate after the financial liberalization.

Table 20 (in the appendix) shows that the estimated coefficient for structural break remains stable after several robustness tests. Column 1 includes to equation (19) a change in levels (which takes the value of 1 if $t > 2001$, and 0 otherwise). The estimated coefficient for the change in levels is no significant, and its inclusion does not affect either the estimated coefficient or its statistical significance for the structural break. Column 2 tests for a change in the slope of productivity growth after the trade liberalization in 1996. Again, the estimated coefficient for trade openness is no statistically significant, whilst the coefficient for the structural break of the financial liberalization remains constant and significant. Results are unchanged to include a falsification test for the year 1998 (column 3).

Table 15: Acceleration of RTFP Growth

	Dependent variable: Cumulative RTFP Growth	
	(1)	(2)
Trend	17.586***	13.884***
	(0.630)	(0.537)
Structural Break in Slope (2001)		8.992***
		(1.120)
R^2	0.981	0.997
N	17	17

Notes: all regressions include a constant. *,**, *** significant at 10, 5, 1%, respectively.

5.6 Contribution to Aggregate Productivity Growth

In this section I discuss how the increase in aggregate productivity growth relates to the mechanism implied by the model, namely that the reduction of the asymmetries in the access to financial markets encourages firms to enhance their productivity. To account for this effect, I follow Petrin and Levinsohn (2011); Basu, Pascali, Schiantarelli, and Serven (2009); and Foster, Haltiwanger, and Syverson (2008) among others, and decompose aggregate RTFP growth between within firm growth (TE) and reallocation effects across firms (RE). This is,

$$RTFPG_t = TE_t + RE_t = \sum_{i,t}^{N_t} s_{i,t}\, dRTFP_{i,t} + RE_t$$

where i and t denote firm and year; N_t denotes the total quantity of firms in the economy; $s_{i,t}$ is the firm's share in total value added, where the weight is computed as the average between t and $t-1$; and $dtfp_{it}$ is the increase in firm's RTFP. Columns 1-3 in table 16 present the main results for the population of firms.

Confirming the results of the previous section, column 1 in Panel A reports an acceleration of RTFP growth rate between the three years before and after the reform (1998-00 and 2002-04). Average aggregate RTFP growth passed from an average of 5.8% to 9.7% per year. The decomposition of RTGP growth in the pre- and post-reform period is revealing. Whilst reallocation effects accounted for the bulk of the expansion in aggregate RTFP before the reform: 83.4% of the total increase (column 2 of panel B), it accounted for only 18.0% in the post-reform period. Inversely, technical efficiency explained 16.5% of aggregate RTFP growth in the before the reform, and 82% after the liberalization (column 3 in panel B). Briefly, technical efficiency accounts for the most of the aggregate RTFP growth after the liberalization of capital flows.

To understand how much of the expansion of aggregate RTFP is explained by the balanced panel used in section 5, I compute the total technical efficiency growth for these firms. Interestingly, column 4 indicates that, both before and after the reform, the balanced panel explains almost the total of the expansion in within firm productivity. Or, put it differently, the expansion in the post-reform period appears to be due to the productivity growth of incumbent firms, which account for 75.4% of the total increase in aggregate RTFP growth (panel B). [TO BE COMPLETED!! (Melitz Slovenia)]

The firm-level evidence presented in section 5 indicated that domestically owned firms rose their RTFP the most following the capital openness. I now turn to analyze how this expansion contributed to the increase in aggregate technical efficiency. With this purpose, I decompose the technical efficiency of the balanced panel into growth by foreign and home firms (columns 5 and 6). Figures in panel B suggest that, prior to the liberalization, the increase in technical efficiency was similarly accounted for by foreign and home firms. Foreign firms explained 48.6% of the total expansion in technical efficiency (8% from a total of 16.5%), and home firms 51.4%. The reform seems to have transformed this pattern: after 2001, most of the increase is explained by foreign firms: 84% (68.9% of a total of 82%). To understand this result, recall that the change in aggregate technical efficiency is weighted by the firm's market share. Thus, despite that domestic firms rose their RTFP the most, their small market shares limit their contribution to total RTFP growth. Inversely, the efforts of foreign owned firms weight significantly more in RTFP growth.

Table 16: Contribution to Aggregate RTFP Growth

	Total Sample			Balanced Panel		
	RTFPG	Reallocation	Technical Efficiency	Technical Efficiency		
				All Firms	Foreign Firm	Home Firm
	(1)	(2)	(3)	(4)	(5)	(6)
	A- Mean Growth Rate					
Before	5.8	4.8	1.0	0.9	0.46	0.48
After	9.7	1.7	7.9	7.3	6.67	0.63
	B- Contribution to Aggregate RTFP Growth (column 1)					
Before	100.0	83.4	16.5	16.5	8.0	8.4
After	100.0	18.0	82.0	75.4	68.9	6.5

6 Conclusion

Cross-country studies illustrate a positive impact of capital openness on aggregate productivity. To explain this feature, theoretical literature has focused on the effect of the reallocation of resources among firms. In this view, aggregate TFP raises as a result of

the increase in market shares of more productive firms. In this paper I present firm-level evidence illustrating that increases in within firm productivity are a major determinant of the expansion of aggregate productivity following a capital account deregulation episode. I showed that in a world were technology is endogenous, the access to external finance conditions firms' innovation efforts. More precisely, I illustrated that, in financial autarky, heterogeneous access to international credit markets generates monopolistic rents, which distorts firms' innovation efforts and lowers aggregate TFP. Capital openness reduces the asymmetries in the access to external finance, and deepens market competition. The reduction in mark-ups encourages both leader (foreign firms) and laggard (domestic) firms to increase their innovation efforts. As a result, capital openness not only raises the level of aggregate TFP, but also accelerates its growth rate. Using an extensive database covering the population of manufacturing firms, I investigated the impact of the deregulation of the financial account in Hungary in 2001. I presented firm-level evidence reporting the increase in market competition and firms' innovation efforts, and the reduction in mark-ups. My estimations suggest a significant decrease in the productivity differences in sectors with pre-eminence of MNC (i.e. technological catch up by domestic firms), and escape-competition effects in competitive industries dominated by domestic firms. On the aggregate, within firm productivity growth accounts for more than 80% of the RTFP enhancement in the post-reform period.

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7 Appendix

7.1 Definition of Variables

The database contains information on firms' output, materials, employment, capital, sales and exports. It also provides information on price indexes at four-digit NACE industries levels of materials, investment, producer and value added. With this information, I construct real value added as the real output minus real expenses in materials, deflated at the producer and the materials price indexes, respectively.

The construction of the capital stock series requires some elaboration. The database provides information about the book value of tangibles and intangibles capital. Following the perpetual inventory method and Kátay and Wolf (2008) considerations for the Hungarian database, I estimate capital stock as the real value of fixed assets. To compute the capital stock, I use the entire period that the sample offers: from 1992 to 2004. First, I construct the investment flows. As the database provides none information about firm's investment, I estimate it as a residual from the increase in the accounting capital in the year plus the depreciation value.

$$p^I_{jt} I_{ijt} = \Delta AK_{ijt} + \delta_{it} AK_{ijt-1}$$

where p^I_{jt} is the price of investment in the 4-digit NACE sector j at period t; I_{ijt} is firm's investment; ΔAK_{ijt} is the increase in the accounting value of fixed assets; $\delta_{it} AK_{ijt-1}$ is the depreciation value. Having constructed the value of the nominal investment for each firm and year, I can estimate the series of capital stock for each firm:

$$K_{it} = (1 - \delta_{it}) K_{it-1} + I_{it}$$

where both capital and investment are deflated at the four-digit NACE price index; and the initial condition of the capital stock is the value in the year the firm enters in the database.

From the Cobb-Douglas production function, I estimate firm's productivity:

$$Y_{it} = TFP_{it} L_{it}^{\beta_s} K_{it}^{\alpha_s}$$

where i, s and t denote firm, two-digit industry sector and year; β_s and α_s are the estimated elasticities of the production function. For robustness, I use the three most used methodologies to estimate those elasticities: Petrin and Levinsohn (2011), Olley and Pakes (1996), and De Loecker and Warzynski (2012). Then, firm's total factor productivity becomes:

$$ln\hat{TFP}_{it} = lnVA_{it} - (\hat{\beta}_s lnL_{it} + \hat{\alpha_s} lnK_{it}) \tag{20}$$

where the $\hat{}$ represents estimated values.

7.2 Firm-Level Analysis: Identification Strategy and Robustness Tests

Table 17: Comparison of the Difference in Growth Rates Preceding the Reform

	Home	Foreign	Difference in Means
Capital Intensity	0.056	0.049	0.007
	(0.004)	(0.009)	(0.008)
Labor Productivity	0.063	0.069	-0.006
	(0.005)	(0.009)	(0.010)
RTFP	0.024	0.025	0.000
	(0.005)	(0.009)	(0.010)
Markup	-0.017	-0.003	-0.014
	(0.005)	(0.008)	(0.009)
Debt/Sales	0.030	0.039	-0.009***
	(0.001)	(0.002)	(0.002)
N	12495	3849	16344

Notes: Std. errors in parenthesis. The table reports the mean of the variable growth rate within the three years preceding the reform (1998-2000).

Table 18: Robustness Test 1

	Capital Intensity					
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic	0.249***	0.260***	0.171***	0.254***	0.241***	0.282***
	(0.026)	(0.040)	(0.031)	(0.027)	(0.026)	(0.026)
Domestic * Exporter		-0.019				
		(0.050)				
Exporter		0.008				
		(0.044)				
Constant	0.205***	0.204***	0.306***	0.224***	0.281***	0.180***
	(0.053)	(0.058)	(0.059)	(0.055)	(0.061)	(0.053)
Firm-level controls	yes	yes	yes	yes	yes	yes
Sector fixed-effects	yes					
Local trends		yes	yes	yes	yes	yes
Global trends		yes	yes	yes	yes	yes
R^2	0.060	0.030	0.019	0.029	0.029	0.031
N	5448	5443	4747	4950	4881	5158
	Labor Productivity					
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic	0.046***	0.041*	0.070***	0.052***	0.061***	0.060***
	(0.015)	(0.024)	(0.020)	(0.018)	(0.016)	(0.017)
Domestic * Exporter		0.006				
		(0.030)				
Exporter		-0.030				
		(0.029)				
Constant	0.456***	0.362***	0.342***	0.346***	0.327***	0.334***
	(0.030)	(0.043)	(0.045)	(0.043)	(0.042)	(0.042)
Firm-level controls	yes	yes	yes	yes	yes	yes
Sector fixed-effects	yes					
Local trends		yes	yes	yes	yes	yes
Global trends		yes	yes	yes	yes	yes
R^2	0.235	0.041	0.040	0.039	0.029	0.040
N	5448	5443	4747	4950	4881	5158
	RTFP					
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic	0.032*	0.035*	0.057***	0.031*	0.039**	0.039**
	(0.016)	(0.021)	(0.020)	(0.018)	(0.017)	(0.018)
Domestic * Exporter		0.006				
		(0.023)				
Exporter		0.010				
		(0.029)				
Constant	0.369***	0.370***	0.323***	0.343***	0.352***	0.341***
	(0.033)	(0.042)	(0.047)	(0.045)	(0.043)	(0.042)
Firm-level controls	yes	yes	yes	yes	yes	yes
Sector fixed-effects	yes					
Local trends		yes	yes	yes	yes	yes
Global trends		yes	yes	yes	yes	yes
R^2	0.155	0.082	0.088	0.086	0.077	0.087
N	5448	5448	4747	4950	4881	5158

Notes: Std errors are clustered at time and 4-digit NACE industry level. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and TFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998). Column 1 controls for four-digit industry fixed effects. Column 2 controls for export status, where exporter is defined as having an average export share larger than 0.05 between 1998 and 2000. Column 3 removes those foreign firms whose foreign shares exceed more than 90% of total shares on average between 1998 and 2000. Column 4 restrict the analysis to foreign firms that are not used as export platforms (more than 90% of exports). Column 5 removes the top 1 percentile of firms (in value added). Column 6 controls for firms that change the ownership status between the pre- and post-reform periods (285 firms).

Table 19: Robustness Test 2

	RTFP		Markups		
	WLP	DLTL	PCM	WLP	DLTL
	(1)	(2)	(3)	(4)	(5)
Domestic	0.028***	0.081***			
	(0.009)	(0.026)			
Foreign			-0.127**	-0.034***	-0.024*
			(0.051)	(0.011)	(0.013)
Constant	0.285***	0.627***	-0.159*	-0.109***	-0.143***
	(0.037)	(0.118)	(0.082)	(0.022)	(0.040)
Firm-level controls	yes	yes	yes	yes	yes
Local trends	yes	yes	yes	yes	yes
Global trends	yes	yes	yes	yes	yes
R^2	0.034	0.065	0.006	0.028	0.019
N	4864	4839	5029	4864	4839

Notes: Std errors are clustered at time and 4-digit NACE industry level. Global industry controls include capital intensity and TFP growth rate of the 4-digit NACE industry in the United States between 1998-00 and 2002-04. Local industry controls are capital intensity and TFP average growth rate at 4-digit level in Hungary in the late 90s. Firm level controls are age, employment and RTFP in the initial year (1998). Column 1 reports the RTFP measure with the coefficients of the production function estimated following Wooldridge (2009) and Petrin and Levinsohn (2011) methodology. Column 2 reports the RTFP of the translog production function using the De Loecker and Warzynski (2012) methodology to estimate the elasticities of the factor of production. Column 3 reports the price-cost margin estimated as in Aghion, Bloom, Blundell, Griffith, and Howitt (2005). Column 4 and 5 present the markup estimated using the elasticities computed for columns 1 and 2, and following equation (12).

7.3 Definition: Competition, RTFP and Markup Dispersions

To compute the dispersion in RTFP (markup) within sectors, I first estimate each firm average level of RTFP (markup) in the pre-reform period (1998-2000). Next, I compute the dispersion as the difference in the average level of RTFP (markup) between the 90th percentile and the 50th percentile firm within each three-digit NACE industry. More precisely,

$$\kappa_j = p90_{i,j} - p50_{i,j} \tag{21}$$

where κ denotes RTFP (markup) dispersion, i and j index the firm and the three-digit NACE industry. After estimating the RTFP dispersion following equation (21), I compute the evolution of the RTFP (markup) as the difference between the change before and after.

$$\Delta\kappa_{j,t} = \kappa_{j,t} - \kappa_{j,t-1} \tag{22}$$

A negative $\Delta\kappa$ denotes a reduction of RTFP dispersion in the industry in the period under analysis.

To compute the level of competition in each sector, I follow Aghion, Bloom, Blundell, Griffith, and Howitt (2005) and Nickell (1996), and compute the Lerner Index (LI_{ijt}) of market competition for each three-digit industry. The Lerner Index is as follows,

$$LI_{ijt} = \frac{\text{operating profit}_t - \text{financial costs}_t}{\text{sales}_t}$$

where operating cost is computed as the total sales minus the payroll and materials costs; the estimated financial costs of capital is the net capital stock valued at the interest rate.

As in Aghion, Bloom, Blundell, Griffith, and Howitt (2005), the measure of competition is the average of the Lerner Index across firms within the industry,

$$C_{jt} = 1 - \sum_{i \epsilon j} s_{ijt} LI_{ijt}$$

where s_{ijt} is the market share of firm i in the three-digit sector j, and C_{jt} is the competition index.

7.4 Aggregate Productivity Growth: Robustness Test

Table 20: Acceleration of RTFP Growth: Robustness Tests

	Dependent variable: Cumulative RTFP Growth		
	(1)	(2)	(3)
Trend	13.523***	14.468***	13.845***
	(0.601)	(3.319)	(1.019)
Structural Break in Level (FL) (2001)	7.015		
	(5.620)		
Structural Break in Slope (FL) (2001)	8.407***	9.115***	8.897***
	(1.194)	(1.351)	(2.368)
Structural Break in Slope (TL) (1996)		-0.673	
		(3.769)	
Structural Break in Slope (Falsification Test) (1998)			0.116
			(2.527)
R^2	0.997	0.997	0.997
N	17	17	17

Notes: all regressions include a constant. *,**, *** significant at 10, 5, 1%, respectively.

7.5 Figures

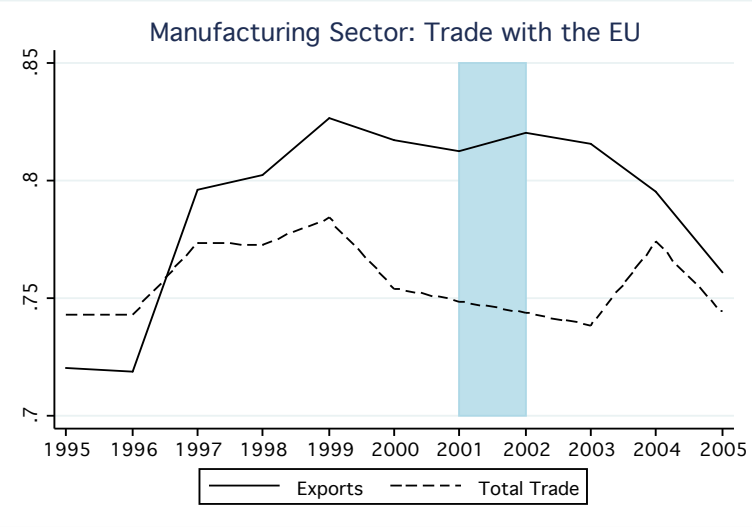

Figure 4: Total trade and exports with the European Union

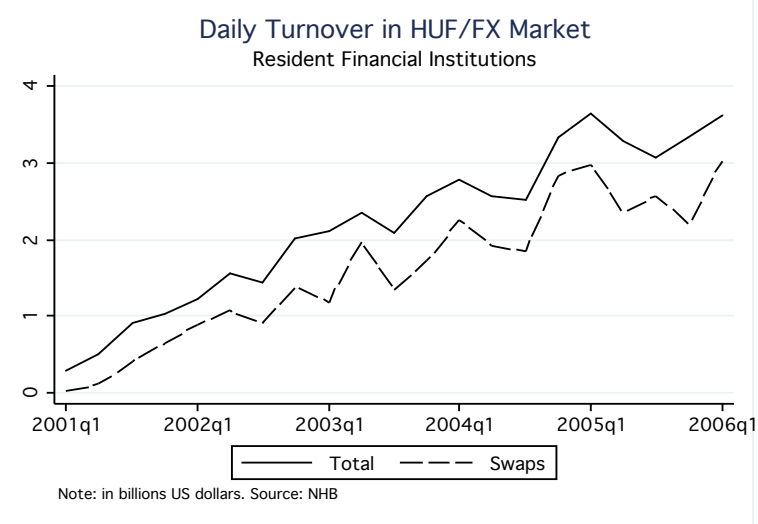

Figure 5: Deregulation of the Foreign Exchange Market

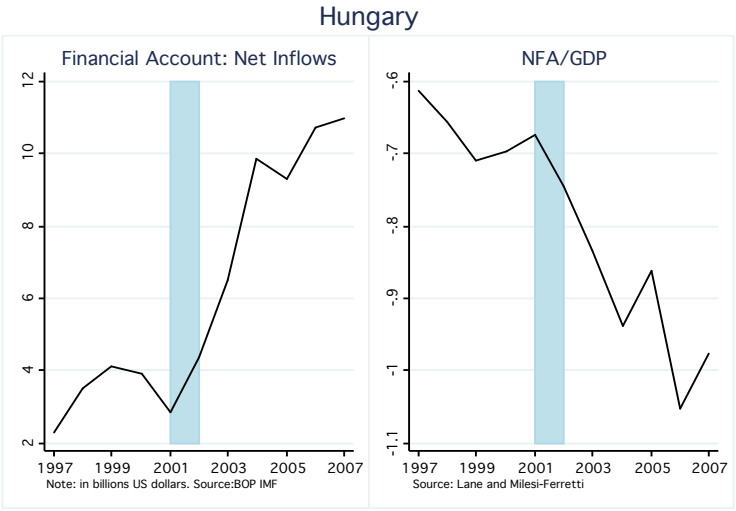

Figure 6: Impact of the Liberalization on the BOP and the Net External Position

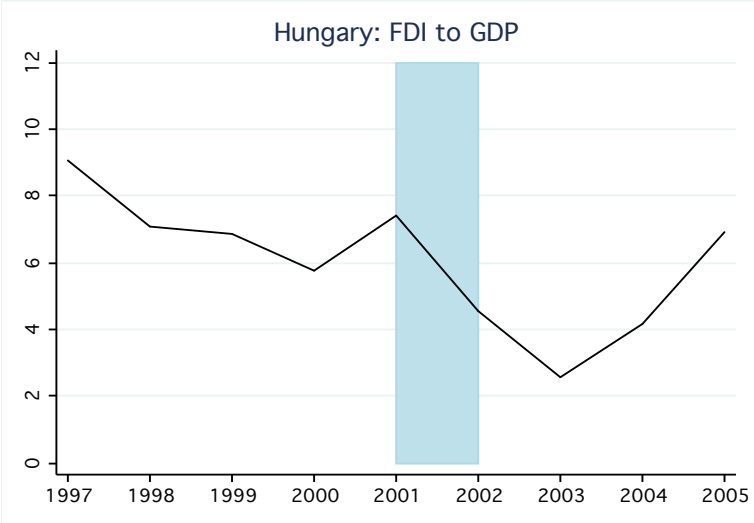

Figure 7: Evolution of Foreign Direct Investment

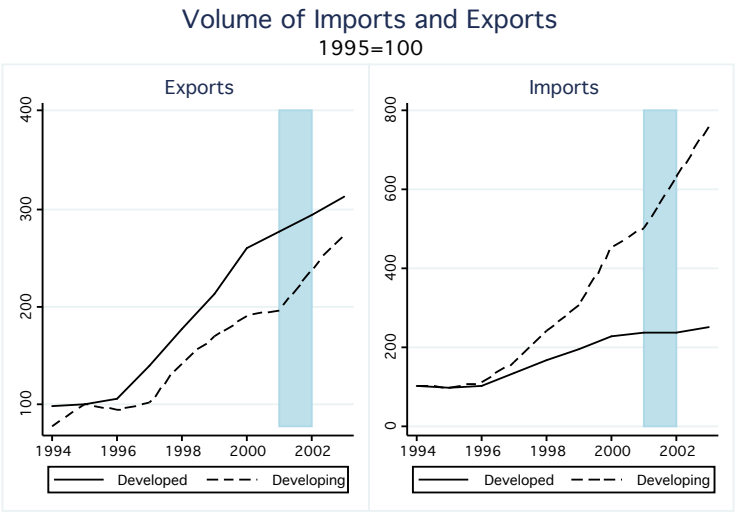

Figure 8: Evolution of Trade

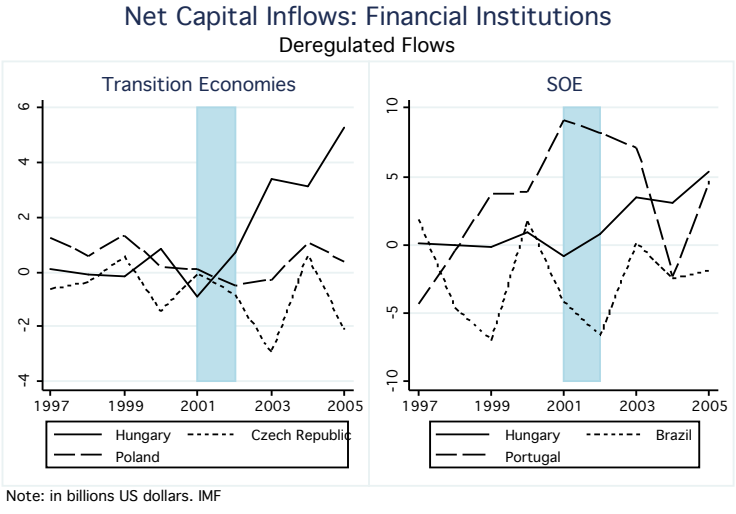

Figure 9: Capital Inflows Towards Transition and Small Open Economies