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December 2002
Revised November 2004

Abstract

We use newly assembled data on regulation in several sectors of many OECD countries to provide evidence that regulatory reform of product markets is associated with an increase in investment. A component of reform that plays a very important role is entry liberalization, but privatization also has a substantial effect on investment. Sensitivity analysis suggests that our results are robust.

1 Introduction

In the past decade the rate of GDP growth has been remarkably different amongst OECD countries. One of the most striking and often cited comparisons is the one between the US with a 4.3 percent average GDP growth in the second half of the nineties and large continental European economies (Germany, Italy and France) with 2 percent average growth. One commonly held explanation of these differences is that a stricter regulation of markets has prevented faster growth in many European countries especially in a period, the nineties, of rapid technological innovation. Is this true? This paper suggests that the answer is "yes": various measures of product market regulation are negatively related to investment, which is an important engine of growth.

*We would like to thank Frank Gollop, Silvana Tenreyo, Alessandro Sembenelli, Xavier Vives, three anonymous referees, and participants at seminars at Boston College, Brandeis, European Economic Association's 18th Annual Congress, Federal Reserve Bank of Boston, IGIER Bocconi, International Society for New Institutional Economics' 7th Annual Conference, NBER Summer Institute, Stockholm School of Economics, University College of Dublin, and World Bank for useful comments. Alesina is grateful for financial support to the NSF for a grant through the NBER. The views expressed in the paper are those of the authors and do not necessarily represent those of the institutions to which they are affiliated.

Most OECD countries have experienced some form of regulatory reforms (deregulation for short) implying entry liberalization and privatization in the last decades. However, the timing, extent, nature, and starting point varies across countries. For instance, the United States started deregulating earlier, already in the seventies. In 1977, 17 per cent of the US GNP was produced by fully regulated industries, and by 1988 this total had been cut to 6.6 percent of GNP.[1] Other early and decisive reformers have been New Zealand and Britain, while laggards have been Italy and France.

We rely on these diverse histories to study the effects of regulatory reforms in sectors which were traditionally most heavily sheltered from competition and have witnessed, at different times and to different degrees, some form of deregulation and privatization in various countries. Specifically, we look at the effects of regulation on investment in the transport (airlines, road freight and railways), communication (telecommunications and postal) and utilities (electricity and gas) sectors. We measure regulation with different time varying indicators that capture entry barriers and the extent of public ownership, among other things.

Regulatory reforms have had a significant positive impact on capital accumulation in the transport, communication, and utilities industries. In particular, both liberalization of entry in potentially competitive markets and privatization of public enterprises seem to have spurred investment.[2] There is also evidence that the marginal effect of deregulation on investment is greater when the policy reform is large and when changes occur starting from already lower levels of regulation. In other words, small changes in a heavy regulated environment are not likely to produce much of an effect.

Much of the literature on the effects of regulation in OECD countries is concerned with the labor market, as for instance, Blanchard and Wolfers (2000). Work on the macroeconomic effects of goods market is more limited.[3] Blanchard and Giavazzi (2003) develop an insightful model of both labor market and product market regulation and their interconnection. Nicoletti et al. (2001a, b) provide empirical evidence in favor of a negative effect of anti-competitive product market regulation on employment in a panel of OECD countries. Bertrand and Kramarz (2002) show that regulation in the French retail trade industry has lowered employment, and Pissarides (2001) and Haefke and Ebell show that this result carries over to mod-

[1] See Winston (1993). The figures are from the January 1991 Survey of Current Business.

[2] Our conclusion that less intrusive government intervention favors private investment is consistent with the finding by Alesina et al. (2002). They show in a panel of OECD countries that a reduction of the size of government measured by total spending and total taxation over GDP increases the private accumulation of capital. Results by Blanchard and Perotti (2002) on the US are on the same line.

[3] There is of course a vast literature on the microeconomics of regulation and deregulation. See for instance the surveys by Joskow and Rose (1989), Peoples (1998), and Winston (1993).

els in which equilibrium employment (unemployment) results from a job-matching process. Moreover, Nicoletti and Scarpetta (2003) find that product market regulation lowers multifactor productivity growth in OECD countries, while Bassanini and Ernst (2002) find a negative effect of regulation on R&D. Finally, Djankov, La Porta, Lopez de Silanes, and Shleifer (2002) focus on regulations that affect how easy it is to start a business in 85 countries. Their paper contrasts developing countries with developed ones and lends support to the view of excessive regulation as a hindrance to entrepreneurship.[4] To our knowledge, there are no contributions in the literature that use broad time varying measures of product market regulation and look at the relationship between regulatory reforms and investment in a panel context.

The paper is organized as follows. Section 2 presents a simple model and discusses several channels through which regulation can affect capital accumulation. Section 3 describes our data and, in particular, the measurement of the regulatory environment. Section 4 discusses our results in sectors (utilities, telecommunication, transport) which were heavily regulated and have experienced various forms of deregulation. The last section concludes.

2 Product Market Regulation and Investment: Some Theory

Product market regulation can influence investment in several ways. First, changes in regulation affect the markup of prices over marginal costs, because of their impact, for instance, on entry barriers and, hence, on the number of firms. This mechanism is emphasized by Blanchard and Giavazzi (2003) in a non-competitive model of employment determination. Second, regulation can influence the costs that even existing firms face when expanding their productive capacity. For example, red tape and other forms of regulatory burdens can increase firms' costs of adjusting the capital stock and hamper their capacity to react to changes in fundamentals. Third, for certain sectors, regulation imposes a ceiling on the rate of return on capital that firms are allowed to earn. This affects the demand for capital relative to labor (Averch and Johnson (1962)). Finally, if product markets regulatory reforms occur together with privatization (or nationalization) policies, changes in ownership structure can also affect investment.

We begin by embedding the first two ideas in a standard model of investment

[4] A related literature asks the question whether competition stimulates firms' productivity. See, for instance, Nickell (1996) who shows that both the level and growth rates of firms' productivity are positively affected by measures of competition. This suggests that regulatory reforms should have positive productivity effects, insofar as they succeed in stimulating competition.

with imperfect competition in the output market.[5] We will show that regulatory reforms that result in reduction in entry barriers, in the markup of prices over cost and in adjustment costs tend to stimulate capital accumulation. We do then emphasize that there are counterarguments to this conclusion. For instance, removing the ceiling on the rate of return that can be earned on capital may reduce the desired capital stock and, therefore, investment. Moreover, agency problems and political mandates make the effect of privatization ambiguous.

Finally, it should be considered that in some network industries such as utilities and telecommunications, reforms entailing service liberalization and price rules for accessing networks can have conflicting influences on investment. For instance, lacking appropriate regulation, vertically-integrated network owners can have incentives to strategically restrict capacity to prevent entry of other service providers. While unbundling of networks can help solving competition problems, its effects on investment depend on the governance structure of the newly-created network companies, which in some cases can provide few incentives for maintenance and expansion of capacity. Similarly, ill-designed access prices, whereby for instance prices do not cover network costs, can discourage investment in new capacity. Conversely, access prices that are too high may cause overcapacity, with service providers inefficiently investing in their own networks.

The difficulty of pinning down at a theoretical level the effect of product market reforms on investment mirrors an analogous problem in assessing its effect on innovation. The early endogenous growth literature suggested that greater product market competition generates less innovative activity because it reduces the monopoly rents accruing to innovators. More recent contributions point out that more competition may stimulate R&D because it encourages R&D investments aimed at escaping competition (See, for instance, Aghion et al. (2001), and Aghion et al. (2002)). Vives (2004) shows that greater market size and /or product substitutability, usually associated with deregulation, tend to increase R&D. It is true that a decrease in entry costs in an industry, in a free entry context, tends to decrease the innovation effort per firm. However, aggregate investment can still increase due to a surge in the number of entrants. All this emphasizes the importance of empirical work in assessing the effect of deregulation on the dynamic behavior of the economy.

[5] In Blanchard and Giavazzi (2003) output is a function of employment only. The focus of this paper is on product and labor market regulation. We abstract from non-competitive labor markets and from labor market regulation, but we endogenize the capital stock. See also Spector (2002).

2.1 Regulation, the markup and adjustment costs

We assume that each monopolistic competitive firm produces a differentiated product with capital and labor and faces a demand for its good of the form:

$$\frac{Y_i}{\overline{Y}} = D\left(\frac{P_i}{\overline{P}}\right) = \left(\frac{P_i}{\overline{P}}\right)^{-\varepsilon} \tag{1}$$

where $\overline{Y}$ is average real output demanded, $\overline{P}$ the average price level, and ε the elasticity of demand.[6] As in Blanchard and Giavazzi (2003), we assume that the elasticity of demand varies inversely with the degree of product market regulation: tighter regulation is associated with a lower elasticity. One way to rationalize this is to assume that the elasticity of demand is an increasing function of the number of firms, m. Hence, $\varepsilon = g(m)$, where $g'(\cdot) > 0$.[7] If we define the markup of prices over marginal costs as $(1+\mu) = \left(\frac{1}{1-\frac{1}{\varepsilon}}\right)$, then μ is a decreasing function of the number of firms ($\mu = \mu(g(m))$, with $\mu' < 0$).

We begin by assuming that the regulatory authority (the government for short) determines administratively the number of firms. This assumption is not too far from reality in most of the sectors we deal with in the estimation (the only exception being road freight). In this case, deregulation of product markets leads to a larger number of firms, hence, a decrease in μ. In the next section, we let instead the number of firms to be endogenously determined by a standard entry condition, but entry is costly and regulation determines the size of such costs. Firms choose capital and labor to maximize the present discounted value of cash flow V:

$$V = \int_0^{\infty} e^{-rt}\left[\frac{P_i}{\overline{P}}F(K_i, L_i) - \frac{W}{\overline{P}}L_i - I_i - \frac{b}{2}(\frac{I_i}{K_i})^2 K_i\right]dt \tag{2}$$

[6] If the demand functions are derived from Dixit-Stiglitz preferences, $\overline{P}$ has the standard CES form.

[7] Other aspects of regulation may also affect the elasticity of demand, for any given m. For instance, changes in tariff and non tariff barriers may affect the availability of foreign products on domestic markets and, hence, the elasticity of demand. Similarly, the latter will be affected by the introduction of common standards across countries. A simple way to modify the model to account for such effects would be to write, as Blanchard and Giavazzi (2003) do, $\varepsilon = \overline{\varepsilon} g(m)$, where $g'(\cdot) > 0$ and $\overline{\varepsilon}$ captures the aspects of product market regulation mentioned above. Since we do not focus on changes in trade barriers or on the introduction of common standards, we will continue with our simpler specification. Finally, note also that an inverse relation between the markup and the number of firms can be obtained in a variety of models and does not require a model with product differentiation. For instance, it holds in a model with Cournot competition and homogeneous products.

where K_i, L_i, and I_i denote capital, labor and investment, respectively. $F(K_i, L_i)$ is linear and homogeneous in K_i and L_i with decreasing returns to each factor, W is the nominal wage (assumed to be identical for each firm) and r is the real rate of interest.[8]

Firms face adjustment costs that have the standard linear homogeneous quadratic form $\frac{b}{2}(\frac{I_i}{K_i})^2 K_i$. We assume that product market regulation also affects b; in particular, deregulation decreases it. With this we capture the reduction in the shadow and actual costs "of doing business" associated with red tape and other administrative impediments that hamper firms' choices. The maximization problem is subject to the goods' demand function (1) and to the capital accumulation equation:

$$\dot{K}_i = I_i - \delta K_i \tag{3}$$

For the sake of simplicity, we assume that r is exogenous, as in a small open economy, and constant.[9] We can then easily derive the first order conditions for labor, investment and the capital stock. Imposing the symmetric equilibrium so that $P_i = \overline{P}$, substituting the first order condition for investment into the first order condition for capital and in equation (3) and rearranging, we obtain:

$$f(k) - kf'(k) = (1+\mu)w \tag{4}$$

$$\dot{k} = \left[\frac{1}{b}(q-1) - \delta\right]k \tag{5}$$

$$\dot{q} = (r+\delta)q - \left[(1+\mu)^{-1} f'(k) + \frac{1}{2b}(q-1)^2\right] \tag{6}$$

where $k_i = K_i/L_i$, $w = W/\overline{P}$ and we have dropped subscript i since all firms behave identically in equilibrium. Equations (5) and (6) determine the equilibrium

[8]Note that we are assuming constant return to scale. Some industries may be regulated because they display natural monopoly characteristics due to the presence of increasing returns. We can easily model increasing returns following Rotemberg and Woodford (1995) by using the production function $F(K_i, L_i) - \Phi$ with $F(K_i, L_i)$ displaying constant returns, and Φ representing a positive constant determined by technology only and capturing fixed costs. Note that since the first order conditions and the equations of motion remain unaltered the conclusions obtained in section 2.1 would be unchanged.

[9]Note that many of the countries covered in our sample are indeed small open economies. Another way of closing the model is to consider explicitly the consumption choice of individuals, as in Abel and Blanchard (1983). This complicates the model, without providing additional insights for the purpose at hand.

path for the capital-labor ratio, k, and the shadow value of capital, q, for a given μ and b. Also, given the assumption of a fixed labor supply, $\overline{L}$, equations (5) and (6) determine the equilibrium level of the aggregate capital stock as $K = k\overline{L}$. The system is saddle-path stable. Using (5) and (6), we obtain the steady state value of k as:

$$f^{'}(k) = (1+\mu)\left[(r+\delta) + b\delta\left(r + \frac{\delta}{2}\right)\right] \tag{7}$$

Equation (7) implies that an unanticipated permanent increase in the number of firms allowed to operate generates a decrease in the markup, μ, and leads (*ceteris paribus)* to an increase in the steady state value of k (since $f^{''}(k)$ is negative), i.e. $\partial k/\partial m > 0$. Following the decrease in μ, the shadow value of capital jumps up, leading to an increase in the investment rate until the new steady state is reached. Similarly, for given μ, a decrease in the adjustment cost parameter b leads to an increase in the steady state level of k, i.e. $\partial k/\partial b > 0$. In response to a regulatory reform that decreases the cost of adjusting the capital stock, the shadow value of capital initially jumps up and then it settles to a lower steady state value. Moreover, firms' investment is now more responsive to the marginal profitability of capital. Hence, the capital stock increases in the long-run.

In conclusion, deregulation, by decreasing μ or b or both, leads to an expansion of the capital stock and investment through both the markup and the adjustment cost channel. Using the previous results and the first order condition of the firm with respect to labor (4), one can show that the real wage decreases in μ and b. A decrease in the markup or in the adjustment cost parameter leads to a higher capital stock and, hence, to a higher marginal product of labor. Moreover, the markup also acts as a tax on the use of labor, at each level of k_i. Hence, a decrease in μ leads to a higher labor demand and, given a fixed labor supply, to a higher equilibrium wage.[10]

2.2 Regulation and entry: endogenizing the number of firms

Up to this point, we have assumed that the government can mandate the number of firms in the market. It is more realistic to assume that the number of firms is endogenously determined and can only be indirectly affected by the government

[10]Note that in the Blanchard and Giavazzi's (2003) model, there is an inverse relationship between the real wage and the markup as well. Exogenous decreases in the markup lead to a higher real wage also in the dynamic general equilibrium model of Rotemberg and Woodford (1995) who allow for a variable labor supply and capital accumulation. Investment also increases, following a decrease in the markup.

through regulation of entry. Firms entry and exit the market and the number of firms is determined by the following condition:

$$V = \int_0^{\infty} e^{-rt} \left[\frac{P_i}{\overline{P}} F(K_i, L_i) - \frac{W}{\overline{P}} L_i - I_i - \frac{b}{2} (\frac{I_i}{K_i})^2 K_i \right] dt = \overline{c} K_i \tag{8}$$

where $\overline{c}K_i$ measures entry costs, established by regulation and assumed to be proportional to capital. Note that the model's qualitative conclusions on the effect of regulation on investment do not change if we assume that entry costs are proportional to labor ($c = \overline{c}L_i$) or are fixed ($c = \overline{c}$). Equation (8) implies:

$$\frac{dV}{dt} = rV - \left[\frac{P_i}{\overline{P}} F(K_i, L_i) - \frac{W}{\overline{P}} L_i - I_i - \frac{b}{2} (\frac{I_i}{K_i})^2 K_i \right] \tag{9}$$

In steady state $I_i = \delta K_i$, and $dV/dt = 0$. Hence, given the linear homogeneity of $F(K_i, L_i)$, in the symmetric equilibrium, we can rewrite the entry condition that allows to determine the number of firms m as:

$$f(k) - \frac{W}{\overline{P}} - \delta(1 + \frac{b\delta}{2})k = r\overline{c}k \tag{10}$$

From the first order condition for labor, the wage is a function of k. Moreover, k is an implicit function of μ, hence m, and b through (7), i.e. $k = k(\mu(g(m)), b)$, with $k_m > 0$ and $k_b < 0$. Therefore, (10) determines implicitly the number of firms as a function of entry costs, c, the adjustment cost parameter b, the depreciation rate δ, the interest rate r, and the fixed labor supply, $\overline{L}$.

The effect of a change in entry costs on investment can be decomposed in: *a)* the impact of entry costs on the number of firms and *b)* the effect of the number of firms on the capital stock, i.e. $\partial k/\partial \overline{c} = (\partial k/\partial m)(\partial m/\partial \overline{c})$. We have already shown above that $\partial k/\partial m > 0$, hence we need to determine the sign of $\partial m/\partial \overline{c}$. One can check that, without further assumptions, the sign of $\partial m/\partial \overline{c}$ is ambiguous. If $F(K_i, L_i)$ is Cobb-Douglas with an elasticity of output with respect to capital equal to α, it is possible to show that a sufficient condition for deregulation to lead to an increase in the number of firms ($\partial m/\partial \overline{c} < 0$) is:

$$\mu < \frac{1}{\alpha} - 1 - \frac{r + rb\delta}{r + \delta + rb\delta + \frac{b\delta^2}{2}} \tag{11}$$

This condition is almost surely satisfied for reasonable parameters combinations, so that a decrease in entry costs generates an increase in the number of firms, a decrease in the markup, and an increase in the capital stock. For instance, for

$\alpha = 0.35, r = 0.02, \delta = 0.06, b = 10, \partial m/\partial \overline{c}$ is negative if the markup μ is lower than 157%. Thus, a reduction in entry costs leads to an increase in the number of firms and a lower mark up.[11]

Let's now consider the steady state effect of a change in the adjustment cost parameter, allowing for a change in the equilibrium number of firms that may occur as a result of variations in b. In the long-run with m variable, the total effect is $dk/db = (\partial k/\partial b) + (\partial k/\partial m)\,(\partial m/\partial b)$. As shown above, deregulation captured by a decrease in b has a positive effect on the capital stock, for a given m, since $\partial k/\partial b < 0$. Also, $(\partial k/\partial m) > 0$. However, it is not possible to sign $\partial m/\partial b$, and, hence, the total effect, without additional assumptions. Again, some algebra leads us to conclude that, under a Cobb-Douglas technology, the condition in (11) guarantees that $dk/db < 0$. Hence, also in this case, a regulatory reform that decreases the cost for the firm to adjust their capacity leads to a higher level of the capital stock in the long-run.

The general conclusion that can be derived from the models we have analyzed so far is that deregulation of product markets has a positive effect on capital accumulation if it generates a reduction in the markup of prices over marginal costs (for instance through a reduction in entry barriers) or if it lowers costs of adjusting the capital stock.

2.3 Additional channels

Regulation can affect investment through additional channels. First consider capital market imperfections. Assume that, because of informational asymmetries, there is imperfect substitutability between internal and external sources of finance. If deregulation leads to a decrease in markups and in the availability of internal funds, it may have a negative effect on investment through this cost of capital channel. Although this reasoning is compelling for firms severely affected by informational asymmetries and with limited collateralizable assets, such as small and young firms, it is less convincing for the large firms that operate in the sectors we will concentrate upon in our empirical work.

The second channel is operative when regulation imposes a ceiling on the rate of return on capital invested in some sectors. If the constraint binds, the choice of factor proportion may be altered in favor of more capital intensive techniques and the amount of capital used increases relative to the one chosen in the absence of constraints. This is the well know argument due originally to Averch and Johnson

[11] If the production function is $F(K_i, L_i) - \Phi$, in order to allow for increasing returns, the term $-\frac{\Phi m}{\overline{L}}$ should be included on the lhs of (10) making more likely that a decrease in entry costs increases m. The sufficient condition in (11) remains unchanged.

(1962) and refined, subsequently, by other authors.[12] The basic idea is that by investing in additional capital, firms increase the base to which the (constrained) rate of return is applied, resulting in a greater total remuneration for capital. The consequence is that reduction in the rate of return on capital below the profit maximizing level (resulting from the imposition of a binding ceiling) leads to an increase in the capital stock. The lower the allowed rate of return is, the greater is the capital stock employed by the firm.[13] Removing the binding constraint would, instead, reduce the desired capital stock and therefore investment.

The last argument that we consider has to do with the presence of public or semi-public enterprises, which in many countries accounted for a large fraction of production in some sectors such as utilities and transport, and also in the manufacturing sector. Product market regulatory reforms that have taken place in the last decades have often been accompanied by privatization. The disappearing or reduced importance of a dominant publicly owned player, facing a soft budget constraint, is one of the reasons why deregulation has lead to a decrease in entry barriers for new privately owned firms.[14] The model with entry costs we have analyzed above captures therefore the shrinking role of public enterprises if we think of $\overline{c}K_i$ as a shadow cost.

However, public enterprises may have been heavy investors because of a political mandate imposed on them or because of their managers's incentives. Managers of public enterprises often behave as empire builders, because their reward in terms of monetary compensation, power, and perks may be related to the size of the organization. It is also unlikely that capital markets can effectively restrict this type of behavior. Alternatively, their objective may be to maximize political support, and this may lead to set prices below the profit maximizing level (Peltzman (1971)). Thus, one may have overexpansion and over-investment in public enterprises, so that with privatization total investment might fall. In order to disentangle the multifaceted effects of privatization one would need a break down of data on an internationally comparable basis of investment by sectors and by type of firm: private, with public participation, public, etc. Unfortunately, these data are not available. Therefore, if total investment increases after a policy change that

[12] See also Takayama (1969) and Baumol and Klevorick (1970). The relevance of the Averch-Johnson model has been debated empirically, typically in the power generating sector, with mixed results. See, for instance, Petersen (1975) and Boyes (1976).

[13] One can obtain similar predictions if the regulatory authority sets directly the (relative) prices firms can charge and mandates that firms satisfy all demand at those prices. If prices are set below the (monopoly) maximizing prices output demanded would rise relative to the unconstrained case. As a result the demand of both capital and labor would be higher, for given factor prices.

[14] Sappington and Sidak (2003) show that public enterprises have stronger incentives to foreclose entry to competitors than private enterprises.

implies both privatization and a lowering of entry barriers, it may mean that the increase of private investment more than compensate the possible fall of investment in privatized enterprises.

Summing up, the effect of "deregulation" on investment is, at a theoretical level, ambiguous. Reforms which imply reduction in entry barriers and in the markup are likely to lead to an increase in investment. Aspects of deregulation that remove binding constraints on rates of return may determine a reduction of investment. Finally, the effect of privatization is ambiguous. In the end, the answer has to be found empirically.

3 The Data

For our empirical assessment of the effects of product market regulation we use time varying measures of regulation for several non manufacturing industries in OECD countries for which investment, capital and value added data are also available. In the two next subsections we describe in detail the construction of the main variables used in estimation.

3.1 The Industry-Level Regulation Data

In order to capture the intensity of regulation, we use data collected by Nicoletti et al. (2001), (who extended the cross-sectional data contained in the OECD International Regulation Database) and described in detail by Nicoletti and Scarpetta (2003). These data are used to construct time-series indicators of overall regulation, barriers to entry and public ownership from 1975 to 1998 in 21 OECD countries (Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, UK, Greece, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Sweden, US, New Zealand) for seven non-manufacturing industries: electricity and gas supply, road freight, air passenger transport, rail transport, post and telecommunications (fixed and mobile). The regulatory indicators measure on a scale from 0 to 6 (from least to most restrictive) restrictions on competition and private governance. Industry-specific regulation data were collected from both national sources (by means of specific surveys) and published sources. Consistent historical data for the 1975-1998 period were drawn from various publications and were vetted by OECD experts. Table A1 in the appendix contains details on the construction of the indicators.

The summary index of regulation includes information on entry barriers, public ownership, the market share of the dominant player(s) (in the telephone, gas and railroad sectors), and price controls (in the road freight industry). Entry barri-

ers cover legal limitations on the number of companies in potentially-competitive markets and rules on vertical integration of network industries. The barriers to entry indicator takes a value of 0 when entry is free (i.e.: a situation with three or more competitors and with complete ownership separation of natural monopoly and competitive segments of the industry) and a value of 6 when entry is severely restricted (i.e.: situations with legal monopoly and full vertical integration in network industries or restrictive licensing in other industries). Intermediate values represent partial liberalization of entry (e.g. legal duopoly, mere accounting separation of natural monopoly and competitive segments). Public ownership measures the share of equity owned by central or municipal governments in firms of a given sector. The two polar cases are no public ownership (0 value of the indicator) and full public ownership (a value of 6 for the indicator). Whenever data are available (i.e. telecoms, air transport), intermediate values of the public ownership indicator are calculated as an increasing function of the actual share of equity held by the government in the dominant firm. In some cases (e.g. the energy industries), a simpler scale is used pointing to full or majority control by the government (a value of 6), various degrees of mixed public/private ownership (intermediate values), marginal public share or full private ownership (a value of 0).

The construction of the indicators involved the following steps. First, separate indicators for barriers to entry, public ownership, market share of new entrants, and price controls were created at the finest available level of industry disaggregation (e.g. mobile and fixed telephony). Second, these indicators were aggregated at the industry level taking simple averages or revenue-weighted averages (when aggregating horizontal segments of industries, such as mobile and fixed telephony). Third, the index of overall regulation is obtained by averaging in each of the seven industries the indicators of barriers to entry, public ownership, market share of new entrants, and price controls. Finally, we used simple averaging of the indices to reach the level of industry aggregation for which investment and value added data are available. More specifically, we have aggregated the regulation indices for the seven sectors in three broader sectors: utilities (electricity and gas), communication (telecommunications and post), and transportation (airlines, road freight and railways).

In our regressions we use four different indicators of regulation: $REGOL$, the overall indicator including all the regulation dimensions; $REGNO$, which includes all dimensions except public ownership; $BEVI$, which summarizes barriers to entry (comprising legal restrictions and vertical integration), and $REGPO$, which includes only public ownership information. The reason for isolating the effect of public ownership is that, in principle, public ownership per se does not imply rules and restrictions that private investors have to follow. However, it is likely to influence the shadow cost of entry for private firms. Moreover, as dis-

cussed above, investment choices of public enterprises may differ from those of private firms. The market share of new entrants will not be used individually as an explanatory variable. It is certainly useful to measure the effectiveness of entry liberalization in promoting competition, but, as an outcome variable, it is also the component most affected by potential endogeneity problems. Finally, we do not use the indicator of price controls by itself because data on price controls are available only for the road freight industry.

Figure 1 plots the level of regulation, as measured by the summary indicator $REGOL$, in 1975 and in 1998 on the horizontal and vertical axis respectively. Countries-sectors differ both in terms of the level of regulation and in terms of changes in the regulatory environment. Virtually all the observations are below the 45 degree line indicating a general trend toward liberalization and privatization. Interestingly, no country except the US had low regulation at the beginning of the sample in the three broad industry aggregates. The US was the least regulated economy at the beginning of the sample, was still so in 1998, and implemented strong deregulation policies over the period. For example, the index measuring the level of regulation in the US in the transport sector is equal to 4.25 in 1975 and to 0.75 in 1998, a decrease of about 82%. Deregulation has also been particularly strong in the UK and New Zealand, which were highly regulated at the beginning of the sample, while they rank among the most "market-oriented" economies in 1998. For example, regulation decreased by 86% from 5.5 to 0.75 in the transport sector in New Zealand and by 78% (from 5.63 to 1.25) and 69% (from 5.08 to 1.58) in the utilities and communications sectors in the UK. On the contrary, countries like Italy, France, Greece were among the most regulated economies in 1975 and were still so in 1998.

The timing of regulatory reforms also differs across countries. Figures 2 and 3 plot the average across all seven non-manufacturing industries of the index $BEVI$ and $REGPO$ for the following representative countries: US, UK, New Zealand, Germany, France, Spain and Italy. While the first three countries reduced entry barriers starting from the late seventies/early eighties, in Italy and Spain the process did not begin till the nineties, and in France and Germany the changes that occurred during the eighties were minor. The index measuring the extent of public ownership points to a generalized trend towards privatization. Once again, the process has been rather timid in Italy and France and much more decisive in New Zealand and UK. Note that the US is the only country that does not show a tendency to reduce public enterprises. However, the US had the smallest beginning of period level of public ownership, much below the level of continental Europe.

3.2 The Investment and Other Data

The economic data on investment, capital stock, and value added at the country-sector-year level for the period 1975-1998 come from the OECD STAN database for Industrial Analysis, Revision 3 (ISIC Rev. 3), augmented with data from the OECD's International Sectorial Database (ISDB). These databases cover both services and manufacturing sectors for the OECD countries. The macroeconomic data for the non-manufacturing sectors for which we have indices of regulation are available at the following level of industry aggregation: (i) electricity, gas and water, (ii) communications and posts, (iii) transport and storage, and (iv) transport, storage and communications, for countries in which no separate data for communications and transport is available. From now on, we will name the sectors defined in (i), (ii), (iii), and (iv) utilities, U, communications, C, transport, T, and transport and communications, TC, respectively. We use the data at the most disaggregated level (sectors U, C, T) whenever they are available and data for sectors U and TC otherwise. Sectors U, C, T are available for Belgium Canada, Germany, Denmark, Finland, France, UK, Italy, Sweden, sectors U and TC for Australia, and the US, and sector U for Japan. We merge the data contained in the augmented STAN-ISDB data set with the database containing the regulation indices $REGOL$, $REGNO$, $BEVI$, and $REGPO$. As mentioned above, because data on investment, capital, and value added are not available for each single industry for which regulation indices exist, we mapped the industry-level regulatory indicators into the non-manufacturing aggregates covered by our STAN-ISDB industrial statistics database. Investment in utilities, transport and communication sectors represents about 18% of total business investment in OECD countries, approximately the same share as the one of the manufacturing sector. Hence, our analysis on the effect of deregulation on investment covers quite a large component of business sector investment in OECD countries.

Figure 4 plots the average of investment as a share of the capital stock in the utility, communications, and transport sectors in the US and UK (selected as the early and more decisive deregulators) and in the three largest continental European countries, Italy, France and Germany, (selected as late and timid deregulators). The pattern of the investment rate in one group of countries is the opposite of the other: while in US and UK investment as a share of the capital stock increased from 3.7% in 1975 to 8.15% in 1998, in the large continental European countries the investment rate decreased by 5 percentage points from 9.4% to 4.4%. As shown in figures 1-3, US and UK strongly liberalized product markets starting in the late seventies/early eighties, while deregulation reforms were almost absent in Italy, France and Germany till the nineties.

We can get some additional prima facie evidence on the effect of deregulation

by checking whether the trend behavior of the investment rate in each sector of a particular country changes after the beginning of deregulation in that sector as measured by the overall index $REGOL$.[15] Controlling for sector/country effects and for time effects, we find that the coefficient of the trend is negative and statistically significant before the beginning of deregulation (the coefficient is equal to -0.0015 and the t-statistics is equal to -4.66) and that there is a positive and significant change in the slope of the trend after the beginning of deregulation (the slope coefficient increases by 0.0011 with an associated t-statistics on the change of 4.98). There is also a positive intercept shift but it is not significant (0.0020 with a t-statistics of 1.29).

4 Investment and Regulation: Econometric Results

We now turn to a systematic econometric investigation of the effect of regulation on investment. We first discuss the results in the context of a simple dynamic panel model of investment and regulation, controlling for sector/country fixed effects and common or sector specific year effects. We show that our proxies for regulation have a significant negative effect on investment in almost all cases. We then present evidence that our conclusions are robust to various extensions and sensitivity checks.

4.1 Basic Specification

We base our investigation on estimation of various versions of an unrestricted dynamic model of investment of the form:

$$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=0}^{2} \beta_\eta REG_{ijt-s} + \gamma_{ij} + \zeta_t + (or\ \zeta_{jt}) + \varepsilon_{ijt} \tag{12}$$

where t represents years, i denotes countries and j sectors. REG is one of our four indices of regulation described above ($REGOL$, $REGNO$, $BEVI$, and $REGPO$). The remaining terms capture country/sector specific fixed effects, and common (or sector specific) year dummies.

If we take the simple models of the previous section literally, regulation should not have a long-run effect on the investment rate, as the latter equals simply the depreciation rate in the steady state. However, even simple changes would invalidate this result. For instance, if adjustment costs are specified as in Uzawa (1969),

[15] For several countries the various indices of regulation are flat and then start declining. The date of the first decline is defined as the beginning of deregualtion.

so that gross investment turns into capital at a decreasing rate, changes in the adjustment cost parameter associated with deregulation will affect the steady state value of the investment rate (we have not used this model in the theoretical section because it is more complicated). More fundamentally, it is possible to envision endogenous growth models in which regulation may affect the steady state growth rate of the capital stock, and, hence, the investment rate. For this reason, in our econometric work, we let the data decide whether or not there is a long-run effect of regulation on the investment rate.

We estimate three models that differ for the number of lags of the regulatory index included in equation (12). The most general model contains the contemporaneous, once lagged, and twice lagged value of the regulation variable. The intermediate model restricts the coefficient of the contemporaneous value of the regulation index to be equal to zero. The most restricted model only includes the once lagged value of the regulation indicator. We do so to be sure that results are not sensitive to the number of lags of the regulatory index included in the regression. In particular, the specifications that exclude the contemporaneous value of the regulatory indicator are less open to criticisms about the endogeneity of the regulatory index itself due to deregulation occurring contemporaneously with a positive (or negative, for that matter) idiosyncratic shock to investment.[16]

For brevity sake, we show only results for the intermediate model containing the regulation index lagged one and two periods. Results for the other models are available in the working paper version of this paper. For compactness, we report: (*i*) the sum of the coefficients of the regulation variable and the marginal probability of the test for its equality to zero, (*ii*) the value of the long-run multiplier and the marginal probability of the test for its significance, (*iii*) the marginal probability of the test on the hypothesis that the coefficients of the index of regulation are jointly zero. We also include the sum of the coefficients of the lagged dependent variable and the marginal significance level for the test of first order serial correlation based on Arellano and Bond (1991). Note that for the intermediate model the test on the joint equality to zero of the coefficients can be interpreted as a test of Granger causality (from regulation to investment).

In Table 1, part I, we present the results obtained when the model is estimated by OLS with country/sector effects and common year dummies, while in Table 1, part II, we allow for sector specific year dummies.[17] We find a significant nega-

[16] Although it is possible that regulation at time t is correlated with the idiosyncratic shock at the same time, one must remember that the likelihood of such correlation is reduced by the time lags associated with the design, approval, and implementation of the necessary legislative and administrative changes.

[17] OLS estimation with country and sector fixed effects yields consistent estimates in panels with large T. In our case T is indeed fairly large (T=24). Standard errors are corrected for heteroskedas-

tive effect of regulation on investment: the sum of the coefficients for summary measures of regulation and the long-run coefficients are always significant at the 1% level across models. The test of joint significance of the coefficients presents a similar picture. We can never reject the hypothesis of no serial correlation in the residuals. When we allow for sector-specific year effects, measures of regulation display a negative and significant long-run effect as well. Again $REGOL$, $BEVI$, $REGPO$ are significant at around the 1% level. The exception is $REGNO$ that now has a marginal significance level between 1% and 6%. Again, there is no evidence of serial correlation.

Note that this last set of results is very important because technological advances, that are likely to have a sector specific component, were occurring at the same time of regulatory reform, and one needs to control for such technology shocks, when evaluating the effect of deregulation. The inclusion of sector specific year dummies also addresses the possibility that regulation itself may respond to such sector specific technological opportunities, generating an endogeneity problem for the regulation variable in models that do not control for such shocks. For instance, technological change associated with cellular phones and wireless technology may have meant that a new market structure was optimal in the telecommunication sector and may have lent impetus to deregulation. It is very informative that for our measures of regulation still we detect a significant long-run effect, even after controlling for sector specific year dummies. The size of the long-run effects decreases only minimally.

Results in Table 1, part I and II, are consistent with the idea that a reduction in barriers to entry is likely to have a positive effect on investment because it leads to a decrease of the markup and, possibly, of the cost associated with capital expansion. Also privatization exercises a positive effect on investment. This suggests that the reduction of barriers to entry for private firms associated with privatization more than compensate the reduced importance of potential overinvestment problems due to managerial incentives.

In order to have an idea of the size of the effect of changes in regulation on investment, consider an unit decrease in $REGOL$, for Table 1, part I. The investment rate increases by slightly less that one percentage point in the long-run (.863 of one percent to be precise). Since the investment rate is approximately equal to 6% on average, this would imply an increase to almost 7%. Note that if $REGOL$ decreases from its third quartile value (5.6) to its first quartile value (3.2), this change generates an increase in the investment rate of approximately two percentage points, which is quite large. The same experiment for $BEVI$ leads to a total increase of 1.5 percentage points ($BEVI$ changes from 5.8 to 3.6 going from the

ticity.

third to the first quartile), while for $REGPO$ to an increase of 1.6 percentage points ($REGPO$ changes from 5.8 to 2.3 going from the third to the first quartile). Consider also that the sectors in our panels are highly capital intensive: the capital to gross output ratio equals approximately 4.2 and the capital to value added ratio equals 6.5. As a result, the increase of investment as a percentage of gross output or value added is much larger.

Another way of gathering a sense of the magnitude of the changes is to make some experiments with actual values of the indices in different time periods in one country or across countries. Consider, for example, the regulatory reforms implemented in the UK in the transport and communications sector. In the period 1975-1983, the overall index of regulation was constant and equal to 3.8 and the average value of the investment rate was 5.0%. Starting from 1984, the index $REGOL$ shows a trend toward deregulation and reaches a value of 0.8 in the period 1994-1998. Our model predicts an increase in the investment rate in the long-run of 2.5 percentage points (from 5.0% to 7.5%). The actual increase was 3.0 percentage points.

Let's now compare average values of the regulation indicator $REGOL$ across countries. For instance, in the period 1994-1998, the average value of $REGOL$ in the transport and communication sectors is 0.8 in US, 3.42 in Germany and in France, and 4.7 in Italy. The investment rate is 9.0% in US, 5.6% in Germany, 5.9% in France, and 6.8% in Italy. One can compute that if Germany and France regulation changes from 3.4 - their own value - to the US one equal to 0.8, the model predicts an increase in the investment rate by 2.3 percentage points in the long-run, from Germany's average value of 5.6% to 7.9% and from France's average value of 5.9% to 8.2%, much closer to the US average level of 9.0%. Finally, suppose that regulation in Italy changes from 4.6 - its own value - to the US one equal to 0.8, the model predicts an increase in the investment rate by 3.3 percentage points, from 6.8% to 10.1%.

The results presented so far rely on a large T argument for consistency, given the presence of the lagged dependent variable (see Nickell 1981). In our case T=24 for most country/sectors. Moreover, one needs to assume lagged regulation to be uncorrelated with the idiosyncratic shock at time t. We have also estimated our models by GMM methods in differenced form, as proposed by Arellano and Bond (1991). In this case one relies on large N for consistency. We have observations for 32 country/sectors, which means that some caution is needed in relying excessively on these results. The one step GMM results for the differenced version of the equations estimated in Table 1, part I, are reported in Table 1, part III. Lags two and higher of investment and regulation are used as instruments together with lagged two through four of population, GDP per capita, cumulative years of left wing governments, and union density (see Djankov et al (2002), Mulligan

and Shleifer (2003) and Botero et al. (2003)).[18] Differencing removes the country/sector effects. The test of serial correlation suggests the presence of first order serial correlation (as one would expect if the error term in the level model is serially uncorrelated), but there is no evidence of second order serial correlation, making the use of the second lag of the variables as instruments legitimate. The Sargan test of over-identifying restrictions also does not suggest gross mis-specification of the equation. The overall results are again supportive of a significant role for regulation as a determinant of investment. The marginal significance level vary between 1% and 4% and the size of the effect is only marginally smaller than those obtained when models are estimated by OLS.[19]

4.2 Investment, Deregulation and Privatization

We have shown that deregulation increases total investment, which includes both private investment and investment by public or semi public enterprises. Ideally we would like to separate the two, but data limitations do not allow us to do so. Data for selected countries (and periods) show that investment of public enterprises has decreased, especially in Europe, probably as a result of tighter budget constraints faced by public enterprises and of the process of privatization.[20] What we can do is to include both measures of deregulation and privatization in the equation for total investment and ascertain if our conclusions concerning the effect of lowering barriers to entry, for which the theoretical predictions are sharper, still hold. Note that this is quite an important yet difficult exercise since in several instances the process of deregulation and liberalization have proceeded together. In our sample, the correlation coefficient between $REGNO$ and $REGPO$ is 0.46 while the correlation between $BEVI$ and $REGPO$ is 0.45. The main results when we include either $REGNO$ and $REGPO$ or $BEVI$ and $REGPO$ at the same time, are reported in Table 2.[21] Interestingly, the long-run coefficient for $BEVI$ continues to

[18] The issue of the determinants of regulation is very important and has generated much discussion in the literature. However, it goes beyond the scope of this paper and a short discussion would not do justice to it.

[19] Results are very similar if we include in the instrument set lags two through four of the other indicators of labor market regulation used in section 4.3 below.

[20] For instance in the period 1982-1998 non-agricultaral business investment of public enterprises went down from about 30 per cent of total non-agricultural business investment to about 10 per cent in Italy and Portugal and from about 16 per cent to 12 per cent in Germany and Belgium (see CEEP, various years). See also Bertero and Rondi (2002) for evidence that tighter budget constraints has led to a decrease in investment by public enterprises in Italy.

[21] For breveity sake, as in Table 1, here and in the following tables, we present only the results for the intermediate model containing the regulation index lagged one and two periods. Results are similar for the other models. Also, for Tables 2 and 3 we report only the values of the long-run multipliers and the marginal probability of the tests for their significance.

be significant at the 1% level, while $REGPO$ is now significant at the 5% level. The size of the coefficient for $BEVI$ is reduced but not by much (from -.00623 to -.00562), while the one for $REGPO$ decreases more substantially (from -.00649 to -.00391). This suggests that the results for the decrease in barriers to entry are stronger, as the theory would suggest, compared to the one for privatization. Results are similar for the specification with $REGNO$ and $REGPO$.

4.3 Controlling for Other Country Specific or Country/Sector Specific Variables.

Next we check wether our conclusions concerning deregulation are robust to the inclusion of country specific or country/sector specific variables that may affect investment. The country specific variables are the GDP to capital ratio of the business sector, the real interest rate, the cyclically-adjusted value of the ratios between government expenditure and tax revenue to GDP, and measures of labor market regulation. All variables are lagged once and twice to minimize endogeneity problems. A summary of the results is presented in Table 3, part I.

Our conclusions are virtually unchanged with the inclusion of these variables. As an aside, note that public spending and taxation have a negative, but not significant effect on the sectorial investment rates. This evidence is at least weakly consistent with that of Alesina et al. (2002). Moreover, it is very important that our results are robust to the inclusion of indicators of labor market regulation and flexibility, since some of the countries have introduced significant labor market reforms in the 80's and 90's.[22] We measure regulation in the labor market using OECD data on employment protection, replacement rate, bargaining coordination, bargaining centralization, degree of corporativism and union density. As an example, we report the results when we use data on the degree of corporativism. This is the only labor market indicator that has a statistically significant (at least at the 5% level) long-run effect on investment in all regressions of Table 3, part I. The estimates suggest that an increase in corporativism reduces investment. Instead, changes in the replacement rate have a negative and significant (at the 10% level) long-run effect on investment in the specifications including $REGOL$, $REGNO$, and $BEVI$, but not $REGPO$. All other labor markets indicators do not have a statistically significant long-run effect on investment, except when we use the indices of bargaining coordination, bargaining centralization and union density together with $REGPO$. In all specifications, the conclusions for product market regulation

[22] In our sample, the correlation between our summary measure of regulation $REGOL$ and the union density and the replacement rate variables is equal to 0.13 and 0.10, respectively; the correlation between $REGOL$ and the employment protection index is 0.60, while the correlation between $REGOL$ and the remaining indices measuring regulation in labor markets is between 0.3 and 0.4.

do not change.

Our next set of experiments consists of adding country/ industry specific variables, such as the real price of investment goods, the real wage and the value added-to-capital ratio (all lagged once and twice), as additional regressors.[23] Results are reported in Table 3, part II.[24] The long-run coefficients of the real price of investment goods and of the real wage are not significant and the significance and size of the regulatory variables is not altered. The value added to capital ratio has a significant and positive long-run effect on the investment rate. The long-run coefficients of $REGOL$ remains significant at around the 1% level, those for $BEVI$ and $REGPO$ are now significant at around the 5% level (6.0% and 4.2% respectively), while $REGNO$ becomes now insignificant. If we want to calculate the overall impact of regulation on investment, it is also necessary to know the effect of regulation on the value added-to-capital ratio. In the last part of Table 3, we present the results obtained when regressing Y/K on two lagged value of itself and two lagged values of the regulation indices. While we cannot reject the equality to zero of the long-run coefficient for $REGOL$, $REGNO$, and $REGPO$,we can reject this hypothesis for $BEVI$ that is significantly and negatively related to Y/K. In summary, we can conclude that for all our measures of regulation except $REGNO$, our fundamental conclusions on the effect of deregulation on investment still hold.

4.4 Heterogeneity in Short-Run Response

So far we have assumed that the response to regulation is the same across sectors and countries. We now allow for heterogeneity in short-run responses, while maintaining the assumption of an identical long-run effect. We begin by reparametrizing

[23] The real price of investment is calculated by dividing the sector/country specific price deflator for investment by the sector/country specific value added deflator. The real wage is the log of the nominal wage per worker in each sector/country divided by the corresponding value added deflator.

[24] The specification with the value added to capital ratio could be rationalized as the linear approximation of a model with quadratic adjustment costs and a Cobb-Douglas production function. At each point in time the marginal revenue product of capital equals $(\alpha/(1+\mu))(Y/K)$, where α is the elasticity of output with respect to capital, μ as usual is the markup, and Y denotes value added. Investment will be an increasing function of the present discounted value of the marginal revenue product of capital (with coefficient $1/b$, assumed constant for simplicity). Take a linear approximation of the shadow value of capital around the sample average values of μ and Y/K. Assume then that the markup is a linear function of regulation and that forecasts for regulation and Y/K are based on a simple bivariate AR(2) system. This would lead to a model of investment that includes two lagged values of the proxy for regulation and Y/K.

the intermediate model as follows:

$$\begin{aligned}\Delta(I/K)_{ijt} &= \vartheta_1 \Delta(I/K)_{ijt-1} + \lambda_1 \Delta REG_{ijt-1} + \vartheta_2 (I/K)_{ijt-2} + \\ &\quad + \lambda_2 REG_{ijt-2} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt} \qquad (13)\end{aligned}$$

where $\vartheta_1 = (\alpha_1 - 1)$, $\lambda_1 = \beta_1$, $\vartheta_2 = (\alpha_1 + \alpha_2 - 1)$, $\lambda_2 = (\beta_1 + \beta_2)$, and $\alpha_1, \alpha_2, \beta_1$, and β_2 are the coefficients in equation (12). In equation (13), the long-run effect of regulation is captured by $-\lambda_2/\vartheta_2$, while the short-run response depends upon λ_1 and ϑ_1. We let the coefficients λ_1 and $\vartheta_1$differ across countries/sectors. We find that regulation does not have a statistically significant effect on investment in the short-run, in the sense that $\lambda_1$is not statistically significant. The only exception occurs in the specification in which regulation is measured by $REGPO$ for some, but not all, countries/sectors. Second, the results on the long-run effect of regulatory reforms on investment are virtually unchanged. In fact, $REGOL$, $REGNO$, $BEVI$ and $REGPO$ have a negative and statistically significant effect (at the 5% level or better) on investment and the size of the coefficients is similar to the one obtained in Table 1, (see Table 4).

4.5 Non-linear Effects of Regulatory Reforms

We now investigate whether there is evidence of a non linear response of investment to regulatory changes. To start with, we check whether the long-run effect of regulation on investment depends on the level of regulation itself. In particular, we add to the model, reparametrized as in equation (13), the square of the variable REG_{ijt-2}. Results are reported in Table 5, part I. The coefficients on the linear term REG_{ijt-2} remain negative and significant for all the summary measures of regulation, while the coefficient on the square term is positive and significant at the 5% level for $REGOL$, $REGNO$ and $BEVI$, but not for $REGPO$. These results imply that the marginal effects of regulatory reform starting from very high levels of regulation are basically zero. The marginal effects of deregulation are substantial and positive when starting from a more deregulated environment.

Another interesting experiment is to see whether the long-run effect of regulation on investment also depends on the magnitude of the change occurred in regulation between 1975 and 1998. We interact the variable REG_{ijt-2} in equation (13) with two dummy variables, $LARGE$ and $SMALL$. $LARGE$ ($SMALL$) is equal to one if the change in the overall regulation index between 1975 and 1998 is bigger (smaller) than the median change in the sample and zero otherwise. Results are reported in Table 5, part II. We find that regulation has a negative and statistically significant coefficient when its change is "large", but not when it is "small". However, a test on the equality of the coefficients of REG_{ijt-2} multiplied by $LARGE$ and $SMALL$ cannot be rejected at conventional critical levels.

Finally, in Table 5 part III, we investigate whether the timing of regulatory reforms matters. More specifically, we check whether deregulation of product markets positively affects investment both in countries that have undertaken reforms early on in the sample and in the "late deregulators" countries. We define two dummy variables, $LATE$ and $EARLY$. $LATE$ ($EARLY$) is equal to one in countries-sectors where we do not observe (do observe) any decrease in the overall regulation index before 1990 and zero otherwise. As before, we interact the variable REG_{ijt-2} in equation (13) with the two dummy variables. We find that deregulation has a negative and statistically significant effect only when interacted with the dummy $EARLY$. In countries-sectors that begin deregulating product markets in the 1990's, a one unit decrease in regulation has no impact on investment. Moreover, the coefficient of the dummy variable $LATE$ is generally negative and statistically significant.

Note that one may fail to find a statistically significant effect on investment in "late deregulators" simply because there is not enough variation in the regulation data. However, it is also the case that countries that were opened up to competition earlier in the sample are those that deregulated more deeply. Our conclusions on the lack of short-run effects still hold.

5 Conclusions

Tight regulation of the product markets has had a large negative effect on investment. The data for sectors that have experienced significant changes in the regulatory environment suggest that deregulation leads to greater investment in the long-run. A component of reforms that plays a particularly important role is entry liberalization, but privatization also has a positive effect on investment. These results are consistent with theoretical predictions. A reduction in entry barriers generates a reduction of the markup and, hence of the penalty of expanding production, in terms of lost monopoly profits. This results in greater investment. When it comes to public ownership, there are contrasting forces at work. While a reduction in public ownership can be seen as lowering the shadow cost of entry, agency problems and political mandates affecting the behavior of public managers may lead to over-accumulation of capital. The empirical analysis suggests that the reduction in the shadow cost of entry is the dominant factor.

Our results are robust to several sensitivity checks and extensions. In particular, we find that the marginal effect of deregulation depends on how deep the change is: more decisive regulatory reforms have a greater marginal impact. Moreover, the marginal effect is greater when one starts from lower levels of regulation. The implication of our analysis is clear: regulatory reforms that substantially lower entry

barriers spur investment. However, one must be aware that this is just a piece of the puzzle in assessing the impact of product market reform on the dynamic behavior of the economy. As we have discussed the effect of deregulation on innovation is theoretically ambiguous and more empirical work is needed before we can reach definitive conclusions on the impact of deregulation on overall dynamic efficiency. In addition, an assessment of the optimality of product market reforms requires a full welfare analysis. This goes beyond the scope of this paper and we leave it for future research.

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Table 1: Regulation and Investment

	REGOL	REGNO	BEVI	REGPO
Part I				
Sum = $\alpha_1+\alpha_2$	0.76**	0.77**	0.77**	0.77**
Sum = $\beta_1+\beta_2$	-0.002**	-0.0014**	-0.0016**	-0.0015**
Pvalue test on H_0: $\beta_1+\beta_2 = 0$	0.0001	0.0013	0.0001	0.0015
Pvalue test on H_0: $\beta_1 = \beta_2 = 0$	0.0004	0.0026	0.0006	0.005
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0086**	-0.0063**	-0.0068**	-0.0065**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.00008	0.0008	0.0001	0.0011
Pvalue Arellano-Bond test for AR(1)	0.25	0.28	0.26	0.28
Nobs	578	578	578	578
Part II				
Sum = $\alpha_1+\alpha_2$	0.78**	0.78**	0.78**	0.77**
Sum = $\beta_1+\beta_2$	-0.0016**	-0.001*	-0.0014**	-0.0014**
Pvalue test on H_0: $\beta_1+\beta_2 = 0$	0.004	0.062	0.004	0.003
Pvalue test on H_0: $\beta_1 = \beta_2 = 0$	0.016	0.17	0.016	0.010
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0074**	-0.0046*	-0.0063**	-0.0063**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.003	0.055	0.0045	0.0017
Pvalue Arellano-Bond test for AR(1)	0.40	0.43	0.40	0.37
Nobs	578	578	578	578
Part III				
Sum = $\alpha_1+\alpha_2$	0.76**	0.76**	0.76**	0.76**
Sum = $\beta_1+\beta_2$	-0.0018**	-0.0012**	-0.0014**	-0.0015**
Pvalue test on H_0: $\beta_1+\beta_2 = 0$	0.0022	0.0066	0.0028	0.02302
Pvalue test on H_0: $\beta_1 = \beta_2 = 0$	0.007	0.012	0.006	0.072
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0075**	-0.0052**	-0.0058**	-0.0063**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.006	0.008	0.007	0.04
Pvalue Sargan test	0.24	0.23	0.23	0.25
Pvalue Arellano-Bond test for AR(1)	0.00003	0.00004	0.00003	0.00003
Pvalue Arellano-Bond test for AR(2)	0.98	0.99	0.99	0.98
Nobs	546	546	546	546

Notes: Dependent variable I/K_{ijt} defined as investment divided by the capital stock of country *i*, sector *j*, year *t*. Regulation indices used: *REGOL*, *REGNO*, *BEVI*, *REGPO*. OLS estimates in Part I and in Part II. GMM estimates in Part III. Country-sector specific fixed effects and common year dummies are included in Part I and in Part III. Country-sector specific fixed effects and sector specific year dummies are included in Part II. Estimated model:

$$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$$

REG stands for one of the following: *REGOL*, *REGNO*, *BEVI*, *REGPO*. **5% significance level. *10% significance level.

Table 2: Liberalization and Privatization

	(1) REGNO and REGPO	(2) BEVI and REGPO
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0047**	-0.0056**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.01	0.001
Long-run coefficient = $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	-0.0044**	-0.0039**
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.04	0.05

Notes: Dependent variable I/K_{ijt} defined as investment divided by the capital stock of country i, sector j, year t. Regulation indices used: *REGOL*, *REGNO*, *BEVI*, *REGPO*. Country-sector specific fixed effects and common year dummies are included. Estimated model:

$$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s REGPO_{ijt-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$$

REG stands for *REGNO* in column 1 and for *BEVI* in column 2. *REGPO* is included in both columns. **5% significance level. *10% significance level.

Table 3: Regulation, Investment and Country or Country/Sector Specific Controls

	REGOL	REGNO	BEVI	REGPO
PART I				
$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s (Y/K)_{it-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0084**	-0.006**	-0.0066**	-0.0067**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.0003	0.003	0.0003	0.0023
Long-run coefficient = $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	0.029	0.034	0.035	0.029
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.45	0.39	0.37	0.47
$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s (RIRL)_{it-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0089**	-0.0066**	-0.0071**	-0.0067**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.00005	0.0006	0.0001	0.001
Long-run coefficient = $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	-0.105	-0.115	-0.118	-0.09
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.18	0.16	0.14	0.27
$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s (G/Y)_{it-s} + \sum_{s=1}^{2} \lambda_s (T/Y)_{it-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0091**	-0.0062**	-0.0067**	-0.009**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.001	0.003	0.0003	0.048
Long-run coefficient = $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	-0.057	-0.056	-0.06	-0.034
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.31	0.35	0.30	0.57
Long-run coefficient = $(\lambda_1+\lambda_2)/(1-\alpha_1-\alpha_2)$	-0.061	-0.075	-0.079	-0.028
Pvalue test on H_0: $(\lambda_1+\lambda_2)/(1-\alpha_1-\alpha_2) = 0$	0.25	0.21	0.24	0.16
$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s (CORPOR)_{it-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0076**	-0.0053**	-0.006**	-0.006**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.0008	0.009	0.0011	0.003
Long-run coefficient = $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	-0.0077**	-0.0078**	-0.0073*	-0.01**
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.041	0.05	0.06	0.007
PART II				
$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s (RPI)_{ijt-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0082**	-0.0058**	-0.0064**	-0.0064**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.0002	0.0025	0.0004	0.0011
Long-run coefficient $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	0.0105	0.010	0.0096	0.015**
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.16	0.19	0.21	0.048
$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s (RW)_{ijt-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0064**	-0.0049**	-0.0056**	-0.0048**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.0009	0.006	0.0007	0.0032
Long-run coefficient = $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	-0.0004	-0.0013	-0.0033	0.001
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.96	0.87	0.69	0.91
$(I/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (I/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \sum_{s=1}^{2} \psi_s (Y/K)_{ijt-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.0059**	-0.003	-0.004*	-0.0052**
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.01	0.14	0.06	0.004
Long-run coefficient = $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2)$	0.32	0.34	0.31	0.36
Pvalue test on H_0: $(\psi_1+\psi_2)/(1-\alpha_1-\alpha_2) = 0$	0.0018	0.0023	0.006	0.0001
PART III				
$(Y/K)_{ijt} = \sum_{s=1}^{2} \alpha_s (Y/K)_{ijt-s} + \sum_{s=1}^{2} \beta_s REG_{ijt-s} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$				
Long-run coefficient = $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2)$	-0.013	-0.014*	-0.014**	-0.0073
Pvalue test on H_0: $(\beta_1+\beta_2)/(1-\alpha_1-\alpha_2) = 0$	0.16	0.097	0.046	0.35

Notes: Dependent variable I/K_{ijt} defined as investment divided by the capital stock of country *i*, sector *j*, year *t*. *REG* stands for one of the following: *REGOL*, *REGNO*, *BEVI*, *REGPO*. Additional country specific regressors added in PART I: Y/K= GDP to capital ratio of the business sector, RIRL= real long-term interest rate, G/Y= cyclically-adjusted ratio of government expenditure to GDP, T/Y= cyclically-adjusted ratio of tax revenue to GDP, CORPOR=degree of corporativism. Additional country/industry specific regressors added in PART II: RPI= real price of investment goods, RW= real wage, Y/K= value added-to-capital ratio. In PART III: Y/K= country/industry specific value added-to-capital ratio. Country-sector specific fixed effects and common year dummies are included. **5% significance level. *10% significance level.

Table 4: Regulation and Investment: Heterogeneity Across Countries and Sectors

	REGOL	**REGNO**	**BEVI**	**REGPO**
ϑ_2	-0.27**	-0.27**	-0.27**	-0.27**
	(-7.12)	(-7.02)	(-7.11)	(-7.14)
λ_2	-0.002**	-0.0016**	-0.0017**	-0.0014**
	(-3.63)	(-3.33)	(-3.76)	(-2.99)
Long-run coefficient = - (λ_2/ϑ_2)	-0.007**	-0.006**	-0.0062**	-0.0051**
Pvalue test on H_0: - (λ_2/ϑ_2) = 0	0.0002	0.0005	0.00013	0.00163

Notes: Estimated model:

$$\Delta(I/K)_{ijt} = \vartheta_1 \Delta(I/K)_{ijt-1} + \lambda_1 \Delta REG_{ijt-1} + \vartheta_2 (I/K)_{ijt-2} + \lambda_2 REG_{ijt-2} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$$

I/K_{ijt} defined as investment divided by the capital stock of country *i*, sector *j*, year *t*. *REG* stands for one of the following: *REGOL*, *REGNO*, *BEVI*, *REGPO*. ϑ_1, λ_1 differ across country-sectors. Country-sector specific fixed effects and common year dummies are included. t-statistics in parenthesis. **5% significance level. *10% significance level.

Table 5: Regulation and Investment: Nonlinearities

	REGOL	REGNO	BEVI	REGPO
PART I: Level and Square of Regulation				
ϑ_2	-0.25**	-0.24**	-0.24**	-0.23**
	(-7.30)	(-7.02)	(-7.08)	(-6.87)
REG	-0.007**	-0.0075**	-0.0064**	-0.0031**
	(-3.06)	(-3.07)	(-3.09)	(-1.96)
REG^2	0.0007**	0.0008**	0.0006**	0.0002
	(2.31)	(2.51)	(2.40)	(1.08)
PART II: Size of Change in Regulation				
ϑ_2	-0.24**	-0.23**	-0.23**	-0.23**
	(-6.70)	(-6.53)	(-6.61)	(-6.74)
*REG*LARGE*	-0.0021**	-0.0016**	-0.0018**	-0.0017**
	(-4.14)	(-3.63)	(-4.18)	(-3.73)
*REG*SMALL*	-0.0014	-0.0008	-0.001	-0.0005
	(-1.22)	(-0.84)	(-1.33)	(-0.32)
*Pvalue test on H_0: REG*LARGE= REG*SMALL*	0.47	0.32	0.26	0.36
*Long-run coefficient = - (REG*LARGE / ϑ_2)*	-0.009**	-0.007**	-0.008**	-0.007**
*Pvalue test on H_0: - (REG*LARGE / ϑ_2) = 0*	0.00004	0.0003	0.00007	0.0002
*Long-run coefficient = - (REG*SMALL / ϑ_2)*	-0.006	-0.003	-0.004	-0.002
*Pvalue test on H_0: - (REG*SMALL / ϑ_2) = 0*	0.21	0.39	0.17	0.74
PART III: Timing of Change in Regulation				
ϑ_2	-0.24**	-0.24**	-0.24**	-0.23**
	(-6.85)	(-6.68)	(-6.81)	(-6.84)
*REG*LATE*	-0.0003	-0.0003	-0.0004	0.0037
	(-0.20)	(-0.37)	(-0.62)	(1.66)
*REG*EARLY*	-0.0022**	-0.0019**	-0.002**	-0.0016**
	(-4.05)	(-3.62)	(-4.11)	(-3.37)
*Pvalue test on H_0: REG*LATE= REG*EARLY*	0.12	0.052	0.03	0.018
*Long-run coefficient = - (REG*LATE / ϑ_2)*	-0.0011	-0.0011	-0.0017	0.016
*Pvalue test on H_0: - (REG*LATE / ϑ_2) = 0*	0.84	0.71	0.53	0.101
*Long-run coefficient = - (REG*EARLY / ϑ_2)*	-0.009**	-0.008**	-0.008**	-0.007**
*Pvalue test on H_0: - (REG*EARLY / ϑ_2) = 0*	0.00004	0.0002	0.00004	0.0006

Notes:
Estimated model in PART I:

$$\Delta(I/K)_{ijt} = \vartheta_1\Delta(I/K)_{ijt-1} + \lambda_1\Delta REG_{ijt-1} + \vartheta_2(I/K)_{ijt-2} + \lambda_2 REG_{ijt-2} + \lambda_3 REG^2{}_{ijt-2} + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$$

Estimated model in PART II:

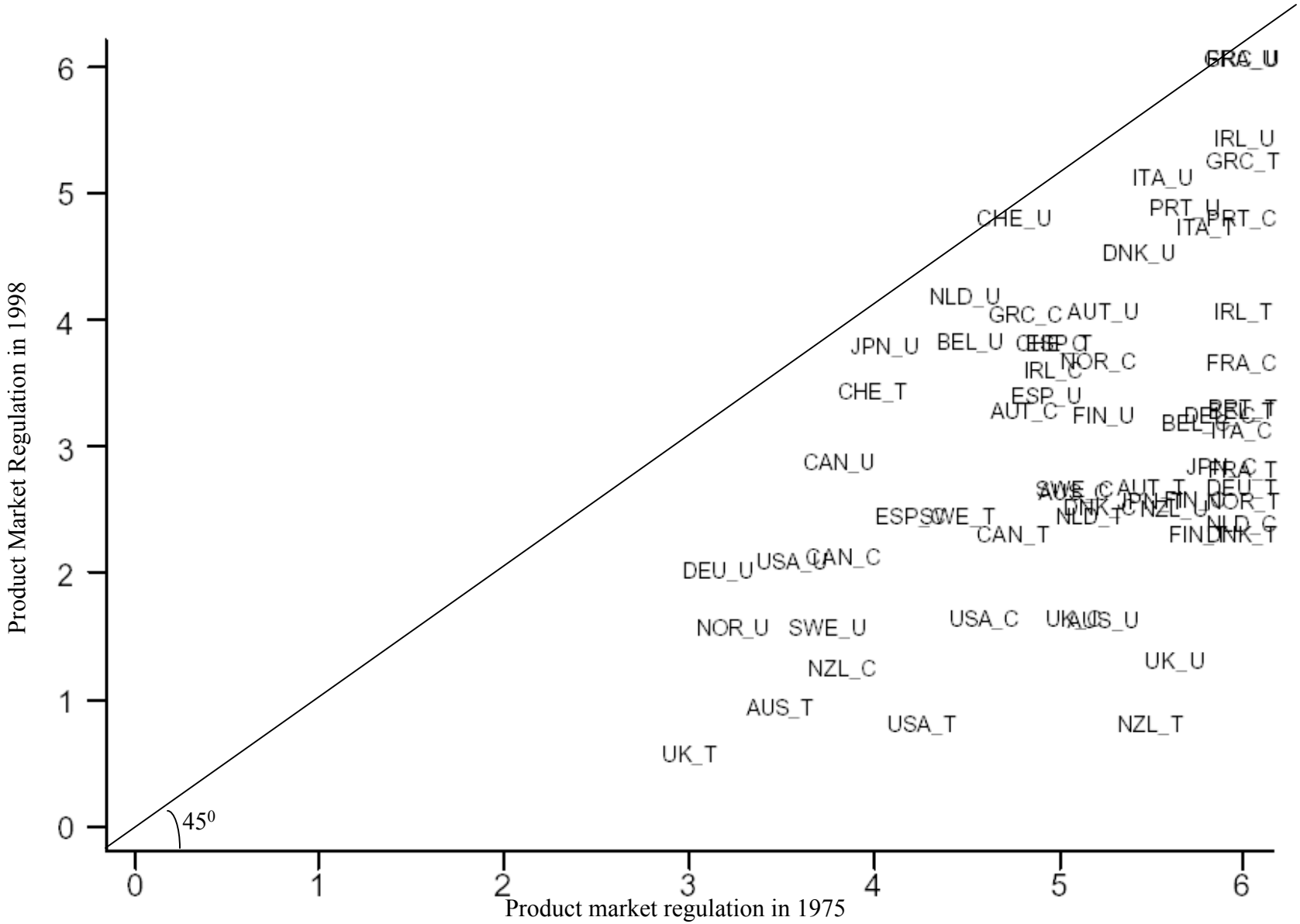
$$\Delta(I/K)_{ijt} = \vartheta_1\Delta(I/K)_{ijt-1} + \lambda_1\Delta REG_{ijt-1} + \vartheta_2(I/K)_{ijt-2} + \lambda^L{}_2 REG_{ijt-2}(LARGE) + \lambda^S{}_2 REG_{ijt-2}(SMALL) + \eta_0 LARGE + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$$

Estimated model in PART III:

$$\Delta(I/K)_{ijt} = \vartheta_1\Delta(I/K)_{ijt-1} + \lambda_1\Delta REG_{ijt-1} + \vartheta_2(I/K)_{ijt-2} + \lambda^{LA}{}_2 REG_{ijt-2}(LATE) + \lambda^{EA}{}_2 REG_{ijt-2}(EARLY) + \eta_0 LATE + \gamma_{ij} + \zeta_t + \varepsilon_{ijt}$$

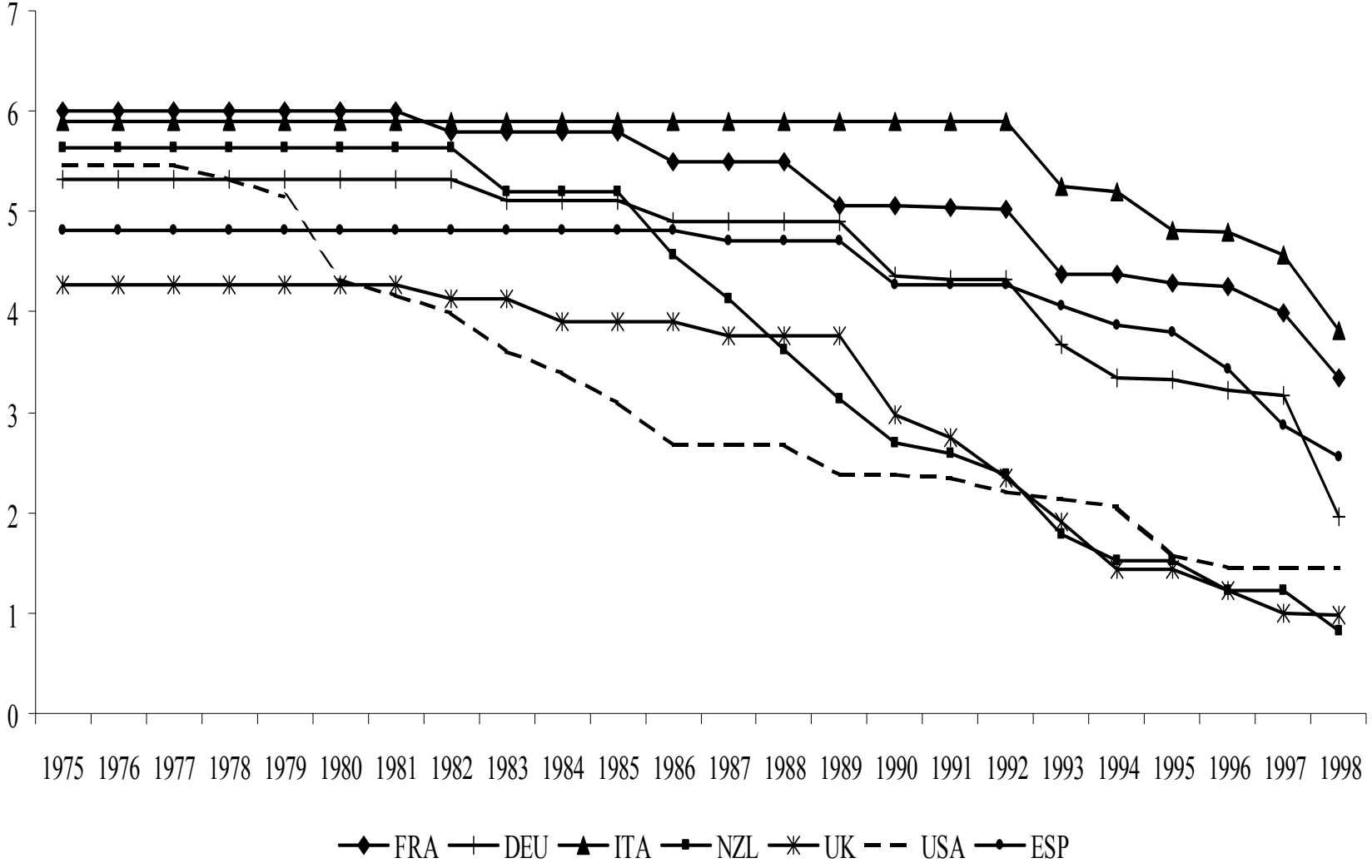
I/K_{ijt} defined as investment divided by the capital stock of country *i*, sector *j*, year *t*. *REG* stands for one of the following: *REGOL*, *REGNO*, *BEVI*, *REGPO*. *LARGE* (*SMALL*) is equal to one if the change in the overall regulation index between 1975 and 1998 is bigger (smaller) than the median change in the sample and zero otherwise. *LATE* (*EARLY*) is a dummy variable equal to one if the overall regulation index begun decreasing before (after) 1990 zero otherwise. Country-sector specific fixed effects and common year dummies are included. t-statistics in parenthesis. **5% significance level. *10% significance level.

Figure 1: Regulation 1975 - 1998



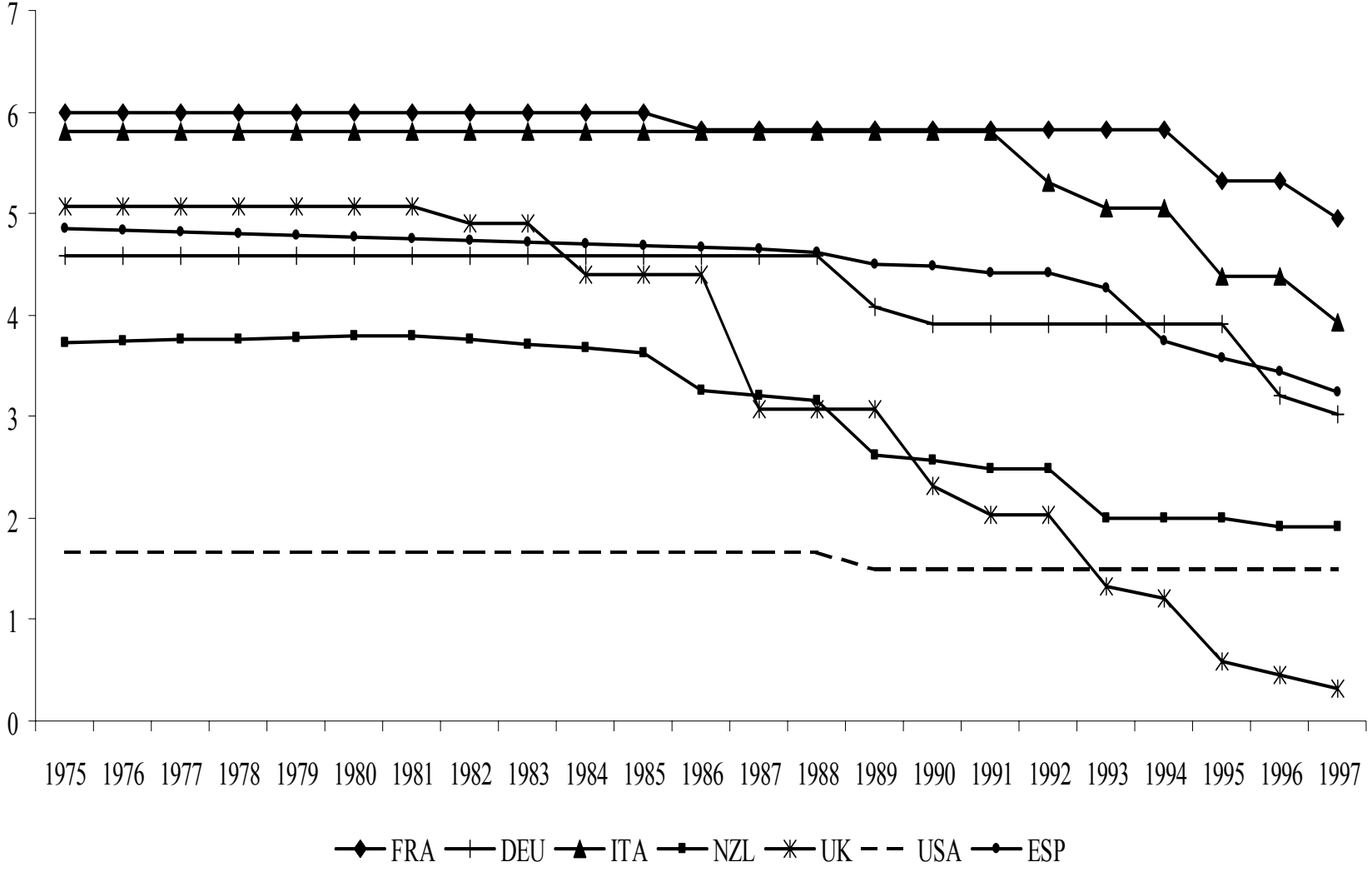
•Sectors: *(i)* utilities, *U*, including electricity, gas and water; *(ii)* communications, *C*, including communications and posts; *(iii)* transport, *T*, including transport and storage.
•Countries: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Switzerland (CHE), Germany (DEU), Denmark (DNK), Spain (ESP), Finland (FIN), France (FRA), United Kingdom (UK), Greece (GRC), Ireland (IRE), Italy (ITA), Japan (JPN), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Sweden (SWE), United States (USA), New Zealand (NZL).
•Regulation measured by the overall index *REGOL*.

Figure 2: Entry barriers in selected countries, 1975 - 1998



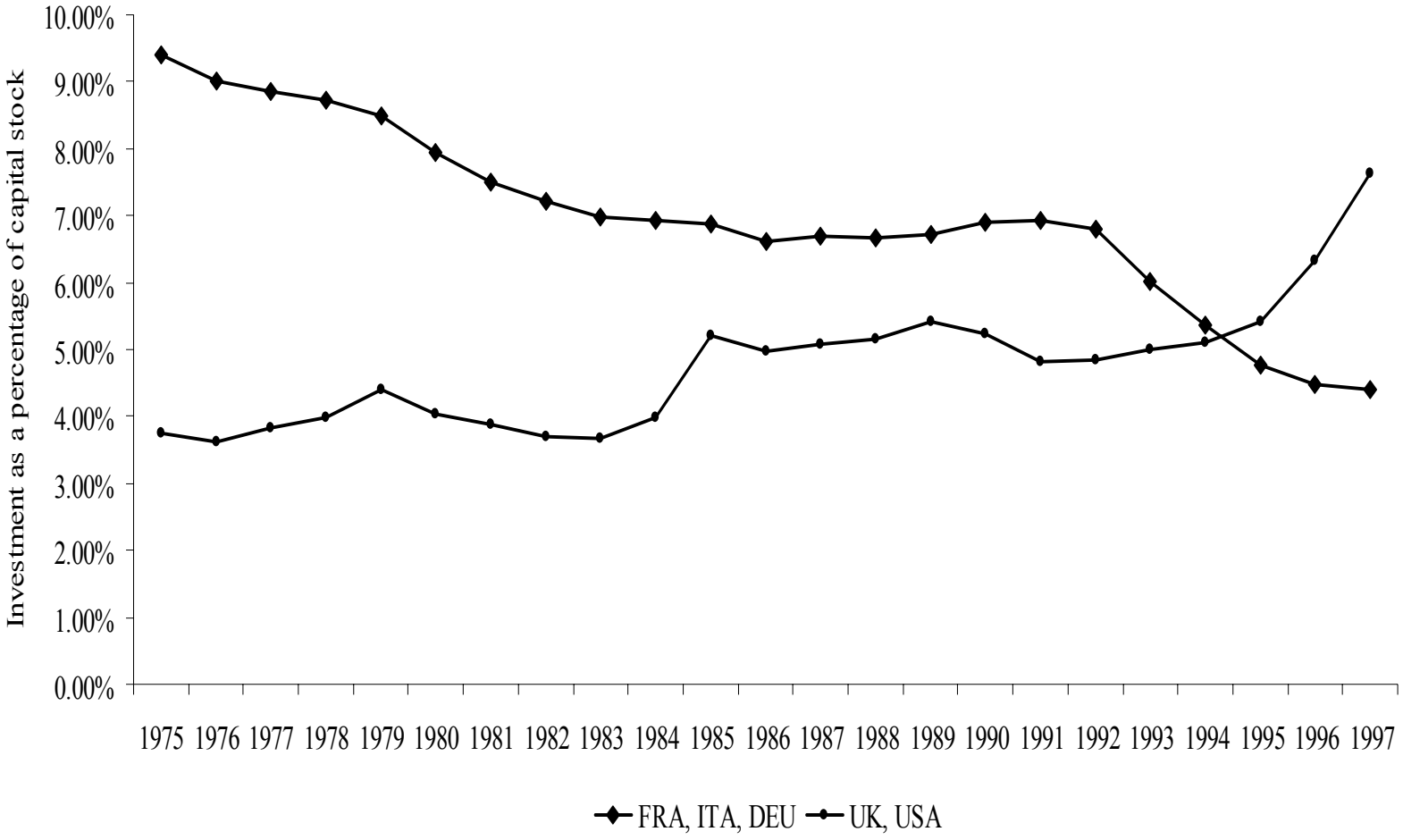
•Countries: Germany (DEU), Spain (ESP), France (FRA), United Kingdom (UK), Italy (ITA), United States (USA), New Zealand (NZL).
•Index of entry barriers measured by the indicator *BEVI*.

Figure 3: Public ownership in selected countries, 1975 - 1998



•Countries: Germany (DEU), Spain (ESP), France (FRA), United Kingdom (UK), Italy (ITA), United States (USA), New Zealand (NZL).
•Index of public ownership measured by the indicator *REGPO*.

Figure 4: Investment in selected countries, 1975 - 1998



•Countries: Germany (DEU), Spain (ESP), France (FRA), United Kingdom (UK), Italy (ITA), United States (USA), New Zealand (NZL).

APPENDIX: Construction of the overall index of regulation

TABLE A1

Sector	Item in indicator	Weights	Description	Weight	Coding
Electricity					
	Entry	*1/3*	Average of three indicators: existence and features of third party access (TPA), existence of a liberalised power market (PM), thresholds for free choice of supplier (FC).	*1/3* *1/3* *1/3*	TPA = Regulated:0, Negotiated:2, Single Buyer:4, or None:6. PM = Yes: 0, No = 6 FC = 0GW: 0, <251GW: 1, <501GW: 2, <1001GW: 3, ≥1001GW: 4, no choice: 6
	Vertical integration	*1/3*	Average of two indicators: vertical separation between generation and transmission (GTS); and overall vertical separation between generation, transmission, distribution and supply (OS)	*1/2* *1/2*	GTS = integrated: 6; accounting separation: 3; separate companies: 0 OS = integrated (incl. accounting separation): 6; some segments unbundled: 3; complete unbundling: 0
	Public ownership	*1/3*	Share of government in major companies		Private: 0; mostly private: 1.5; mixed: 3; mostly public: 4.5; public: 6
Gas manufacture and distribution					
	Entry	*1/4*	Average of indicators of degree of entry regulation in gas production (P), transportation (T) and distribution (D)	*1/3*	In each industry segment = regulated: 6; partly regulated: 3; unregulated: 0
	Vertical integration	*1/4*	Degree of separation between competitive and non-competitive activities		Full separation between P, T and D: 0; full separation between P and T/D: 1.5; some separation between P and T/D: 3; some separation between T and D: 4.5; no separation: 6
	Public ownership	*1/4*	Share of government in major companies		Public owned: 6; mixed private/public: 3; private: 0
	Market structure	*1/4*	Market share of dominant operator		No dominant market player: 0; one participant has more than 50% market share in relevant market, or many local de facto monopolies: 3; one participant has more than 90% market share: 6
Railways					
	Entry	*1/4*	Average of legal barriers to entry in passenger and freight businesses	*1/2*	Legal monopoly or compliance with EC directive: 6; Regulated entry or open tendering franchise: 3; Free entry: 0

	Vertical integration	*1/4*	Degree of separation between competitive and non-competitive activities		Fully separated: 0; Full separation anticipated but not fully undertaken yet: 1.5; Legal separation: 3; Accounting separation: 4.5; Fully integrated: 6
	Public ownership	*1/4*	Share of government in major companies		Public owned: 6; mixed private/public: 3; private: 0
	Market structure	*1/4*	Market share of dominant operator		No dominant market player: 0; one participant has more than 50% market share in relevant market, or many local de facto monopolies: 3; one participant has more than 90% market share: 6
Road freight [1]					
	Entry	*1/2*	Legal barriers to entry		Free entry: 0; partially liberalised: 3; regulated entry (restrictive licensing): 6
	Prices	*1/2*	Extent of price regulation		No regulation: 0; guidelines given to companies: 3; regulated: 6
Air transport [2]					
	Entry	*1/2*	Average of indicators for entry in domestic routes (DR) and international routes (IR)	*Share of international traffic in total*	DR = Domestic market liberalised: 0; domestic market not liberalised: 6 IR = No regional aviation market , no open sky agreement: 6; regional aviation market, no open sky agreement: 3; no regional aviation market, open sky agreement: 3; regional aviation market and open sky agreement: 0
	Public ownership	*1/2*	Percent share of government in major airline (SH)		6*SH/100
Post					
	Entry	*1/2*	Average of indicators of degree of entry regulation in basic letter, basic parcel and courier services	*Revenue shares of the three activities in 1999*	In each activity = regulated: 6; partly regulated: 3; unregulated: 0
	Public ownership	*1/2*	Average of indicators of degree of public ownership in basic letter, basic parcel and courier services		In each activity = public owned: 6; mixed private/public: 3; private: 0
Telecommunications [3]					
	Entry	*1/3*	Average of indicators of entry restrictions in trunk, international and mobile communications	*Revenue shares of the three*	In each activity = legal monopoly: 6; legal duopoly: 3; free entry: 0

	Market structure	*1/3*	Average of indicators of market structure in trunk, international and mobile communications	*activities in 1999*	In each activity = 6*(1-market share of new entrants)
	Public ownership	*1/3*	Percent share of government in incumbent operator (SH)		6*SH/100

Notes:

1. Indicator value in 1998 based on more detailed assessment of entry and pricing regulations, and weights based on factor analysis. For details, see O. Boylaud and G. Nicoletti (2000) "Regulatory reform in road freight and retail distribution", OECD Economics Department Working Paper, No. 255. Less detail available for the 1975-1997 period.
2. For more details, see R. Gonenc and G. Nicoletti (2000) "Regulation, market structure and performance in air passenger transportation", OECD Economics Department Working Paper, No. 254.
3. For more details, see O. Boylaud and G. Nicoletti (2000) "Regulation, market structure and performance in telecommunications", OECD Economics Department Working Paper, No. 237.