*Oxford Economic Papers* 49 (1997), 291–306

# FIRM RESTRUCTURING AND THE OPTIMAL SPEED OF TRADE REFORM

*By* PHILIPPE BACCHETTA* *and* HARRIS DELLAS†

* *Studienzentrum Gerzensee, CH-3115 Gerzensee, Switzerland, Université de Lausanne, and CEPR, London,* † *Catholic University of Louvain*

We study the consequences and optimality of alternative speeds of trade liberalization when investment (restructuring) activities help firms learn their true level of efficiency and determine survival prospects. In contrast to the existing literature, we find that a gradual trade reform might be preferred when authorities are more preoccupied with the longer term. We also show that costs of business closures have an ambiguous impact on the optimal pace of liberalization.

## 1. Introduction

THE LAST few years have witnessed the vigorous and widespread application of policies of economic liberalization in a large and diverse group of countries. This is particularly true for trade policies. For example, the new consensus on the benefits of trade openness and export oriented growth has led many developing countries to start a process of trade liberalization. The political changes in former socialist countries have created the possibility of a wide variety of economic reforms. While new questions are continually asked, the optimal choice of the speed of liberalization remains the critical practical concern.

Broadly speaking, one can classify the existing literature dealing with the speed of economic reform into two categories.[1] The first strand of the literature contains models which emphasize the role of economic distortions in the determination of the optimal speed. The popular belief within this category is that precipitous liberalization is optimal in the absence of economic frictions (distortions), while in their presence, the optimal speed depends on the type of friction. If frictions take the form of adjustment costs (Leamer, 1980; Mussa, 1982) then a low speed may be preferable. If there are costs to moving too slowly (Bruno, 1988), fast reforms may fare better (see also Dellas and De Vries, 1995).

The second—and comparatively younger—category stresses the role of political considerations in the determination of the pace of reform in general. Lipton and Sachs (1990) attribute the precipitous measures taken in Poland to fears connected to the danger of credibility loss and resurgent bureaucracy.

[1] There is another related strand which deals with the sequencing of liberalizations of various sectors of the economy such as the current account, the capital account, financial markets, the labor market, etc. (see for example Edwards, 1989, 1992; McKinnon, 1991; or Funke, 1993). It is often argued in that literature that a trade liberalization should precede other reforms but there is no discussion of the speed of the reform *per se*.

Dewatripont and Roland (1992, 1995) argue in favor of gradualism in a model that explicitly incorporates political constraints.

The general message emerging from the literature is that gradualism is desirable when short-term considerations are important. On the other hand, long-term efficiency would recommend a precipitous reform. In this paper we would like to challenge this view. We show that gradualism might be superior when longer-term considerations are more important. Moreover, we show that high short term restructuring costs might justify a 'big bang' reform.

Most models examining the speed of reform miss an important aspect, namely, that agents usually face a significantly different environment as a result of economic reform. Adaptation to the new conditions may require the restructuring of operations, the improvement of productivity and so on. Typically, some firms survive this experience while others do not. A fundamental issue then concerns the process by which the firms learn how well suited they are for operating in the transformed economy and whether they have made the right choice of activities.

The uncertainty that accompanies liberalization can be resolved either in a gradual or in a precipitous manner. Alternative reform paces may be associated with differences in the speed, accuracy, and cost of learning about the new environment. Thus, different speeds of reforms in general have different revealing properties for economic agents. We believe that the revelation properties of different speeds represent a critical aspect of any substantial reform. If the properties of the learning process affect the overall feasibility as well as the cost of the reform, then it is useful to try to spell out the interactions between the optimal speed of reform and learning.

Of all the possible sources of uncertainty that might arise in a liberalization process, we select to study one that looks at the performance of the private sector.[2] We start with the plausible assumption that firms are heterogeneous. They come in different types, each type being associated with different relative talents. In a sheltered environment, it is quite conceivable that firms have neither the opportunity nor the incentive to attempt to learn their true level of competitiveness. Subsequently, when trade is liberalized, a firm may not know how successful it will prove in its particular line of business or what kind of activity represents its comparative advantage. If performance depends on firm

[2] The relationship between gradualism and learning has also been studied in papers on economic stabilization which, however, emphasize different sources of uncertainty. For example, in Bertocchi and Spagat (1992) the policymaker is uncertain about the expectations formation mechanism of the private sector, while in Bertocchi and Spagat (1997), he is uncertain about the structural parameters of the economy. In the latter paper, the speed of learning is determined uniquely by the speed of liberalization; in our paper, the relationship between these two speeds is ambiguous, depending also on firm restructuring activities. In Cukierman and Liviatan (1992), there exist different types of policymakers and the public learns about which type they face. On the other hand, Fernandez and Rodrik (1991) examine the role of individual uncertainty in trade reform but do not focus on the pace of liberalization. Finally, Dewatripont and Roland (1992) study the role of individual uncertainty which is private information, while Dewatripont and Roland (1995) include aggregate reform uncertainty.

type, and there is a relationship between luck and effort and between effort and firm type, then a firm may be able to learn—at least partially—about its ability to compete by making the appropriate investments (effort). For instance, an incumbent sheltered firm can find out about its prospects for survival in the new environment by undertaking some restructuring activities. In general, restructuring (investment) accomplishes two things. First it contributes positively to the profitability of those firms that have made the right choice (they have chosen an activity that matches their strengths). And second, by making it easier for the firm to discover its type,[3] it serves as a fitness revelation mechanism and improves the long-term allocation of resources.

In this paper we assume that the more extensive the restructuring activities, the greater the informational value of observed performance for evaluating competitiveness. The resolution of uncertainty may not in general be perfect (at least in the medium run) because performance also contains elements of chance. Subsequently, some firms may fail (not fail) even if they restructure simply because of bad (good) luck.

We examine how the speed of liberalization affects the incentives to, as well as the degree of, restructuring. We then trace the repercussions for profitability as well as the accuracy of type revelation. The latter issue is important because of the implications of revelation for the long-term decisions of the firms. Limited restructuring activities coupled with bad luck may cause many would-be efficient firms to mistakenly conclude that they do not have good long term prospects and exit (similarly, inefficient firms may decide to prolong their stay). The speed of reform can affect the quality of learning through its effects on the amount of restructuring.

In this framework, gradualism has attractive properties as it is more revealing than precipitousness. This new informational angle generates a number of interesting results concerning the pace of reform, some of which are at variance with the conventional wisdom in the area. We show that even in the absence of specific market frictions—such as credit market imperfections—there is no presumption that a big bang approach is optimal. Moreover, the informational dimension of reform may make gradualism optimal in situations in which the government looks beyond the short term as far as allocation of resources is concerned. Gradualism's superior longer term performance is due to the fact that it supports higher firm profits in the early stages of reform. Higher profits make investment in restructuring (and hence revelation) more affordable.

Our analysis offers new insights on the optimal speed of reform when the government is concerned about the short run implications of firm closures independent of firm type (for well known reasons, such as the increase in the

[3] In situations without restructuring where learning would be completely passive, it might be possible for a fast speed of reform to be associated with faster learning (see Bertocchi and Spagat, 1997).

rate of unemployment).[4] It turns out that gradualism is not necessarily associated with a lower rate of business closures. This is because the commonly held belief, that firm closures are fewer the less draconian the measures (i.e. under a gradualistic program), may not be true when the firms are engaging in self-selection. The speed of liberalization and the short-term rate of firm failures can be negatively correlated when the proportion of competitive (efficient) firms in the industry is small. This is because restructuring activities and revelation are smaller with precipitousness (as expected profits are smaller), which makes many inefficient firms prolong their stay in business. However, a presumption of a positive relationship still remains.

The next section presents the model where firms learn their abilities by restructuring. We examine the optimal reaction of firms to a gradual and to a precipitous trade liberalization. In Section 3, we analyze the optimal speed of trade reform for a government maximizing welfare. Section 4 offers some concluding comments.

## 2. The model

### 2.1. *General framework*

We use a two-period model to examine the liberalization of a domestic sector protected from foreign competition. Initially, the firms enjoy commercial protection via a combination of subsidies and trade barriers (our analysis can easily accommodate other forms of protection). Imports pay an *ad valorem* tariff $t$ that drives a wedge between world prices, $p^*$, and domestic prices, $p$ ($p = p^*(1 + t)$). We define a gradual liberalization to be the policy that eliminates the subsidies during the first period and the tariff during the second.[5] A precipitous one involves the simultaneous removal of both protective measures in the first period.

The sector consists of a continuum of firms, each one associated with a real number in the interval (0, 1) (one can alternatively assume the existence of a countable number of firms). Before the liberalization, existing firms in this sector are assumed to behave similarly and also to be less efficient than foreign firms. To become more competitive, domestic firms will need to

[4] Aghion and Blanchard (1994) argue that a fast speed of liberalization may prove detrimental in the long run because of its undesirable effects on unemployment. They argue in favor of a program of job creation before the implementation of liberalization.

[5] There exist alternative ways for dealing with the speed of liberalization. One involves a single policy variable (or instance, either taxes or subsidies) and whose level is adjusted either precipitously or gradually. Our results are robust to such modeling. Another one could define gradual liberalization to involve first the removal of the tariff and later the removal of the subsidies. Under some structures of subsidies, our main results would survive. With lump-sum subsidies, however, a tariff-first reform has a different impact on firms: the tariff affects positively production, while the lump-sum subsidy in general does not. Consequently, while our analysis focuses on the speed of reform its implications regarding the sequencing depend on the form of the subsidy.

restructure.[6] For simplicity, we assume that restructuring takes place only during the first period (allowing it to continue in the second period does not affect the results in any significant way).

Let the population of firms consist of two types, high and low, and assume that high type firms have an absolute advantage in this sector (they are efficient) while no type has an absolute advantage in the other sectors.[7] Let the share of the high types in the population be known and equal to $m$.

The type of a firm is initially unknown and can only be revealed through restructuring activities.[8] Moreover, revelation is assumed to be only partial as firms infer their type from a random output. When restructuring does not take place, then there is no information regarding type. If $x$ represents the degree of restructuring in the first period, then firm output in both periods is assumed to be given by

$$\begin{bmatrix} y_H = \mu_H + F(x) & \text{for the high type} \\ y_L = \mu_L & \text{for the low type} \end{bmatrix} \tag{1}$$

where $F(x)$ is increasing and concave and $F(0) = 0$. Thus we consider the case where restructuring benefits only the high type.[9] The level of output of a single firm, $y_i$, $i = H, L$ is observable, but $\mu_H$ and $\mu_L$ are unobservable random variables distributed over exactly the same domain, with the same mean $\mu$. Each firm is randomly assigned a draw from the $\mu_H$ distribution if it is a high type and from the $\mu_L$ distribution if it is a low type. The firm, having observed a level of output $y$, must draw an inference about its true type based on its knowledge of the probability distribution of the $\mu$'s,[10] and decide whether to continue production in this sector.

The cost of production is assumed to be $c(x) + B$, where $c(x)$ is the cost of restructuring and $B$ is a constant measuring payments to other factors of production (assumed constant in the analysis). We will require that $\mu < B/p_1$ which implies that all firms have negative expected profits with no restructuring. Obviously, expected profits are negative for the low type independent of the pace of liberalization and the degree of restructuring. Consequently, if a firm

[6] A natural question arises as to why the firms do not carry out the restructuring before the liberalization. A simple story would involve a subsidy that guaranteed firms a certain level of profits independent of the degree of restructuring. Such guaranteed profits together with a small, non-recoverable—through the subsidy—personal cost of restructuring to the managers of the firm would suffice to avert it. If the personal cost takes the form of a fixed number then it can be left out in the analysis of restructuring under liberalization without any consequences.

[7] We can alternatively define types in terms of comparative advantage and assign absolute advantage to one type in all activities (see Dellas, 1992).

[8] It is possible that different restructuring activities contribute differently to type revelation and productivity. And also that revelation can occur through activities other than restructuring. Such possibilities add a portfolio choice dimension but do not affect the spirit of the analysis.

[9] This particular specification is adopted so that the properties of the misclassification function can be easily analyzed. See the Appendix for a more general discussion.

[10] In this model, the firm must infer its type from only one observation of output (in the first period). It is trivial to allow for multiple observations as the basis of inference (see Dellas, 1992, for an application).

knew with certainty that it was of the low type it would find it optimal to exit. The appropriate choice of parameter values can guarantee the existence of a range of restructuring activities over which the expected profits of the high types are positive.

In general, due to an unfavorable output level, some of the high type firms that operated during the first period may end up assigning to themselves a high probability of being a low type and exiting in the second period. Similarly, some low types which were active in the first period may decide to continue producing in the second period. Let $q_H(x)$ be the probability that a high firm stops producing and $q_L(x)$ the probability that a low firm continues producing after observing performance in the first period. Consequently, $(1 - q_H)m$ high types correctly infer their type and remain in business, while $q_H m$ mistakenly perceive themselves as the low type and exit. Similarly, $q_L(1 - m)$ low type firms erroneously decide to stay while the remaining $(1 - q_L)(1 - m)$ exit. In the second period, proportions $q_H$ and $(1 - q_L)$ of the remaining high and low type firms close down.

Misclassification has two negative effects. On the one hand, the economy cannot exploit all its efficiency gains from production since some high type firms stop producing. On the other hand, the economy is wasting resources as some low type firms stay in business. Thus, a reduction in the probabilities of misclassification, $q_H$ and $q_L$, is highly desirable. An important issue is how the degree of restructuring affects the misclassification error. This issue is discussed in detail in the Appendix. It is shown that restructuring reduces at least one type of these errors and possibly both of them.

### 2.2. *Optimal restructuring under perfect capital markets*

Consider the decision problem of a firm on the eve of a liberalization attempt. The firm starts with a prior belief of type and decides whether it will undertake some restructuring activities in order to remain in business. If it does, then it draws an amount of output from the perspective probability distribution (eqs (1)). Upon observing its output level it updates its prior and then decides whether it will continue producing in the second period or not. In the first period, a firm faces the following lifetime expected profits

$$E_1\pi = \max_x\{[E_1\pi_1 + \max\{\delta E_1\pi_2, 0\}], 0\} \tag{2}$$

where $\pi$ is profits, $E_1$ is the expectation before restructuring and $\delta$ is the firm's private discount factor. $E_1\pi_1$ and $E_1\pi_2$ are profits conditional on staying in business during periods 1 and 2 respectively and are given by

$$E_1\pi_1 = p_1\{\theta_{H1}[\mu + F(x)] + (1 - \theta_{H1})\mu\} - [c(x) + B]$$

$$E_1\pi_2 = p^*E_1\{\theta_{H2}[\mu + F(x)] + (1 - \theta_{H2})\mu\} - B$$

where $\theta_{H1}$ is the firm's prior belief (before restructuring) and $\theta_{H2}$ is its posterior belief (after having observed output in the first period) of being the high type.

$p_1$ is the price in the first period and $p^*$ is the price faced in the second period. If $p_1$ is the domestic price under a tariff, i.e. $p_1 = (1 + t)p^*$, then eq. (2) represents expected profits under gradualism. Setting $p_1 = p^*$ in (2) gives expected profits under a precipitous reform.

A firm[11] restructures if $\max(E_1\pi_1) + \max\{\delta E_1\pi_2, 0\} > 0$. A firm stays in business during the second period if $E_2\pi_2 > 0$, that is, if $\{\theta_{H2}[\mu + F(x)] + (1 - \theta_{H2})\mu\} > B/p^*$. The Appendix presents in detail the determination of the exit decision.

Let us assume agnostic firms, that is, $\theta_{H1} = m$. The expected profits of a firm that undertakes an amount of restructuring equal to $x$ is then[12]

$$\begin{aligned} E_1\pi = E_1\pi_1 + \delta E_1\pi_2 = {} & p_1[m(\mu + F(x)) + (1 - m)\mu] - [c(x) + B] \\ & + \delta\{p^*[m(1 - q_H(x))(\mu + F(x)) + (1 - m)q_L(x)\mu] \\ & - [m(1 - q_H(x)) + (1 - m)q_L(x)]B\} \end{aligned} \tag{3}$$

The term multiplied by $\delta$ in (3) gives expected profits in the second period. Only the high types who correctly infer their type ($m(1 - q_H(x))$) make profits. The total number of firms operating in the second period is $m(1 - q_H(x)) + (1 - m)q_L(x)$. Notice that the cost of restructuring is only borne in the first period. Benefits from restructuring, on the other hand, are also obtained in the second period as greater restructuring implies a higher return for high type firms and may also lead to lower misclassification errors.

The optimal degree of restructuring is determined by setting the derivative of (3) with regard to $x$ equal to zero. This gives the following condition

$$\begin{aligned} dE_1\pi/dx = {} & dE_1\pi_1/dx + \delta dE_1\pi_2/dx \\ = {} & \{p_1 mF'(x) - c'(x)\} + \delta\{p^* m[1 - q_H(x)]F'(x) \\ & - m[p^*(\mu + F(x)) - B]q_H'(x) + (1 - m)[p^*\mu - B]q_L'(x)\} = 0 \end{aligned} \tag{4}$$

where $'$ denotes the first derivative. The various effects of an increase in $x$ can be seen through the terms of (4). First, profits of the high type firm in the second period increase. Second, foregone profits of a misclassified high type firm decrease if $q_H' < 0$ (note that $p^*(\mu + F) - B > 0$, otherwise the high types would be unprofitable too). The losses of a misclassified low type firm decrease if $q_L' < 0$ (in the Appendix we present sufficient conditions under which

[11] Remember that firms are similar *ex ante*. Firms could also be heterogeneous initially and the entry decision as well as the degree of restructuring could differ across firms. The simplest way of accomplishing this involves postulating that the firms differ regarding their prior beliefs of their type. Optimist firms would then be more likely to both enter and restructure extensively than pessimist firms.

[12] Note that (3) requires that the sector as a whole cannot find itself in a corner solution in the second period (that is, with either all of the firms staying or exiting). This requirement is easily fulfilled by having each individual firm associated with a different draw from the perspective p.d.f. and making the space of output outcomes suitably span the space of firms. Then there exist firms for which $\theta_{H2}$ approaches zero and firms for which $\theta_{H2}$ approaches unity. As far as the first period is concerned, the suitable choice of parameter values can always guarantee an interior solution for $x$.

restructuring leads to lower misclassification for either one or both types). For the remainder of the analysis it will be assumed that $q'_H(x)$ and $q'_L(x)$ are indeed negative.

Clearly if the expected gains from restructuring are smaller than the expected costs for any $x > 0$, firms will exit the sector before period 1. For instance, this could be the case if the fraction of low types in the population were very large. Nonetheless, the appropriate choice of parameter values can guarantee that $E_1\pi > 0$ for a subset of $x > 0$. The second order condition is $\Omega = p_1 mF'' - c'' - 2\delta p^* mF' q'_H - \delta m[p^*(\mu + F) - B]q''_H + \delta(1 - m)[p^*\mu - B]q''_L$, where $''$ denotes the second derivative. A sufficient condition for an interior maximum is that $E_1\pi > 0$ for some $x > 0$ and that $\Omega < 0$. The latter is satisfied if the production function is concave and both the cost function and the functions giving the probability of misclassification are convex. Assuming that perfect revelation can never be attained no matter how much restructuring is undertaken is sufficient to guarantee the convexity of the latter functions (when $q'_H(x)$ and $q'_L(x)$ are negative). From now on, we assume that there exists a positive level of restructuring that maximizes profits and therefore that (4) holds.

To compare the level of restructuring across the precipitous and gradualistic cases we only need to totally differentiate (4). Given that the second order conditions for a maximum are satisfied, it is straightforward to show that $dx/dp_1 > 0$, which implies that restructuring is higher under gradualism. Profits in each period are also higher. The reason for this is that output prices are higher in the first period under gradualism (relative to precipitousness).

If $q'_H$ and $q'_L$ are negative then restructuring has two effects regarding the waste of resources. First, it lowers the type misclassification error and hence leads to a more efficient long term allocation of resources. At the same time, it involves a useless investment on the part of the firms that will prove to be non-competitive. Consequently, short and long term consideration will tend to pull in opposite directions regarding the evaluation of the properties of alternative paces of reform.[13]

We have implicitly assumed that firms had all the funds necessary to restructure and continue producing as long as their expected profits were positive. However, a serious problem faced by restructuring firms in reforming economies is that the availability of external—to the firm—credit is limited. Hence firms that cannot make an operating profit may be forced out of business even when they would be profitable in the long run. The analysis of how the presence of borrowing constraints affects the incentive to restructure can be easily carried out. It can be shown that the optimal level of restructuring is lower under either pace of liberalization.

[13] A qualification is in order here. Our two period setup draws too sharp a distinction between the short and the long run. With an infinite horizon, the low types will eventually discover their type and exit. So they are misclassified in the medium rather than the long term. There are long term implications for the high types, though, who misclassify themselves and exit after the first period.

## 3. The optimal path of liberalization

Gradualism was shown to have some desirable features. For instance it produces a more efficient long-run allocation of resources; it reduces the number of banruptcies of efficient firms, etc. Nevertheless, the model presented above is a partial equilibrium one as it only analyzes the production side of a particular sector. The effects of the tariff that remains in existence under gradualism, however, are not limited to producers. To be able to evaluate the overall consequences of reform, it is necessary to examine the impact on other agents: consumers and the government.[14] Instead of representing consumption and government revenues explicitly, we use the function $\zeta(t)$ to represent the aggregate cost of a tariff $t \geqslant 0$. Most trade models would imply that this function is positive and increasing: while a tariff represents a government revenue, it is more than offset by the loss in consumer surplus. Moreover, we assume that with no distortion in the economy the cost $\zeta$ of the tariff is higher than the benefit to firms, i.e. $\zeta'(t) > d\pi_1/dt$ at $t = 0$. This simply reflects the view that in a small economy with no distortion the optimal tariff is zero.

The optimal path of liberalization depends on the structure of the economy and on the objective function of the social planner.

### 3.1. *Perfect capital markets*

Assume that the social welfare function $W$ is simply equal to aggregate firm profits minus the aggregate cost of the tariff. Given that there is a large number of firms, aggregate profits are equal to expected profits (by the law of large numbers). Thus

$$W = E_1\pi_1 + \beta E_1\pi_2 - \zeta(t) \tag{5}$$

where $0 < \beta \leqslant 1$ is a social discount factor. Recall that the private discount factor is equal to $\delta$. $\beta$ is greater (smaller) than $\delta$ if the policymakers value the long term more (less) than the private sector.

The optimal path of liberalization is simply given by the level of tariff in the first period, $t$, which maximizes $W$. If $t = 0$, a precipitous liberalization is preferred. If $t > 0$, a gradual liberalization is superior. In this case, the optimal level of the tariff can also be determined. The optimal $t$ is given by the first order condition of (3) with respect to $t$

$$dW/dt = dE_1\pi_1/dt - \zeta'(t) + (dE_1\pi_1/dx + \beta dE_1\pi_2/dx)\, dx/dt \leqslant 0 \tag{6}$$

A tariff has three effects: a positive direct effect on $\pi_1$ through an increase in $p_1$; an increase in the cost $\zeta$; and an indirect effect through the amount of restructuring, $x$. As mentioned above, the sum of the first two terms is

[14] We assume that the sector is small and ignore the other sectors of the economy. A more general equilibrium analysis with a multi-sector economy is of considerable interest, but is left for future research.

negative (by assumption). Thus, to have an interior solution to (6) with $t > 0$ the last term must be positive. When $\beta = \delta$, however, the last term is equal to zero (from (4), and the envelope theorem). In this case, we are at a corner solution and $t = 0$, which means that a precipitous liberalization is optimal. Hence, the type revealing properties of gradualism are not sufficient *per se* to justify a gradual liberalization as they are offset by the efficiency cost of protection.

When $\beta$ is larger than $\delta$, the last term in (6) becomes positive ($d\pi_2/dx > 0$) and can offset the first two terms. This means that when the long term (i.e. second period) allocation is given more weight by the government than by the private sector, a gradual liberalization might be preferred. This is an interesting result because according to conventional wisdom, the greater the emphasis on long-term welfare at the expense of short-term, the faster the optimal rate of liberalization ought to be.

Is there any compelling justification for the discrepancy between the social and private discount factors? This is an issue that has received a great deal of attention in the literature. Broadly speaking, such a possibility arises in the presence of intertemporal externalities. In our case, such externalities might arise from wanting to have only the right type of firms operating in the long run (that is, long-term efficiency could be made an argument in the social welfare function, perhaps of long-term growth externalities). A more mundane reason could be the existence of distortionary taxation of investment income. Note, however, that the adoption of a political economy approach in which the social discount factor is derived endogenously in a political equilibrium would make it harder to generate a discrepancy between the social and private discount factors.

Finally, it can be shown that under imperfect capital markets gradualism is more likely to be optimal when the proportion of high type firms ($m$) is large and when restructuring has strong revealing properties. The reason is that gradualism increases firms' cash flows, allowing the good firms to carry on.

### 3.2. *Social costs of business closure*

A business closure may involve costs other than those internalized by the closing firm (a typical example is the payment of unemployment benefits by the state when the workers are not relocated immediately to other jobs).[15] For simplicity, let us assume that the social cost of a firm closure is linear and equal to $e$. In our model, a firm may shut down during one of three possible instances: just before the liberalization; at the end of the first period; and at the end of the second period. Let us denote by $n_0$, $n_1$, and $n_2$ the number of firms (as a share of the total number of firms) that shut down during these three instances. There are two possible cases: if expected profits are negative ($E_1\pi < 0$),

[15] Dewatripont and Roland (1992) examine the impact of these costs in a two-period model of reform with asymmetric information between firms and the government.

then $n_0 = 1$ and $n_1 = n_2 = 0$, i.e. all firms leave the sector before the liberalization. In this case, the authorities could contemplate imposing some minimum tariff $t^*$ such that $E_1\pi(t^*) = 0$. It is easy to see that it will be optimal to temporarily protect an inefficient sector via a gradualistic pace when $e > \zeta(t^*)$, that is, when the social costs of business closure are high compared to the cost of a tariff. This is the case where the authorities temporarily protect a sector that might not be viable in the long run.

If expected profits are positive ($E_1\pi \geqslant 0$) then $n_0 = 0$, $n_1 = q_H m + (1 + q_L)(1 - m)$ and $n_2 = q_H(1 - q_H)m + q_L(1 - q_L)(1 - m)$. One can now postulate a social welfare function (assuming $\beta = \delta$ and perfect capital markets) as follows

$$W = E\pi_1 + \delta E\pi_2 - \zeta(t) - e(n_1 + n_2) \tag{7}$$

The corresponding first order condition with respect to $t$ (again using (4) and the envelope theorem) is

$$dW/dt = dE\pi_1/dt - \zeta'(t) - e(dn_1/dx + dn_2/dx)(dx/dt) \leqslant 0 \tag{8}$$

where $dn_1/dx + dn_2/dx = 2mq'_H(1 - q_H) - 2(1 - m)q'_L q_L$. Again, the sum of the first two terms in (8) is negative. The sign of the last term, i.e. the effect of a tariff on the number of closures, is ambiguous. A gradual reform is more revealing. Hence it decreases the number of high type firms that close down, but it increases the number of low type firms that go out of business. The overall impact obviously depends on the proportion of each type and on the misclassification error. As an illustration, assume that $q_L(x) = q_H(x) = q(x)$ for all $x$. Then $dn_1/dx + dn_2/dx = 2q(m - q)$. If $m > q$, the last term in (6) is positive and gradualism may be favored; that is, gradualism is more desirable when the proportion of efficient firms in the sector is large.

The intuition is simple. Recall that a higher level of restructuring implies that a larger share of truly efficient firms (high types) and a smaller share of inefficient firms remain in business. If the proportion of high type firms in the population exceeds that of the low type then gradual liberalization will be associated with a smaller rate of business closures. If this effect and the social cost of bankruptcies are large, then a gradual reform can be optimal. If, on the other hand, there are many inefficient firms in the industry and the government is very much concerned about their possible exit then it may try to prevent those firms from correctly inferring their type (and exiting) by adopting a precipitous pace of reform (which limits restructuring). What is interesting about this latter case is the fact that the pace of liberalization and the rate of business closures are negatively related. Unlike the popular presumption which claims the presence of an unambiguously positive link between these two, our analysis identifies reasonable circumstances involving imperfect information and learning under which the relation can be negative. Advocates of a slow pace who base their position on the short-run social costs of business closures must then qualify their view as it is only valid for industries which were characterized by a high proportion of efficient firms before the implementation of liberalization.

The other crucial determinants of the optimal speed of reform in this case are the revealing properties of restructuring for both low and high type firms, i.e. the values of $q'_H$ and $q'_L$ ($dn_1/dx + dn_2/dx$ is a weighted average). A gradual reform is more likely to be optimal when $q'_H$ is large and $q'_L$ small. This simply means that trade liberalization tends to produce few business closures, be they of the high or the low type.

How likely is it that the relationship between the pace of liberalization and the rate of business closures will turn out to be negative? The analysis throughout the paper has been based on the assumption that both $q'_H(x)$ and $q'_L(x)$ are negative. It is worth mentioning, however, that as shown in the Appendix, restructuring is far more likely to decrease $q_H(x)$ than $q_L(x)$. If $q_H(x)$ decreases but $q_L(x)$ increases then the relationship between the pace of liberalization and the rate of business closures will unambiguously be positive.

## 4. Conclusion

In this paper, we examined the role of firm specific uncertainty in the dynamics of trade liberalization. We showed that such uncertainty creates some interesting possibilities regarding the pace of economic reform, possibilities that do not always square with the currently accepted views on these issues. We have shown that, in general, the case for gradualism becomes stronger when there is great emphasis on the longer term allocation of resources (because of informational considerations rather than policy reversal concerns that have been suggested in the existing literature). Interestingly, a big bang approach may prove superior under circumstances that defy conventional wisdom. For instance, we have shown that precipitousness may be optimal when the government is mostly concerned about the social cost of business closures.

Do these results represent theoretical curiosities that are of limited empirical relevance? To answer this question we need to evaluate the importance of the informational considerations associated with restructuring in a changing environment that are emphasized in this paper. We feel that uncertainty with regard to the level of true ability (competitiveness) plays a fundamental role in the determination of the characteristics of all occupational–entrepreneurial choices. This is even more true when the economic environment is undergoing a rapid, dramatic change of the sort associated with economic reform. Existing theories of reform have ignored the learning, type revelation, effects of investment and may thus offer only a partial view of liberalization.

Some of the ideas in this paper are reminiscent of the infant industry argument. Firms start from an inefficient position and gradualism is similar to temporary protection. The infant industry argument advocates such a protection when there are distortions like imperfect capital markets (e.g. see Baldwin, 1969) or externalities and dynamic learning (see Dasgupta and Stiglitz, 1988; Krugman, 1987; Rauch, 1992; Succar, 1987). This literature, however, takes for granted that all the infant firms will grow (in the absence of moral hazard problems), without the influence of any factors of chance. On the other hand,

our analysis assumes the presence of heterogeneous firms, some of which are capable of growing and some not. It associates infancy with a different form of learning from that identified in the literature: learning about comparative advantage rather than learning how to do things. It also relates the desirability of infant protection to the distribution of firm types within the industry. In this sense, the present paper can also be thought of as adding another important, realistic, dimension to the analysis of infant industries.

The model presented has several implications that could be tested empirically. For example, it implies that the speed of economic liberalization is negatively related to the magnitude of restructuring-investment activities. One can also examine how $q$ and $q'$ (which play a critical role in our analysis) vary with the pace of reform by examining the empirical distribution of firm performance as a function of the amount of industry restructuring. If the tails of the distribution become more prolongated and acquire larger mass when restructuring is more intensive then one can argue that restructuring enhances revelation.

## ACKNOWLEDGEMENTS

We are grateful to Lael Brainard, Celia Costa-Cabral, M. Paz Espinosa, and seminar participants at the Universidade Nova in Lisbon, the Universidad del País Vasco in Bilbao, and the Summer Meetings of the Econometric Society in Boston for helpful comments. We also thank two anonymous referees whose suggestions led to a substantial improvement of this paper. We are responsible for all remaining errors.

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## APPENDIX

This Appendix offers a detailed discussion of a firm's learning problem. Let $y_i$ be the output of a firm $i$, $i = H, L$. If $i = H$ then $y$ has the density function $G_H(x, \mu_H)$; otherwise, it has the density $G_L(x, \mu_L)$, where $\mu_H$ and $\mu_L$ are random variable representing the contribution of luck, and $E$ is the expectations operator. The G functions are assumed to satisfy the conditions

$$E(y|G_H) > E(y|G_L) \text{ for all } x > 0 \tag{i}$$

$$d\{E(y|G_H)/dx\} > d\{E(y|G_L)/dx\} \tag{ii}$$

that is, the high type has an absolute advantage in the activity under consideration; and restructuring helps the high type more than the low type. The individual firm knows the form of the $G$ functions but does not know whether its output came from $G_H$ or $G_L$.

An individual firm starts out with a prior belief of being of the high type, say, $\theta_{H1}$. After drawing an observation, $y$, in the first period, it updates its prior according to the Bayesian formula

$$\theta_{H2} = \frac{\theta_{H1}\psi(y|H)}{\theta_{H1}\psi(y|H) + (1 - \theta_{H1})\psi(y|L)}$$

where $\theta_{H2}$ is the posterior probability of being an $H$-type after having observed $y$, and $\psi(y|i)$ is the likelihood function of $y$ for type $i$.

A firm decides to remain in business in the second period if expected profits are positive, that is, if

$$p^*[\theta_{H2}EG_H + (1 - \theta_{H2})EG_L] > B \tag{9}$$

where we are using $EG_i$ as a shorthand for $E(y|G_i)$. (9) can be written as

$$\theta_{H2} > \frac{B/p^* - EG_L}{EG_H - EG_L} \tag{10}$$

Using the definition of the posterior probability the above criterion reduces to

$$\frac{\psi(y|L)}{\psi(y|H)} < \frac{EG_H - B/p^*}{B/p^* - EG_L} \frac{\theta_{H1}}{1-\theta_{H1}} \tag{11}$$

Given $\theta_{H1}$, $B$, $p^*$, and $G_i$, eq. (11) determines a cut-off point of output, $R$, such that for $y < R$ the firm exits and for $y \geq R$ the firm remains in business during the second period (whether the cutoff point is unique or not depends on the form of the p.d.f. assumed). The LHS of (11) depends both on the p.d.f. of $\mu_i$ as well as on the influence of restructuring on output performance. Due to condition (ii), increased restructuring pushes the two p.d.f.s further apart, something that aids type discrimination for any required $\theta_{H2}$. At the same time, though, restructuring may also affect the other moments of the two p.d.f.s, which can be a source of ambiguity (for instance, if the variance of output were an increasing function of $x$). Moreover, restructuring increases expected profits in the second period for any given $\theta_{H2}$, which makes firms inclined to stay even when they feel less confident about being the high type.

The effects of restructuring on the probability of misclassification (the sign of $q'_H$ and $q'_L$) play a critical role in our analysis. In order to be able to say something concrete about it some structure must be imposed on the p.d.f. of the $\mu$'s as well as on the $G$ functions. We assume that[16]

$$G_H = \mu_H + F(x), \quad G_L = \mu_L, \quad \mu_H \sim N(\mu, 1), \quad \mu_L \sim N(\mu, 1), \quad F' > 0, \quad F'' < 0 \tag{iii}$$

Using (iii) we have

$$ln \frac{\psi(y|L)}{\psi(y|H)} = F(x)\left[\mu + \frac{F(x)}{2} - y\right]$$

and substituting in (11) results in the following cut-off point (critical value for exit) for $y$, $R$

$$R = \mu + \frac{F(x)}{2} - \ln\left(\frac{F(x) + \mu - B/p^*}{B/p^* - \mu} \frac{\theta_{H1}}{1-\theta_{H1}}\right)/F(x) \tag{12}$$

The probability of misclassification for the low type, $q_L(x)$, is given by

$$q_L(x) = \text{prob}(y > R|\text{true type} = L) = \text{prob}(y - \mu > R - \mu) = \text{prob}(Z > R - \mu) \tag{13}$$

where $Z \sim N(0, 1)$, and the probability of misclassification for the high type by

$$\begin{aligned} q_H(x) &= \text{prob}(y < R|\text{true type} = H) = \text{prob}(y - (\mu + F(x)) < R - (\mu + F(x))) \\ &= \text{prob}(Z < R - (\mu + F(x))) \end{aligned}$$

Equations (13) and (14) imply that $\text{sign}\{q'_L\} = -\text{sign}\{dR/dx\}$ and $\text{sign}\{q'_H\} = \text{sign}\{d[R - (\mu + F(x))]/dx\}$. Note that restructuring reduces the misclassification error for at least one type. For instance, for restructuring to make the high type more likely to commit a misclassification error ($q'_H > 0$) it is necessary that $dR/dx > 0$.

With some further manipulation exact conditions can be derived under which the probability of misclassification is decreasing in $x$. Namely

$$q'_L < 0 \text{ iff } R < \mu + F(x) - 1/[\mu + F(x) - B/p^*]$$

$$q'_H < 0 \text{ iff } R > \mu - 1/[\mu + F(x) - B/p^*]$$

[16] A few notes are in order. First, the important element here as far as tractability is concerned is that the two p.d.f.s have the same variance (the particular value does not matter) and that the variance is not affected by restructuring. Revelation would be stronger if restructuring decreases the variance. Second, negative output is allowed only for technical convenience. One could instead have chosen to work with a truncated normal.

In general, $q'_H$ is more likely to be negative whenever there is a large fraction of low types and/or the cost $B$ is high. Moreover, $q'_H$ is more likely to be negative than $q'_L$. This is due to the fact that, for a given $\theta_{H2}$, restructuring makes it more profitable to remain in business and as a result the critical value of $\theta_{H2}$ (eq. (10)) decreases. The probability of $q'_H > 0$ is always less than 0.5 while no such constraint exists for prob$(q'_L > 0)$.