On The Dynamics of Trade Reform[*]

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Abstract

Empirical studies of trade reforms suggest that these reforms have a surprisingly small impact on a country's industrial configuration. This industrial structure inertia is difficult to rationalize in standard trade models. This paper develops a two-sector industry dynamics model in which industrial composition inertia arises naturally. The model is then used to study the consequences of different types of trade reforms (e.g. permanent, temporary, gradual, pre-announced) on investment, employment composition and income distribution.

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1. Introduction

Over the last two decades numerous countries have implemented trade reforms. The details and context in which these reforms were enacted vary from country to country. But the debate that precedes the reforms, the weighing of costs and benefits, is remarkably similar in different experiences. Trade reforms are generally expected to have devastating effects on import-competing industries, while creating a boom in other sectors of the economy. Optimistic policy makers expect the expanding sectors to vastly outweigh the demise of the protected sector. Pessimistic government officials worry that the contraction of the import-competing sector will throw the economy into a prolonged, painful recession.

What happens in practice once trade reforms are implemented? In many countries the answer is: not much. A large contraction in the protected sector does not take place; neither does a large expansion in other industries. The small impact associated with many trade reforms is a recurrent theme in the numerous case studies collected by Papageorgiou et al. (1990) and Helleiner (1994). For example, Rayner and Lattimore (1991, page 119) summarize the effects of trade reform in New Zealand as follows: "The 40 years covered by this study of trade liberalization in New Zealand saw many changes, some gradual and some extraordinarily swift and even drastic. But beneath these surface movements the structure of the economy has been remarkably resistant to change". Ros (1994) provides the following summary of the Mexican experience with trade reform in the 1980's: "For those expecting a large, painful, but greatly beneficial reallocation of resources in favour of traditional exportable goods, and labour–and natural resource–intensive goods, the experience with trade liberalization to date will have been greatly disappointing. [...] the 1980's have witnessed an extrapolation of past trends in trade and industrial patterns."

The conclusions of these case studies agree with econometric evidence provided by Roberts and Tybout (1996) for Chile, Colombia and Morocco. Their empirical results indicate that, after controlling for a host of non-trade related effects, entry and exit rates are similar in the aftermath of trade reform in both the import-competing sector and the export-competing sector.

Chile and Morocco are two striking examples of significant trade reforms that produced relatively little reallocation of sectoral activity. Net entry rates into the manufacturing sector in Chile after the trade reforms enacted over the period 1974-1979 are remarkably similar in the import-competing, export-competing and non-traded goods sectors.[1] In Morocco a 21% decline in tariff protection for firms in textiles, beverages, and apparel over the period 1984 to 1990

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[1]The net exit rates for the period 1979-86 are: 24% in the export-competing sector, 20% in the import-competing sector, and 27% in the non-tradable sectors. These rates were computed using 4-digit ISIC data from the Chilean census of manufacturing and the industry classification into export-oriented, import-oriented and non-tradables sectors proposed by Pavncik (1998).

was associated with only a 3.5% decline in employment in these industries (Currie and Harrison (1997)).

This empirical evidence stands in sharp contrast with the predictions of a model where investment is reversible and capital can be freely reallocated across sectors. In such a model, trade reforms–even temporary ones–have very large effects on investment and industrial configuration. Introducing adjustment costs into an otherwise frictionless model of capital allocation preserves the prediction that trade reforms have an impact on capital allocation, with these effects taking place gradually over time.

In this paper we propose an industry dynamics model with irreversible investment as a framework to study the effects of trade reform. Our model naturally implies that there is substantial inertia in the response of an economy to trade reform. Firms that have previously been protected may not exit, even when trade reforms are permanent. And certain reforms–both temporary and permanent–may fail to elicit changes in industrial configuration. Ours is an economy in which the industrial structure is difficult to change and, the changes that do occur tend to be persistent.[2]

We use our model to address a set of questions that emerges every time a reform plan is implemented: (i) should the reform be sudden or pre-announced?; (ii) are there advantages to gradual reforms?; (iii) do failed reforms condition the success of future reforms?; (iv) what is the role of initial conditions in determining the reform outcome?; and (v) is there a relation between the size of the reform and its outcome?

We discuss the effects of different reforms on the distribution of income across factors of production and across sectors of the economy. Both theoretical work (Fernandez and Rodrick (1991), Hillman (1989)) and empirical studies (Little et al. (1970), Krueger (1978), and Papageorgiou et al. (1990)) have pointed clearly to the impact on the distribution of income as a key consideration in the design and implementation of reforms.

Section 2 lays out the basic model that forms the backdrop for our investigation. Section 3 studies the effects of different deterministic reforms in an economy with free access to international capital markets. A final section summarizes the main results.

2. The Model

The economy is populated by a large number of agents who own domestic firms and supply inelastically one unit of labor in every period. They can borrow and lend in the international

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[2]Our emphasis on the role of fixed costs and investment irreversabilities in determining the outcome of trade reforms accords with the recent investment literature which stresses the importance of these features for understanding the episodic nature of investment dynamics (see, for example, Doms and Dunne (1993), Caballero, Engel and Haltiwanger (1995), and Eberly (1997)).

capital market at a real interest rate r^*.[3] For this reason, production and investment decisions–which determine the economy's wealth–can be analyzed independently of agent's consumption and savings decisions. Since we are interested in analyzing production and investment decisions we can do so by focusing on the wealth maximization problem.

Domestic firms take prices as given in the world goods market and produce either good a or b. Domestic prices do not coincide with prices in the world market due to the presence of import tariffs. Our economy has a comparative advantage in the production of good a, so it will tend to export good a and import good b.

Firms choose to enter or exit in response to changes in their industry's profitability. We normalize the time that it takes to enter or exit the industry to one period. It is thus appropriate to interpret each time period in the model as being longer than one year.

In both sectors production is organized in firms as in Hopenhayn (1992). To set up a firm it is necessary to make a one-time investment of ϕ units of good a. If this cost is paid at time t the firm will be able to operate at time $t+1$. Plants produce according to the following technology:

$$Y_{it} = Z_i N_{it}^{\alpha}, \qquad 0 < \alpha < 1, \qquad i = a, b,$$

where Y_{it} denotes the output of sector i and N_{it} the number of units of labor that this sector employs. To simplify we assume that the production functions in the two sectors differ only with respect to the level parameter Z_i. The elasticity of production with respect to labor (α) is assumed to be identical in both sectors.

In every period each firm must pay an overhead cost of ψ units of good a. This overhead cost will induce firms to exit in response to a sufficiently large deterioration in the relative price of their product. With $\psi = 0$ firms would never exit since they would always earn positive profits.

At the end of every period, a firm can choose to produce or to discontinue its operation. To simplify we assume that a firm that discontinues its operations for one period cannot resume its operations in future periods and has a liquidation value of zero. The problem facing an incumbent firm in sector i can be described in terms of the following dynamic programing problem, where π_{it} represents time-t maximal profits in sector i:

$$V_{it} = \pi_{it} + \frac{1}{1+r^*} \max(V_{it+1}, 0).$$

The problem facing a potential entrant in sector i is:

$$\tilde{V}_{it} = \max\left(\frac{1}{1+r^*} V_{it+1} - \phi, 0\right), \qquad i = a, b.$$

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[3]See Albuquerque and Rebelo (1998) for a discussion of trade reforms in an economy with no access to international capital markets.

Optimal profits in the two sectors (in units of good a) are given by:

$$\pi_{at} = \max_{N_{at}}(Z_a N_{at}{}^\alpha - \psi - w_{at} N_{at}),$$

$$\pi_{bt} = \max_{N_{bt}}(p_t Z_b N_{bt}{}^\alpha - \psi - w_{at} N_{bt}).$$

In these expressions w_{at} represents the real wage rate measured in units of good a, and p_t is the domestic relative price of good b in units of good a. To simplify we assume that the international relative price of good b (p^*) is constant. The domestic relative price is given by:

$$p_t = p^*(1 + \tau_t), \tag{2.1}$$

where τ_t is a tariff rate imposed by the government; all tariff revenues are rebated to households in a lump sum fashion.[4] We assume for now that τ_t is constant over time.

Optimal labor hiring decisions in the two sectors are characterized by:

$$\begin{aligned} \alpha Z_a N_a^{\alpha-1} &= w_a, \\ p\alpha Z_b N_b^{\alpha-1} &= w_a. \end{aligned} \tag{2.2}$$

The real wage in this economy is a weighted average of the two product wages, w_a and $w_b = w_a/p$. If momentary utility from consumption of goods a and b (C_a, and C_b) has the Cobb-Douglas form $u = [(C_a^\gamma C_b^{1-\gamma})^{1-\sigma} - 1]/(1 - \sigma)$, the real wage (deflated by the consumer price index) is a geometric average of the two product wages: $w_a^\gamma w_b^{1-\gamma}$. Since we want to be agnostic about the weights used in the construction of the consumer price index, we analyze separately the evolution of both w_a and w_b.

We find it useful to define θ as:

$$\theta \equiv \left(\frac{Z_a}{Z_b p}\right)^{1/(1-\alpha)}. \tag{2.3}$$

It is easy to see that in equilibrium the ratio of employment in the two sectors is equal to θ: $N_a/N_b = \theta$.

Assumption 1: $\theta > 1$.

This assumption is simply a normalization. It implies that the economy has a comparative advantage in producing good a.

Denote the number of incumbents in sector i by M_{it}. Using the labor market clearing condition,

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[4]The results we will discuss continue to hold if we assume that these tariffs are used to finance public expenditures that do not affect the productivity of the private sector or the marginal utility of private consumption.

$$M_{at}N_{at} + M_{bt}N_{bt} = 1, \tag{2.4}$$

we can write the values of N_a and N_b as:

$$N_{at} = \frac{\theta}{M_{at}\theta + M_{bt}}, \tag{2.5}$$

$$N_{bt} = \frac{1}{M_{at}\theta + M_{bt}}. \tag{2.6}$$

Note that when the economy specializes in good a, so that $M_b = 0$, we continue to have $N_{at}/N_{bt} = \theta$. In this case N_{at}/N_{bt} represents the ratio of labor employed by a type a firm relative to the labor employed by a potential entrant into the b sector. When $M_b = 0$ equation (2.5) implies that the available labor is evenly divided among sector a firms.

The values of π_a and π_b are:

$$\pi_{at} = (1-\alpha)Z_a \left(\frac{\theta}{M_{at}\theta + M_{bt}} \right)^{\alpha} - \psi, \tag{2.7}$$

$$\pi_{bt} = p(1-\alpha)Z_b \left(\frac{1}{M_{at}\theta + M_{bt}} \right)^{\alpha} - \psi. \tag{2.8}$$

The problem of finding the investment and exit decisions in the two sectors that maximize the wealth of the economy can be expressed in a recursive fashion:

$$
\begin{aligned}
W(M_a, M_b) \quad = \quad & \max_{M_a', M_b' \geq 0} \left\{ M_a \pi_a + M_b \pi_b + w_a \right. \tag{2.9} \\
& \left. - \phi[\max(M_a' - M_a, 0) + \max(M_b' - M_b, 0)] \right. \\
& \left. + \frac{1}{1+r^*} W(M_a', M_b') \right\}.
\end{aligned}
$$

Here we use primes to denote the value of a variable in the next period. For each θ there exists a unique, bounded and continuous function W. This can be proved using standard techniques for dynamic programming problems with bounded returns (see Stokey and Lucas with Prescott (1989)). There is an explicit analytical solution to the value function W which is described in the appendix.

Lemma 2.1 (Specialization). *The economy has a comparative advantage in producing good a: for any initial value of (M_a, M_b) entry of b firms never occurs.*

Proof. See Lemmas 5.1 and 5.2 in the appendix. ∎

The intuition underlying this result is as follows. Given that firms in sector a have a comparative advantage, they make higher profits than b firms. This implies that the present

value of profits associated with a new firm is higher in sector a than in sector b. Since the cost of entering is the same in both sectors, the equilibrium value of an entrant will be zero in sector a and negative in sector b. Thus we never observe entry in the b sector.

2.1. The Steady State Set

In the steady state of this economy the number of firms in both sectors remains constant. There is not a unique steady state value for (M_a, M_b). The steady state is a set that comprises multiple (M_a, M_b) combinations. These combinations can be characterized by studying the firm entry and exit decisions for both sectors of the economy.[5]

A pair (M_a, M_b) belongs to the steady state set if it satisfies two properties: (i) the value of firms in both sectors is non-negative ($V_{it} \geq 0$, $i = a, b$), which implies that there is no incentive to exit; and (ii) the value of an incumbent is lower than the cost of entry ($V_{it} \leq \phi(1 + r^*)$, $i = a, b$), which implies that there is no incentive to enter.

For latter reference it is useful to define $\overline{M}_a$ as the highest number of a firms compatible with the steady state requirements. The number $\overline{M}_a$ is such that $\pi_a = 0$ in an economy with no b firms:

$$(1 - \alpha)Z_a(1/\overline{M}_a)^\alpha - \psi = 0.$$

$\underline{M}_a$ is defined as the number of a firms such that profits compensate the annuitized entry cost ($\pi_a = \phi r^*$) in an economy with no b firms:

$$(1 - \alpha)Z_a(1/\underline{M}_a)^\alpha - \psi = \phi r^*.$$

Consider first the case in which we start the economy with $M_a > 0$ and $M_b = 0$. Lemma 2.1 implies that there will be no entry of b firms; the labor force will be divided equally among firms in sector a and profits will be given by:

$$\pi_a = (1 - \alpha)Z_a(1/M_a)^\alpha - \psi.$$

Thus, M_a is a steady state if:

$$
\begin{aligned}
\pi_a &\geq 0, \\
\pi_a &\leq \phi r^*.
\end{aligned}
$$

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[5]If we assume that a certain fraction of incumbent firms are forced to exit in every period, the steady state is unique. If p is such that $\theta > 1$ the steady state is given by $M_b = 0$ and $M_a = \underline{M}_a$, which is defined below. The same inertia effects that we discuss continue to be present for small values of the exogenous exit rate, but take place during the transition to the unique steady state, which is only reached asymptotically.
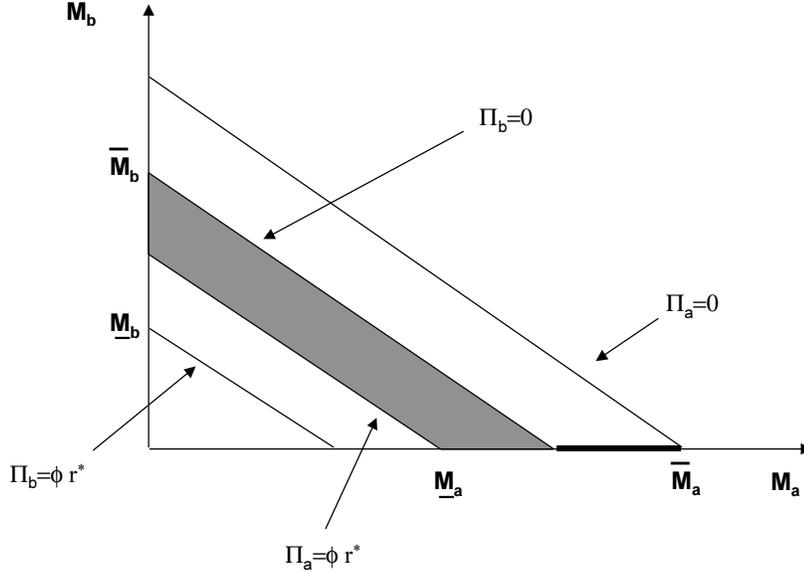
Figure 2.1: Non-Specialized Steady State

that is,

$$\underline{M}_a \le M_a \le \overline{M}_a.$$

Suppose now that we start the economy with $M_a > 0$ and $M_b > 0$, so the fixed costs of setting up M_b firms in sector b have already been incurred. Will the firms in sector b remain in operation? There are two possibilities. Figure 2.1 depicts the case in which firms of type b survive in the steady state. In this case the steady state set is determined by the intersection of the areas defined by the following four conditions: $\pi_a \ge 0$, $\pi_b \ge 0$, $\pi_a \le \phi r^*$ and $\pi_b \le \phi r^*$. This set includes elements in which both M_a and M_b are positive. We call these "non-specialized steady states".

Figure 2.2 depicts the "specialized steady state" case. In this case there are no elements of the steady state set such that $M_a > 0$ and $M_b > 0$. Points in which b firms would be willing to continue producing because $\pi_b \ge 0$ trigger entry of firms in the a sector to the point where b firms become unprofitable and exit.

To determine whether we will have a specialized steady state we ask whether a marginal incumbent in the b sector would survive when the number of a firms is the lowest number consistent with sector a's no-entry condition. This value of M_a is determined by the condition
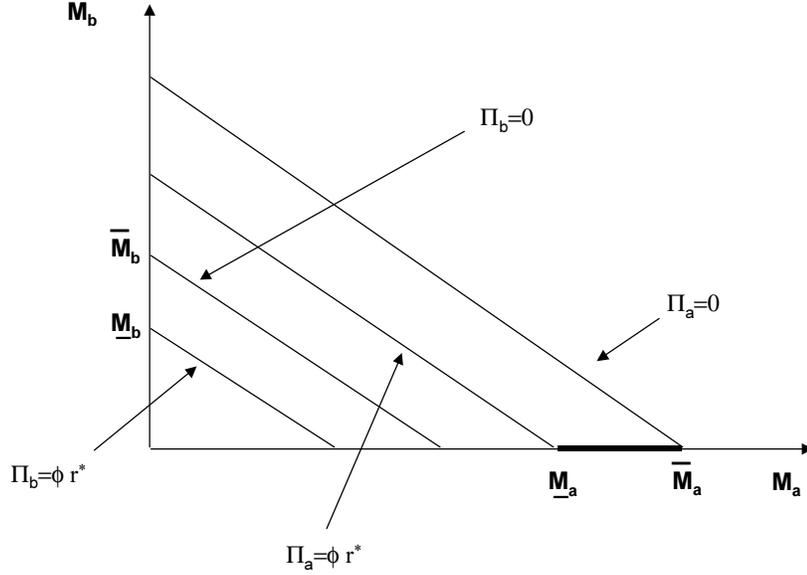
Figure 2.2: Specialized Steady State

$\pi_a = \phi r^*$. A value of M_a lower than the one implied by this condition would mean lower wages and hence higher profits in the a sector. The present value of profits in the a sector would then rise above the entry cost ϕ, thus triggering entry of a firms. When $\pi_a = \phi r^*$, the profits of a marginal firm in sector b can be determined using equations (2.7) and (2.8):

$$\pi_{bt} = \frac{\phi r^* + \psi}{\theta} - \psi.$$

If we define $\bar{\theta}$ as the value of θ consistent with $\pi_{bt} = 0$,

$$\bar{\theta} = 1 + \frac{\phi r^*}{\psi},$$

we obtain the following lemma.

Lemma 2.2. *The steady state is specialized when $\theta > \bar{\theta}$ and non-specialized otherwise.*

Before we study the transition dynamics of the model it is useful to summarize the properties of the set of industry configurations that satisfy $\pi_a = \phi r^*$.

Lemma 2.3. *Denote by $\Omega(\theta)$ the set of pairs (M_a, M_b) that satisfy the condition $\pi_a = \phi r^*$. $\Omega(\theta)$ is given by:*

$$\Omega(\theta) = \left\{ (M_a, M_b) : M_b = \theta \left(\frac{(1-\alpha) Z_a}{\psi + \phi r^*} \right)^{1/\alpha} - \theta M_a \right\}. \tag{2.10}$$

For a given value of θ the real wage rate measured in units of good a, w_a is the same for all $(M_a, M_b) \in \Omega(\theta)$; denote this value as $w_a(\theta)$. The value of w_a is also the same across loci with different θ, that is $w_a(\theta_1) = w_a(\theta_2), \forall \theta_1, \theta_2$.

Proof. Expression (2.10) can be obtained by using equations (2.7), and $\pi_a = \phi r^*$. To show the constancy of w_a note that (2.7) implies that w_a is constant if N_a is constant. To complete the proof note that (2.10) and (2.5) imply that along a locus $\Omega(\theta)$ the value of N_a is constant and independent of θ. ∎

Figure 2.3 illustrates this result. Suppose that there is a decrease in p. Equation (2.3) implies that θ increases from θ_1 to θ_2. This leads to a rotation of the $\Omega(\theta)$ locus from $\Omega(\theta_1)$ to $\Omega(\theta_2)$. The product wage w_a is the same for all points in $\Omega(\theta_1)$. It is also identical in all points along $\Omega(\theta_2)$. Finally w_a is the same in both of these loci.[6]

The intuition behind this result is as follows. In order for the free entry condition, $\pi_a = \phi r^*$ to hold, profits in sector a must be constant. Profits can be written solely as a function of w_a. Thus the real wage w_a must be always the same whenever the free entry condition holds.

2.2. Transition Dynamics

Since the economy can borrow and lend freely in the international capital market and there are no adjustment costs to investment, the transition to the steady state occurs in a single period. The transition dynamics summarized in the following proposition can be derived using the value function W described in the appendix (see lemmas 5.1 and 5.2).

Proposition 2.4. *When $\theta < \bar{\theta}$ the economy converges to a non-specialized steady state. Entry of b firms never occurs. For industry configurations where $\pi_a > \phi r^*$ there is entry of firms in sector a with M_b remaining constant. For all other non-steady state configurations in which $M_a < \overline{M}_a$, b firms make losses and hence exit while M_a remains constant. For industry configurations in which $M_a > \overline{M}_a$ the economy converges to $M_a = \overline{M}_a, M_b = 0$.*

When $\theta > \bar{\theta}$ the economy converges to a specialized steady state. Transition dynamics always involve the exit of all b firms. M_a remains constant when $\underline{M}_a < M_a < \overline{M}_a$, converges to $\underline{M}_a$ when $M_a < \underline{M}_a$, and to $\overline{M}_a$ when $M_a > \overline{M}_a$.

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[6] A symmetric result holds for sector b. In all the points (M_a, M_b) such that $\pi_b = r^*\phi$ the value of w_b is constant and independent of θ.
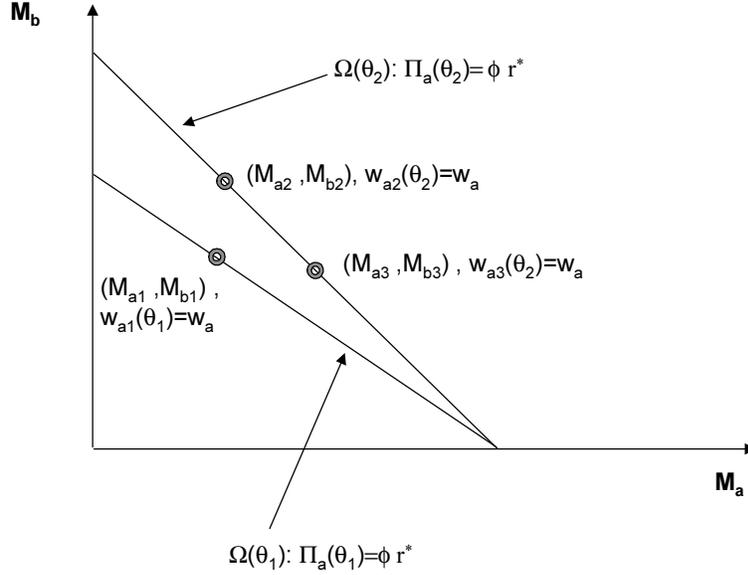
Figure 2.3: The $\Omega(\theta)$ Locus

These transition dynamics are depicted in Figure 2.4 for the "non-specialized steady state" and in Figure 2.5 for the "specialized steady state" case.

3. Trade Reforms

We now discuss the effects of different types of trade liberalization reforms to provide answers to some of the questions posed in the introduction. Trade reforms are a potential Pareto improvement in our economy–if the government could make appropriate transfers among agents everybody could be made better off. Since in practice lump sum transfers are not available and factor ownership is unevenly distributed, trade reforms can result in dramatic changes in income distribution. To study these distribution effects we focus on the impact of reforms on π_a, π_b and the real wage.

We start by studying two permanent reforms, one that is unanticipated by private agents and one that is pre-announced. The dynamics of entry and exit associated with these reforms are characterized using the results in Proposition 2.4. We then turn to reforms that are gradual and to temporary reforms.
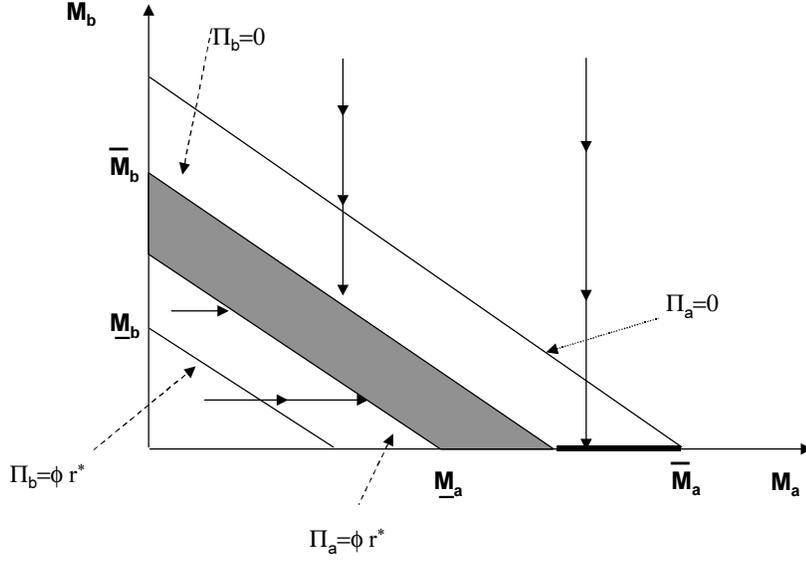
Figure 2.4: Transition Dynamics, Non-Specialized Steady State

3.1. A Permanent Unanticipated Reform

We will now discuss the effects of a permanent unanticipated reform that lowers tariffs thus reducing p, the domestic price of good b. We study two distinct cases: (i) the economy departs from a situation where $\pi_a = \phi r^*$ before the reform; and (ii) the economy departs from an interior point in the steady state set. Since the differences between these two scenarios are similar in all the other reforms we will study, we will later focus only on the first case.

3.1.1. Case 1 ($\pi_a = \phi r^*$ in the initial steady state)

The five panels of Figure 3.1 show the effects of a permanent unanticipated reform in the first case. The top panel shows the locus $\Omega(\theta)$ which gives the (M_a, M_b) combinations such that $\pi_a = \phi r^*$. This will be used to analyze the incentive for a firms to enter. Given that the reform favors the a sector we know from our analysis of transition dynamics that there will be no entry of b firms.

Suppose that p declines from p_1 to p_2. This raises θ from its initial value θ_1 to a new value θ_2 (see equation (2.3)) producing a clockwise rotation in the $\pi_a = \phi r^*$ line. Suppose that the pre-reform industry configuration was at point 1 in Figure 3.1. The decline in p increases the
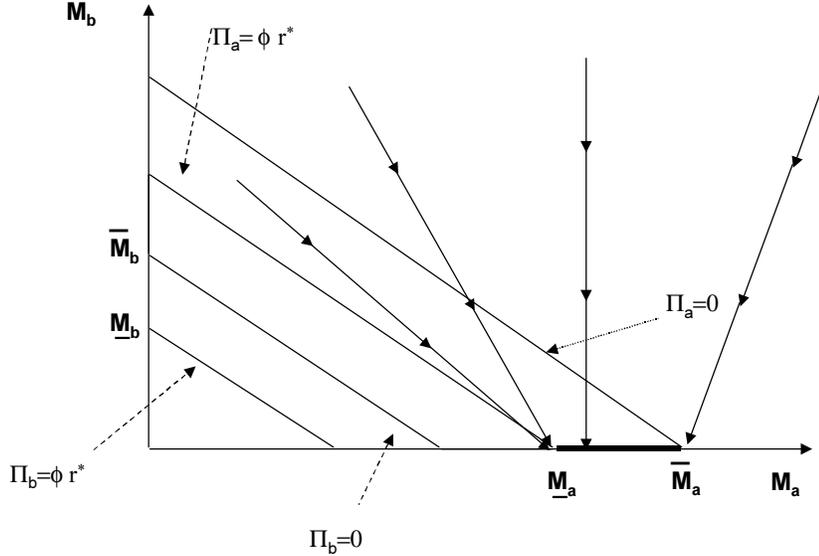
Figure 2.5: Transition Dynamics, Specialized Steady State

profits of sector a to the point where it justifies entry into this sector. What happens in sector b? If the new steady state involves complete specialization all b firms will exit. Otherwise they will continue to make positive profits and remain in operation.

The reform exerts two distinct effects on the real wage. The first is a static effect associated with the change in p. The second reflects the consequences of firm entry. The static effect takes place when p decreases since there is a reallocation of labor towards sector a (see (2.5)). Thus, N_a increases leading to a reduction in w_a (see (2.2)). The reform makes good a more expensive and hence wages measured in units of a fall while wages measured in units of b rise.

If M_a and M_b were fixed this would be the end of the story. However, there is entry in sector a and the economy will move from point 1 to point 2 in Figure 3.1. Recall from Lemma 2.3 that w_a is identical along $\Omega(\theta_1)$ and $\Omega(\theta_2)$. This means that entry will exactly offset the initial decline in w_a, restoring w_a to its pre-reform level. Entry of a firms leads to a reduction in N_b (see (2.6)) and to a second increase in w_b (recall that $w_b = w_a/p$).

The last two panels of Figure 3.1 depict the effects of the reform on the profits of the two sectors. In the first period of the reform a firms receive a profit windfall associated with the decline in w_a at the same time that profits decline in sector b (see (2.8)). Entry of a firms in the second period restores profitability in sector a to pre-reform levels and leads to a further
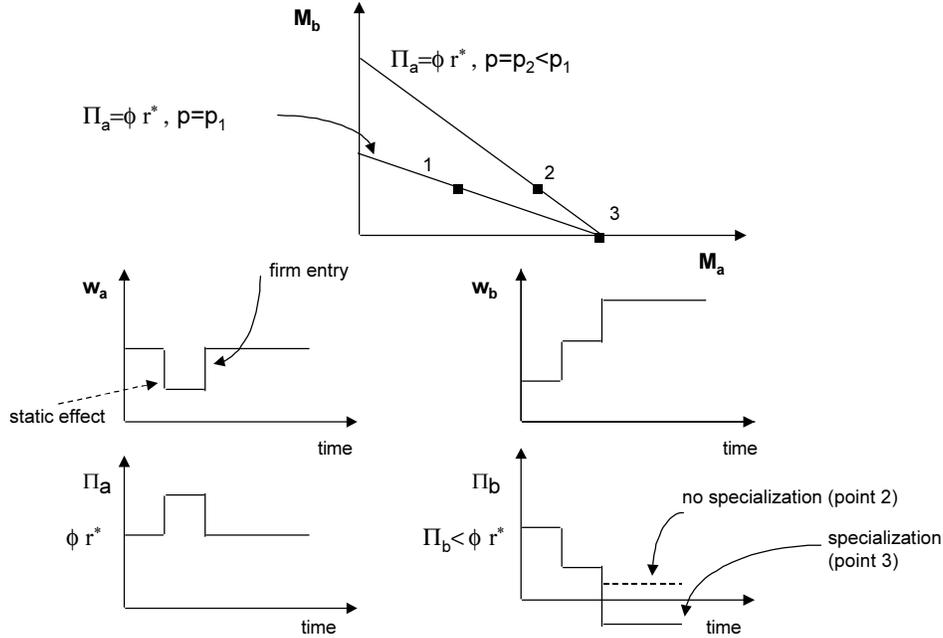
Figure 3.1: A Permanent Unanticipated Reform

reduction in the profits of sector b. When this reduction is severe enough profits in the b sector may become negative. This happens when the new value of θ is higher than $\bar{\theta}$ (Lemma 2.1). In this case the new steady state will entail complete specialization in the production of good a; that is, the economy moves from point 1 to point 3 in Figure 3.1.[7]

Note that the effects of reform are non-linear with respect to the level of tariffs. Small changes in τ tend to produce correspondingly small effects in terms of entry into sector a and no effects on exit from sector b. However, once tariffs fall enough so that the new steady state entails specialization $(\theta > \bar{\theta})$, there is a watershed effect involving potentially significant entry of a firms with exit of all b firms. Figure 3.2 shows how the industry configuration changes in response to changes in the level of tariffs. Suppose the economy starts with a value of θ equal to θ_0, which corresponds to a level of tariffs τ_0. Suppose also that the initial conditions M_{a0} and M_{b0} lie on the schedule $\Omega(\theta_0)$. The figure shows the number of a firms that will enter if tariffs are reduced from τ_0 to a new lower value τ. For tariffs lower than $\bar{\tau}$ (the value of τ consistent with $\theta = \bar{\theta}$) the economy specializes completely–all b firms exit while the number of a firms

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[7]The implication that all b firms exit at the same time creating a large watershed effect would be mitigated in a version of the model where firms have heterogenous productivities, as in Bacchetta and Dellas (1997) and Lu (1998). In such an environment the least productive, smaller firms would tend to exit but more efficient units could remain in operation.
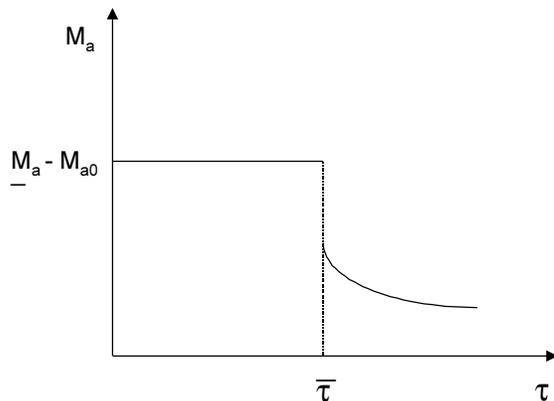
Figure 3.2: The Effect of Tariffs on Firm Entry, Initial Industrial Configuration: $\underline{M}_a > M_{a0}$.

increases to $\underline{M}_a$.

To summarize the main results: an unanticipated reform that lowers tariffs, thus lowering the domestic price of good b, leads to entry in the a sector, motivated by the initial increase in the profitability of this sector. Profitability falls in sector b. The product wage measured in units of good a falls initially but is then restored to its pre-reform level. The values of w_a and π_a are the same in period 2 as before the reform. In contrast, sector b, which was more protected in the pre-reform era features higher product wages (w_b) and correspondingly lower profits. The effects of reforms are non linear in τ; if the new level of tariffs is low enough to be compatible with a specialized steady state there are large effects on firm entry and firm exit.

3.1.2. Case 2 (initial steady state is an interior point)

Consider now the case in which the economy starts off at an interior point in the steady state set, such as point 1 in Figure 3.3. In this case if the change in the domestic price is small enough to cause no entry in sector a, all we observe are static effects: a permanent decline in w_a and in π_b and a permanent rise in w_b and π_a. The economy remains at point 1 despite the reform. The same dynamic effects discussed before will be added if the decline in p from p_1 to p_3 leads
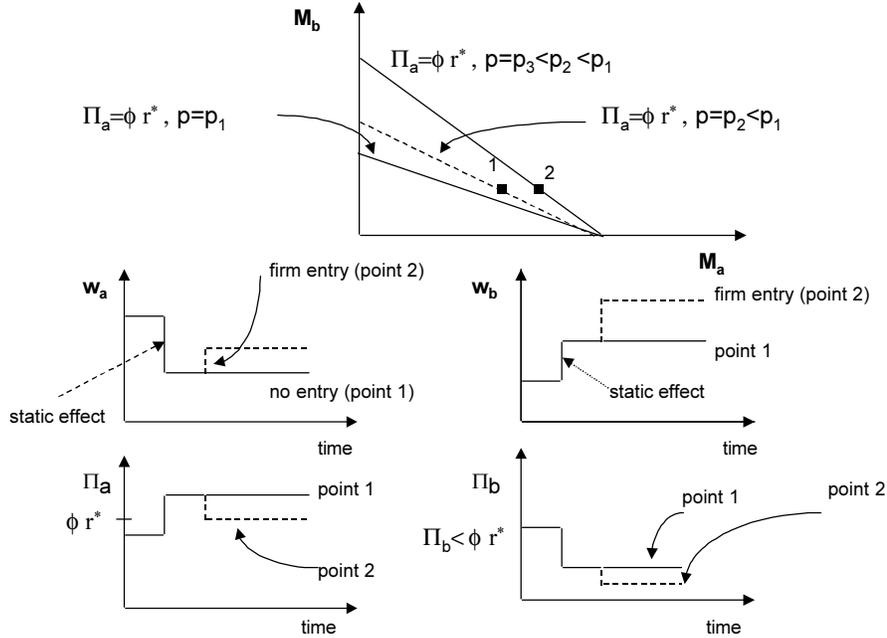
Figure 3.3: A Permanent Unanticipated Reform

to entry in sector a, moving the economy from point 1 to point 2.[8] Figure 3.3 also depicts what happens in this case. Notice that, because we start at a point where $\pi_a < \phi r^*$, entry in sector a does not restore w_a to its pre-reform level. Relative to the situation before the reform, we now observe a permanent decline in w_a and an increase in profits to the level ϕr^*.

In the non-specialized steady state case, the higher the pre-reform steady state value of M_b for a given value of M_a the lower the impact of the trade reform. In other words, if the initial industry configuration is significantly biased away from the economy's comparative advantage, the effects of trade reform will be small in the sense that few firms of type a will enter. Policies that have tilted the economy away from its comparative advantage in the past lead to smaller effects of trade reform in the present.

3.2. A Permanent Pre-Announced Reform

A common alternative to a surprise reform involves announcing in advance the policy changes associated with the reform. Figure 3.4 depicts the effect of a reform that takes place in period 1 and is pre-announced in period 0. In this case entry of a firms eliminates the static effects in period 1. The only effects of the reform on sector a are an expansion in the number of firms

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[8]For simplicity we ignore the case where the change in price is large enough to induce specialization.
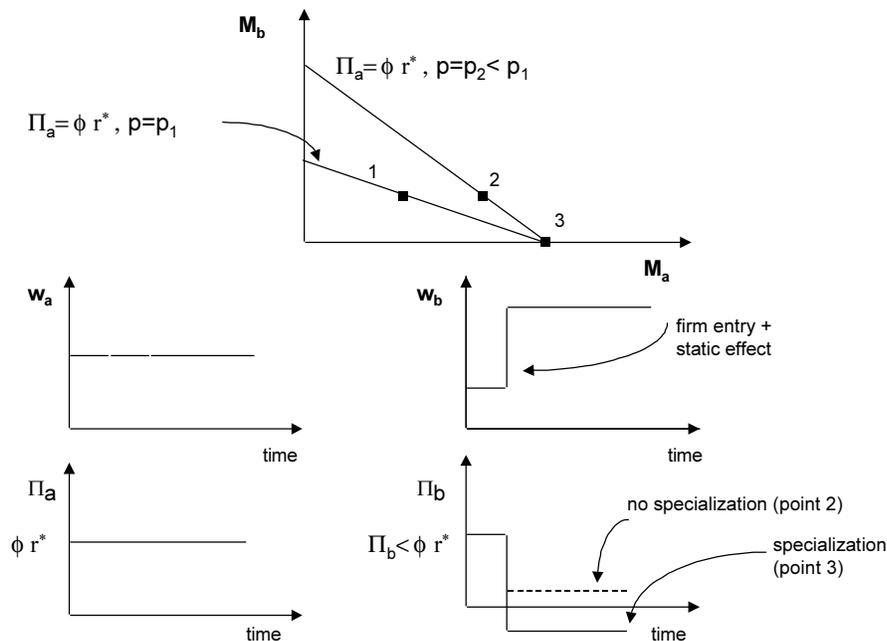
Figure 3.4: A Permanent Pre-Announced Reform

and in the number of workers employed by each firm. Sector b experiences a decline in profits (which become negative if the new steady state is specialized) and an increase in its product wage, w_b.

This reform is clearly worse in welfare terms than the unanticipated reform because the economy waits one period to implement a reform that is welfare improving. To see this, note that the total value of firms at time 0, $W(M_{a0}, M_{b0})$, is strictly higher when the reform is unanticipated than with a pre-announced reform since, keeping M_a and M_b constant for next period is feasible but not optimal. However, pre-announcing the reform may have some advantages for a policy maker concerned with short term effects on the income distribution. While the real wage can fall in an unanticipated reform if good a has a high enough weight in the consumption basket, the real wage is guaranteed to rise in a pre-announced reform.

Pre-announcing also has an important effect on profits. The fact that sector a receives a profit windfall at the same time that sector b is made less profitable may make the unanticipated reform more difficult to sustain. Pre-announcing eliminates the profit windfall to sector a.

In the experiment just described we assumed that the reform has perfect credibility. While it is possible that pre-announcing the reform hurts its credibility (e.g. Stockman (1982)), in the case studies compiled by Papageorgiou et al. (1991) the majority of the pre-announced reforms
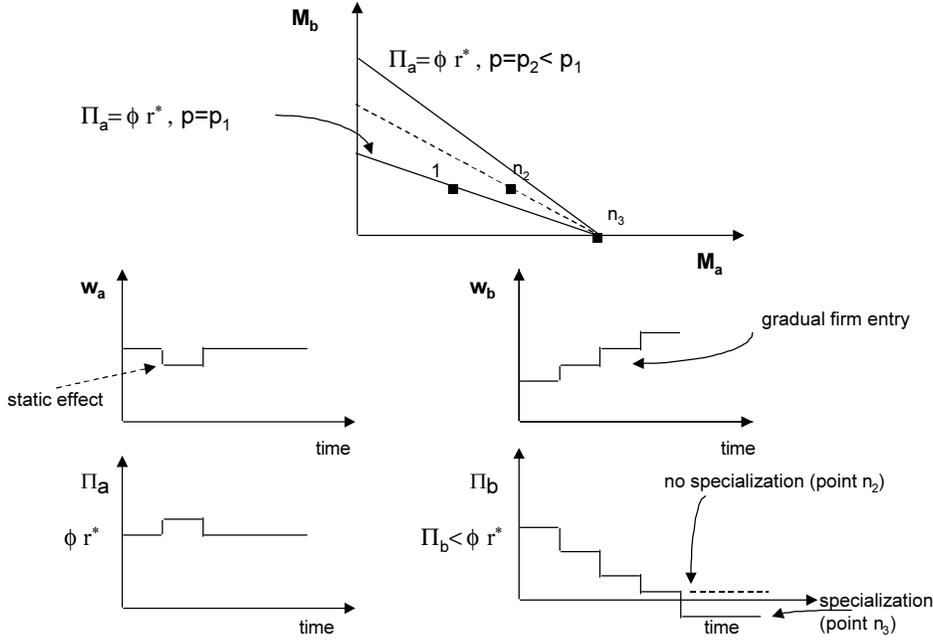
Figure 3.5: A Gradual Permanent Reform

survived either fully or partially.

3.3. A Permanent Gradual Reform

Policy makers often entertain the possibility of pre-announcing a schedule of reforms that are implemented gradually over time. The liberalization of trade within Europe brought forth by the European Union took this gradualist approach. What does gradualism buy us? Suppose that at time zero we announce a gradual reduction in tariffs starting immediately in period zero. The result, depicted in Figure 3.5, is a combination of the two reforms that we just studied. There is an impact of the unanticipated change in p that takes place at time zero. This produces our familiar static effect: a decline in w_a, a rise in π_a, an increase in w_b, and a reduction in π_b. From period 1 on the profitability of sector a remains constant at $\pi_a = \phi r^*$ since firm entry exactly offsets the increase in profits produced by a drop in p. Since at time t the industry configuration is on the locus $\Omega(\theta_t)$, w_a remains constant from period 1 on (see Lemma 2.3). In the b sector the decline in π_b and the rise in w_b which in the previous reform occurs in period 1 now takes place gradually over time in tandem with changes in p.

In terms of welfare this reform is worse than the unanticipated reform because the implementation of welfare improving changes in tariffs is further delayed in time. In terms of its short run

impact on income distribution, this reform also seems dominated by the pre-announced reform. In a gradual unanticipated reform the real wage can potentially fall, and there is a profit windfall to sector a.

Gradual reforms have often been recommended as a way of achieving a smoother reallocation of factors across sectors (Little et. al (1970) and Michaely (1985)). Since these benefits can just as well be achieved through pre-announcement, the case for gradualism must depend on potential credibility effects associated with a gradual implementation of the reform.

3.4. A Temporary Unanticipated Reform

Every time trade reforms are implemented agents debate the extent to which they are likely to be temporary or permanent. Why is this important? Calvo and Mendoza (1994) stress two reasons. The duration of the reform is relevant: (i) in determining the size of the wealth effect experienced by the private sector; and (ii) in setting in motion intertemporal substitution effects in reforms perceived as temporary. Both of these mechanisms affect consumption and labor supply decisions as well as the economy's trade balance.

Our model has a third mechanism through which the temporary nature of the reform may have important consequences. Since investment decisions are irreversible, the duration of the reform becomes a critical determinant of capital and labor reallocation, firm entry, and firm exit.

To see this, consider a temporary unanticipated decline in tariffs announced at time zero that lasts for two periods (the results of longer lasting temporary reforms are similar). After two periods tariff levels return to their pre-reform level. Experiments of this type are common in the literature on temporary reforms (see e.g. Calvo (1988)). Suppose that the pre-reform industry configuration was a point on $\Omega(\theta_0)$, such as point 1 in Figure 3.6.

In this case we will observe entry in the a sector. Without entry in the first period the temporary price decline would raise the present value of profits above the entry threshold $\phi(1 + r^*)$. In period 0 we observe the familiar static effects associated with the unanticipated nature of the reform: w_a and π_b decline at the same time that w_b and π_a increase. In the permanent reform, firm entry into sector a offsets completely the static effects on w_a and π_a. In the temporary reform entry is restricted by the fact that once the reform ends, the present discounted value of profits from period 2 on, V_{a2}, is lower than the entry threshold $\phi(1 + r^*)$. Therefore the marginal entrant into sector a will have excess profits in period 1 since:

$$\frac{\pi_{a1}}{1 + r^*} + \frac{V_{a2}}{(1 + r^*)^2} = \phi.$$

Given that there will be fewer firms a entering some of the static effect will remain. When the reform is reversed in period 2 the economy will look "uncompetitive". Because the number of
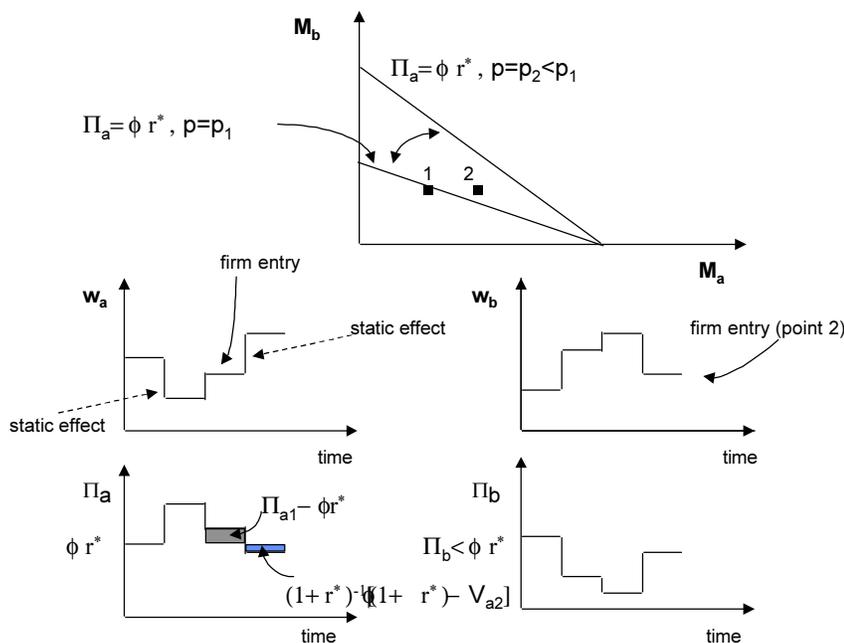
Figure 3.6: A Temporary Unanticipated Reform

firms in the a sector is larger than before the reform, the wage rate is higher measured both in units of a and in units of b. Also, profits are lower in both sectors as compared to the pre-reform era.

Is it possible to observe entry of a firms that is later reversed by exit when the reform ends? The following Lemma states that the answer to this question is negative.

Lemma 3.1. *Consider a temporary reform that lasts for $T > 1$ periods. During the reform period p declines from p_1 to p_2. At time $T + 1$, p reverts back to p_1. We will not observe exit of a firms at any point in time as a response to this temporary reform.*

Proof. See Appendix. ∎

Failed reforms may make future reforms easier from a political standpoint. If opposition to reform stems from the profits being captured by the protected sector, temporary reforms that lead to entry of a firms will permanently lower these profits, thus paving the way for future reforms.

The implication of the model–that temporary reforms generate no exit from the protected sector and modest entry into the sector favored by the reform–accords well with informal descriptions of the outcome of failed reforms. For example, Shepherd and Alburo (1991, page

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292) discuss trade reform in the Philippines as follows (italics are ours): "The 1960-62 import decontrol was undoubtedly a significant achievement [...]. Yet decontrol changed the economy *curiously* little. Certainly it immediately encouraged traditional exports, as well as small amounts of nontraditional manufactured exports. However, while the import substituting manufacturing sector was visibly hit by imports in the early to middle 1960's, it neither contracted [...], nor did its structure change in any obvious ways".

4. Conclusions

In this paper we develop a model that captures the hysteresis in industrial configuration that is a prominent feature of many trade reform experiences. We use this model to characterize the response of an economy to different trade reforms. We consider reforms with different degrees of permanence and timing in a model of industry dynamics with irreversible investment. In our economy it is optimal to immediately liberalize international trade. Yet, these reforms may not take place because of concern over their impact on the distribution of income. A policy maker who does not have the ability to compensate losers may be reluctant to implement reforms that lower the real wage or dramatically alter sectoral profitability.

Our main findings can be summarized by providing answers to the questions posed in the introduction:

(i) Surprise permanent trade reforms in economies with free access to world capital markets can generate important effects on the distribution of income across factors of production and across sectors of the economy; in particular these reforms can lower the real wage and reduce profitability in the traditionally protected sector at the same time that they provide a profit windfall to the sector that is favored by the reform. These effects are not present in a pre-announced trade reform.

(ii) A gradual trade reform is a combination of a smaller unanticipated reform with a sequence of pre-announced reforms. This reform exerts smaller impact effects on the distribution of income than an unanticipated reform.

(iii) Temporary reforms either produce no effects on the industrial configuration or make the economy seem "uncompetitive" once the reform ends: in the post-reform period the real wage is higher than before while profits in both sectors are lower than before. This may help pave the way for future trade reforms. If opposition to trade reform emanates from the protected sector of the economy, failed attempts to liberalize trade can be helpful in attracting entry of new firms and permanently lowering the profitability of the protected sector. Finally, an unanticipated reform that is perceived as temporary has a stronger short-run effect on the distribution of income than one that is permanent.

(iv) Consider two economies with the same number of firms in their comparative advantage sector. If in one of the economies trade protection were pervasive in the past and has created a large protected sector, this dulls the effects of a given tariff reduction in terms of entry of new firms and reallocation of resources toward the comparative advantage sector.

(v) The entry and exit dynamics imbedded in our model, together with the presence of a potential for complete specialization, generate a pronounced non-linearity in the effect of a trade reform. When tariffs fall below a certain threshold we observe a large discrete change in the industrial structure of the economy. Also the fact that the economy has a zone of inaction implies that small reforms are likely to have no effects on firm entry and exit.

There are several extensions of our simple model that would make it a better guide to understanding the origins and consequences of real world reforms. One of the most important extensions is the study of the impact of uncertainty on reform outcome. The inertia effects present in the deterministic reforms that we consider are likely to continue to play an important role in environments with uncertainty–the size of the steady state set will in general be affected by the degree of reform uncertainty.

We assume that there are no costs to the reallocation of labor across sectors. This seems to us a natural first step, in light of the findings reviewed in Papageorgiou et al. (1991), and Edwards (1994) which suggest that the short run effect on unemployment of many trade reforms has been negligible. Including labor reallocation costs, namely the presence of unemployment spells associated with the search for new jobs and the loss of sector specific human capital may make the model a better guide to how the economy responds to terms of trade shocks such as those emphasized in Reinhart and Wickham (1994).[9]

Finally, it would be desirable to integrate our model of the outcome of trade reforms with a political economy model that determines why and when these reforms take place.

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5. Appendix

We start by defining the total output function which will be used in different proofs:

$$y\left(M_a, M_b\right) = M_a Z_a \left(\frac{\theta}{M_a\theta + M_b}\right)^\alpha + M_b p Z_b \left(\frac{1}{M_a\theta + M_b}\right)^\alpha - \psi\left(M_a + M_b\right).$$

The following lemma gives an explicit analytical solution for the function W for various values of θ in the case where the economy reaches a specialized steady state. Lemma 5.2 discusses the case in which a non-specialized steady state is reached. The knife-edge case of $\theta = 1$ is a simplified version of the former case and is omitted.

Lemma 5.1. *Assume $\theta > \bar{\theta} > 1$, so that the economy specializes in the steady state. Then, for any M_b,*

$$W\left(M_a, M_b\right) = \begin{cases} y\left(M_a, M_b\right) - \phi\left(\underline{M}_a - M_a\right) + \frac{1}{r^*}y\left(\underline{M}_a, 0\right) & , M_a < \underline{M}_a \\ y\left(M_a, M_b\right) + \frac{1}{r^*}y\left(M_a, 0\right) & , \underline{M}_a \leq M_a \leq \overline{M}_a \\ y\left(M_a, M_b\right) + \frac{1}{r^*}y\left(\overline{M}_a, 0\right) & , M_a > \overline{M}_a. \end{cases}$$

Proof. The proof uses the above guess with the implied decision rules to show that this function solves problem (2.9). One can show that our guess is strictly concave so that for any (M_a, M_b), problem (2.9) solved with the above W function admits only one solution. Instead of analyzing all feasible paths, we investigate only whether the suggested decision rules solve the first order conditions.

Pick any M_b, and $M_a < \underline{M}_a$. We guess that $M'_b = 0$, and $M'_a = \underline{M}_a$ is optimal. The first-order conditions that need to be verified are:

$$\frac{1}{1+r^*}\left((1-\alpha)Z_a\underline{M}_a^{1-\alpha} - \psi + \frac{(1-\alpha)Z_a\underline{M}_a^{1-\alpha} - \psi}{r^*}\right) = \phi$$

and

$$\mu_b = -\frac{1}{1+r^*}\left((1-\alpha)pZ_b\left(\frac{1}{\theta\underline{M}_a}\right)^\alpha - \psi\right) > 0.$$

The first condition is obviously verified by definition of $\underline{M}_a$. The second condition states that the Lagrange multiplier associated with the constraint $M'_b \geq 0$, is strictly positive. Substituting for $\underline{M}_a$, we have

$$\mu_b = -\frac{1}{1+r^*}\left(\theta^{-1}\phi r^* + \left(\theta^{-1} - 1\right)\psi\right) > 0$$

since $\theta > \bar{\theta}$.

Now, pick $\underline{M}_a \leq M_a \leq \overline{M}_a$, and any M_b. We guess that $M'_a = M_a$, and $M'_b = 0$. The first-order conditions that need to be verified are:

$$0 \leq \frac{1}{1+r^*}W_{M_a}\left(M'_a, M'_b\right) \leq \phi$$

$$\mu_b = -\frac{1}{1+r^*}\left((1-\alpha)\,pZ_b\left(\frac{1}{\theta M_a}\right)^\alpha - \psi\right) > 0.$$

The second condition is equivalent to the one we had before, and is simply a virtue of the fact that there is specialization in sector a in the steady state. The first condition, however, states that the marginal benefit of increasing the number of firms in sector a, $\frac{1}{1+r^*}W_{M_a}(M_a', M_b')$, is not high enough for entry to occur, but is also not small enough to induce exit. To see that the first set of inequalities hold, we replace $W_{M_a}(M_a', M_b')$ by its value at the guessed solution:

$$0 \leq \frac{(1-\alpha)\,Z_a M_a^{-\alpha} - \psi}{r^*} \leq \phi,$$

which is true since $\underline{M}_a \leq M_a \leq \overline{M}_a$.

Finally, let $M_a > \overline{M}_a$, with any M_b. The guess is $M_a' = \overline{M}_a$, and $M_b' = 0$. The associated first-order conditions are:

$$0 = \frac{1}{1+r^*}W_{M_a}(M_a', M_b')$$

and

$$\mu_b = -\frac{1}{1+r^*}\left((1-\alpha)\,pZ_b\left(\frac{1}{\theta \overline{M}_a}\right)^\alpha - \psi\right) > 0.$$

The first condition requires that $(1-\alpha)\,Z_a M_a'^{-\alpha} - \psi = 0$, which is achieved by setting $M_a' = \overline{M}_a$. The second condition holds because $\theta > 1$.

To complete the proof we have to show that the value function W is recovered once we substitute the optimal solution into problem (2.9). This, however, is trivial. ∎

The next lemma characterizes the value function W when $\bar{\theta} \geq \theta > 1$. To facilitate the description of W we provide Figure 5.1, which defines the areas A through E which represent a partition of the feasible set.

In Lemma 5.2 we use the following notation: $m_i(M_j, \pi)$ is next period's value of M_i that solves $\pi_i' = \pi$, when $M_j' = M_j$, $i \neq j$.

Lemma 5.2. *Assume $\bar{\theta} \geq \theta > 1$. Then*

$$W(M_a, M_b)$$
$$= \begin{cases} y(M_a, M_b) - \phi\left(m_a(M_b, \phi r^*) - M_a\right) + \frac{1}{r^*}y\left(M_a(m_b, \phi r^*), M_b\right) & ,(M_a, M_b) \in A \\ y(M_a, M_b) + \frac{1}{r^*}y(M_a, M_b) & ,(M_a, M_b) \in B \\ y(M_a, M_b) + \frac{1}{r^*}y(M_a, m_b(M_a, 0)) & ,(M_a, M_b) \in C \\ y(M_a, M_b) + \frac{1}{r^*}y(M_a, 0) & ,(M_a, M_b) \in D \\ y(M_a, M_b) + \frac{1}{r^*}y\left(\overline{M}_a, 0\right) & ,(M_a, M_b) \in E \end{cases}.$$

Proof. The strategy of the proof is the same as in the proof of Lemma 5.1. The proof uses the above guess for the value function W with the implied decision rules to show that this function
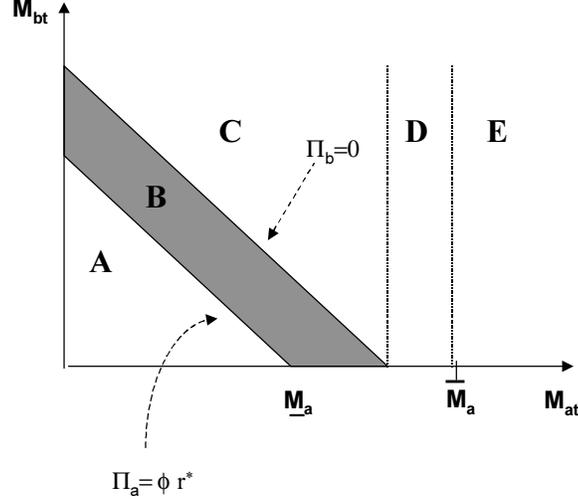
Figure 5.1: The Domain of the W Function: The Non-Specialized Steady State

solves problem (2.9). One can show that our guess is strictly concave so that for any (M_a, M_b), problem (2.9) solved with the above W function admits only one solution. Hence, we restrict attention to the suggested decision rules. This proof is very tedious and repetitive, and since no insight is lost, we shall limit it to the description of one case.

Suppose that $(M_a, M_b) \in A$. Then, we guess that $M'_a = m_a(M_b, \phi r^*) > M_a$, and $M'_b = M_b$, which implies $(M'_a, M'_b) \in B$. The first-order conditions that need to be verified are:

$$\frac{1}{1+r^*} W_{M_a}\left(M'_a, M'_b\right) = \phi$$

and

$$0 \leq \frac{1}{1+r^*} W_{M_b}\left(M'_a, M'_b\right) \leq \phi.$$

The first condition, when evaluated at the guessed optimum (recall the definition of $m_i(M_j, \pi)$), is equivalent to:

$$\frac{1}{1+r^*}\left(\phi r^* + \phi\right) = \phi,$$

whereas the second condition is equivalent to:

$$0 \leq \frac{1}{r^*}\left((1-\alpha)\,pZ_b\left(\frac{1}{\theta M'_a + M_b}\right)^\alpha - \psi\right) \leq \phi.$$

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The left inequality is true since $\bar{\theta} \geq \theta$, whereas the right inequality is true given $\theta > 1$. It remains to show that $M'_a > M_a$. However, this is just an implication of $(M_a, M_b) \in A$, and profits of firms in sector a being decreasing with M_a. Finally, note that with $(M'_a, M'_b) \in B$ we have,

$$W(M_a, M_b) = y(M_a, M_b) - \theta(m_a(M_b, \phi r^*) - M_a) + \frac{y(m_a(M_b, \phi r^*), M_b)}{r^*},$$

when $(M_a, M_b) \in A$. $\blacksquare$

Proof of Lemma 3.1:

Proposition 2.4 implies that there is exit of a firms only when $M_a > \overline{M}_a$, *regardless of the value of p.* However, a value of M_a greater than $\overline{M}_a$ cannot be achieved by any trade reform, temporary or permanent. Thus, in the end of a temporary reform the number of a firms is always lower than $\overline{M}_a$ and, hence, exit does not occur. $\blacksquare$