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ON THE ILLS OF ADJUSTMENT

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Abstract

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1 Introduction

1.1 Adjustment Crises

The need to restructure the economy's productive system and reallocate factors is common to a variety of experiences in the developing world, as countries face changing external opportunities or attempt to liberalize their economic system. Such adjustment episodes are often times of crisis. Those crises have important financial and political dimensions but,

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at a more fundamental level, they can be the symptom of a failure of restructuring to take place in an orderly and efficient manner.

Adjustment crises are generally characterized by an existing productive structure that bears the full burden of the shock and faces extensive destruction, while the pace of creation and investment in the new structure remains excessively timid. In the common experience of countries subject to adverse external shocks, for example, sharp contractions in non-tradables are typically only followed slowly by growth in the tradables sector, giving rise to an acute employment problem. Brisk trade liberalization, it is often feared, may also lead to such a crisis, with an immediate contractionary effect on importables that is hardly counter-balanced by the gradual growth in exportables. Another example is provided by the recent experience of reforming economies in Eastern Europe, where the immediate collapse of the old state sector was typically only accompanied by a sluggish emergence of the new private sector ultimately intended to replace it.

As a consequence of the wedge between sharp immediate destruction and sluggish creation, an employment problem develops. Many workers who lose their jobs in the contracting sectors find themselves either in overt unemployment or being forced to take up much less attractive activity in the informal sector. When the state sector is involved, the employment crisis often leads to a surge in idle public-sector jobs.

1.2 A Micro-Structural Approach

We focus on supply-side aspects of adjustment, commonly viewed as the process by which the productive structure — the sectoral composition of output and allocation of factors, the techniques and relative factor proportions in use — adapts to a new environment.[1] Because of the embodiment of technology in capital, skills and the organization of work, restructuring usually necessitates a reallocation of factors of production, which involves the

[1]See, e.g., Mussa (1978) and Neary (1982) for seminal contributions to the analysis of the supply-side aspects of adjustment.

Our general notion of adjustment abstracts away from the specifics of the environment change that gives rise to it. We do not address, for example, the exchange rate and stabilization dimensions of external adjustment in developing countries; the sequencing of reforms in trade liberalization; or privatization and the behavior of the state sector in the Eastern-European reform experience. One aspect of our approach that makes it less directly applicable to the Eastern European case is the profit-maximizing behavior we assume for the contracting sector, which does not capture the nature of decision-making at the level of state enterprise. For analyses that address this issue, see, e.g., Chadha, Coricelli and Krajnyak (1993), Aghion and Blanchard (1993) and references therein. See also Shimer (1995) and Atkeson and Kehoe (1993) for, respectively, search and moral hazard models of reform sharing several of the positive implications of our model.

destruction of existing production units that developed under the old environment — with the accompanying loss of jobs and scrapping of capital — and the creation of other units better adapted to the new one.

We analyze market impediments to the restructuring process that lead to adjustment crises. A very promising approach, we believe, is to build our macro-analysis on the micro-structure that characterizes exchange in factor markets. We focus on the general incomplete-contracts problem of *appropriability* in labor and capital market transactions, which captures the essence of a broad variety of practical obstacles to well-functioning markets. Appropriability has been identified as a principal dimension of Coasian (1937) transaction description in the New Institutional Economics literature (Williamson, 1975 and 1985; Klein, Crawford, and Alchian, 1978; Hart and Moore, 1988). In our context, the problem arises in the joint use of capital and labor for production, when *specific* investment is required. In the absence of complete and binding contracts, investment specificity gives rise to quasi-rents that are appropriable by workers, who may engage in opportunistic behavior once investment is sunk (Grout, 1984). In Caballero and Hammour (1994), we show the general-equilibrium implications of appropriability for the cyclical and long-run behavior of investment, job flows, unemployment, and wages. In this paper, we trace major characteristics of adjustment crises to appropriability problems, which gain particular bite in times — such as adjustment episodes — when high rates of investment and job creation are required.

It is important to emphasize the prevalence of the appropriability problem, which applies to much more than simply job-specific human capital. There are a number of levels at which capital and labor interact — the individual worker-firm level, the union level, the aggregate political level — each level imprinting its own form of specificity on investment. Investment "specificity," here, is understood as the degree to which the asset would lose of its value if it is put to its best alternative use, possibly by other users. At the individual worker-firm level, the most exposed is specific training and organizational investment in the worker and his job. At the level of unions, or less formal worker coalitions with insider power, assets may have to be put to alternative use outside the firm or even the industry to escape the scope of the union. It is then the totality of firm- or industry-specific assets that may be exposed. At the highest level of political interaction between capital and labor interest groups, even more generic assets become appropriable through such measures as the right to strike, employment protection legislation, redistributive corporate taxation, or even the possibility — historically quite relevant in the developing world — of outright state

expropriation.[2]

1.3 Unbalanced Restructuring, Sclerosis, and Wage "Rigidity"

Problems of appropriability can have highly disruptive consequences on the functioning of labor and capital markets during adjustment. They generally induce the sluggish job creation and excessive destruction that characterize adjustment crises, and the ensuing employment problem. The prospect for firms of having to yield part of the value they invest effectively increases their investment costs, and depresses investment and job creation in the newly expanding sectors. Given the depressed rate of creation, the economic system ought to keep destruction in the contracting sectors at a low enough level commensurate with the creation rate, if it is to avoid wasting resources. Instead, the economy tends to destroy jobs extensively during adjustment. At a time when intense creation and hiring are needed, excessive job destruction and more difficult employment opportunities are the system's endogenous way of restraining the bargaining position of workers in their transactions with firms to avoid wage surges and guarantee the return on investment required by financial markets. Workers who loose their jobs because of the gap between creation and destruction in the formal sector must either take on much less attractive employment in the informal sector, or find themselves openly unemployed when some form of unemployment insurance is available.

Paradoxically, despite excessive destruction at the outset of adjustment, appropriability also induces "sclerosis" in the adjustment process. Sclerosis characterizes a productive structure that, ultimately, does not adjust sufficiently to new conditions — by changing the sectoral composition of output, adopting new techniques, changing the capital-output ratio, etc. In the presence of appropriability, the ultimate extent of restructuring is hampered by the high *effective* creation costs brought about by transactional inefficiencies.

The observed wage behavior implied by the micro-structural inefficiencies we focus on differs from the fixed wages assumed in traditional models of adjustment (e.g., Lapan, 1976; Neary, 1982; Edwards, 1988; Edwards and van Winjbergen, 1989). Those models assume that wages are fixed in terms of the expanding sector's good, or a basket with a large share of it — a necessary condition for excessive destruction. Empirical evidence on wages during adjustment, however, is not supportive of that assumption. In her careful description of

[2]See Thomas and Worrall (1994) for an analysis of appropriability through state expropriation in the case of foreign direct investment.

Latin American labor-market legislation, Cox-Edwards (1993) finds that minimum-wage laws have become largely nonbinding in Latin America today. In comparative studies, authors such as Fallon and Riveros (1989) or Horton, Kanbur and Mazumdar (1994) find a great degree of wage responsiveness during the adjustment experiences of a broad sample of developing countries. In our model, wages may look quite flexible during adjustment, although rigidity will still appear in more subtle ways. In extreme cases, we show that wages may move with exactly the same flexibility as in an efficient economy, but, in order to do so, they require the "quantity" movements of high destruction and underemployment usually associated with rigid wages — a phenomenon we call *covert* rigidity. In other words, labor market problems may disrupt quantities but leave little trace on prices. More generally, we show that wages are characterized by a mixture of "covert" and "overt" rigidity, the degree of which is ultimately determined by the structure of creation costs.

Rather than looking at empirical wage variability, a better measure of the appropriability problem in labor markets can be found in the degree of labor market segmentation. Indeed, when the degree of asset specificity and appropriable quasi-rents differ across sectors — as is normally the case, for example, between the formal and informal sectors — it is very natural that wages also differ in equilibrium. Appropriability can thus very naturally account for labor market segmentation, which is a preponderant feature of labor markets in the developing world (e.g., Lopez and Riveros, 1989; Fallon and Riveros, 1989).

1.4 Policy Responses

By the nature of their driving assumption, fixed-wage models often disassociate the treatment of the destruction margin — driven by fixed wages and their ad hoc adjustment dynamics — and that of the creation margin — driven by investment dynamics. This typically results in a dichotomy between a "short-run" analysis of the effect of fixed wages on destruction, and a more neoclassical "long-run" analysis of creation. Because of this dissociation, fixed-wage models do not naturally lead to an integrated view of the joint effect of different policies on the creation and destruction margins. In fact, the popular prescription of gradualism in the context of those models can be quite sensitive to the fact that its effect on creation is typically not explicitly modeled. In contrast, one of the central features of policy analysis in this paper is the emphasis on the fact that policies targeted at distortions in one margin typically have counter-productive implications for distortions in the other margin. The real test is whether gradualism can close the wedge between creation and destruction to help redress the transitional employment problem. From that point of view,

we find little reason in our analysis for an effective "synchronizing" effect of gradualism on creation and destruction. Gradualism can only reduce the destructive effect of adjustment by also reducing the economy's already depressed creation rate, and thus does not seem to constitute, by itself, an effective solution in terms of economic efficiency.

Policy analysis must go beyond the gradualism versus cold turkey debate, and examine the managed-adjustment policies needed in face of unbalanced restructuring. Despite the fact that the economy's ills are ultimately institutional in nature, we focus, for a number of reasons, on macroeconomic rather than institutional cures. There often is little the government can do to directly remedy incomplete-contracting inefficiencies in transactions. When social institutions and legislation are concerned, change may be either politically infeasible, or undesirable because of its social and distributional consequences. Our analysis of macroeconomic policies is conducted in terms of canonical policies that directly address distortions in the creation and destruction margins. It is there that the interaction between the creation and destruction margins is clearest. On one hand, the depressed rate of creation calls for a creation incentive (e.g., an investment tax credit or an export subsidy), but intensified hiring may in turn put pressure on the labor market and exacerbate destruction. On the other hand, excessive destruction calls for job-protection policies (e.g., employment subsidies in the contracting sectors or "gradualism"), but those may discourage creation by raising the opportunity cost of labor. What is needed is an integrated program that addresses distortions in both margins simultaneously. We argue that healthy adjustment in the presence of appropriability requires a combination of creation incentives in the expanding sectors and employment protection in the contracting ones. Going back to the debate on gradualism, the implication is that a gradualist approach must be supported by vigorous creation incentives to be effective.

The rest of this paper follows in four sections. First, we develop in section 2 a simple model of adjustment that captures supply-side aspects of adjustment and of the disruptive role of appropriability. Section 3 turns to the analysis of the traditional gradualist prescription, and section 4 derives the optimal policies that can restore efficiency. Finally, section 5 presents some concluding remarks.

2 Appropriability in a Simple Model of Adjustment

To fix ideas, we take the example of trade reform as a paradigmatic case of adjustment. We start with a simple model that presents our perspective on restructuring in the adjustment

process and of the disruptive effect of appropriability. In order to have a simple solution, we assume that adjustment is linear in all its aspects. This results in some unpleasant features, such as instantaneous reallocation in the efficient economy, and degenerate destruction more generally. However, our main results do not hinge on linearity, which we relax in sections 3 and 4.

2.1 A Simple Model of Adjustment

Our economy has two goods, X ("exportables") and M ("importables"). Importables are used as the numeraire. The representative infinitely-lived household has linear utility:

$$\int_t^\infty [C_x(s) + C_m(s)]\, e^{-r(s-t)} ds. \tag{1}$$

Household labor supply is perfectly inelastic, with a labor force equal to $\overline{L}$.

Both goods are produced with similar Leontieff technologies. We choose measurement units in such a way that, for each of the goods, one unit of sector-specific capital and a worker combine in fixed proportions to form a *production unit* and produce one unit of the good.

Initial conditions. We assume that before liberalization the economy is closed to international trade and in long-run full-employment equilibrium. Since consumers are indifferent with respect to X and M, both goods have pre-liberalization prices equal to 1 and the initial allocation of factors is arbitrary. We let L_m^- and L_x^- stand for employment in the M and X sectors, where a minus-sign superscript denotes pre-liberalization quantities.

Liberalization. Let the international relative price of X with respect to M be $\theta^* > 1$, which is given for the country. An unanticipated full trade liberalization takes place at $t = 0$. It amounts to exposing domestic consumers and producers to the international relative price. We assume that the capital account is open, and that the world interest rate is r, the same as the domestic discount rate. Since consumers are indifferent between the two goods, they specialize in good M. Producers, on the other hand, would like to specialize in good X. The cost of setting up a new production unit is c_0, which is a generic investment cost that stands for physical capital as well as organizational and training costs. Creation $H(t)$ takes place in the X sector, with all workers being hired from the unemployment pool $U(t)$.

Appropriability. The appropriability of investment is an incomplete-contracts problem

that can afflict the efficiency of the job-creating transaction between a firm that invests c_0 and the worker it hires. When part of the investment is "specific" to the production unit, there may not be a way to write a binding and complete contract to ensure that all the quasi-rents attributable to the investment go to the firm.

To capture this idea, we introduce a parameter $\phi \in (0,1]$ that measures the share of investment whose quasi-rents are appropriable. To fix ideas, consider a job that requires a \$1,000 investment, of which \$700 must be spent on equipment that can be resold at cost and \$300 on specific training to the worker that is of no use elsewhere. When appropriability operates only at the individual firm-worker level, the parameter ϕ is equal to 0.3 if no binding contract can be signed. If the worker belongs to a powerful union, or if his job is protected by legal restrictions, dismissing him and selling the machine may be more difficult and would effectively raise ϕ.

Incomplete contracting creates a flow of appropriable quasi-rents that must be shared by the two parties through a bargaining process. Let $\Pi(t)$ denote the surplus over which a firm and a worker who meet at time t must bargain. Bargaining takes place according to the continuous-time generalized Nash solution. A share $\beta \in (0,1)$ of the surplus goes to the worker and $(1-\beta)$ goes to the firm.

The surplus $\Pi(t)$ is equal to the value that the match creates above what the worker and the firm can effectively claim as their best alternative. Because of the appropriability problem, the firm can only recover $(1-\phi)c_0$ of its investment if it drops out of the match. The worker's best alternative in the calculation of the match surplus is the *shadow wage* $\tilde{w}(t)$, equal to the opportunity cost to a worker of remaining on the job rather than turning unemployed and searching for another job. We can thus write the match surplus as:

$$\Pi(t) = \int_t^\infty [\theta^* - \tilde{w}(s)]\, e^{-r(s-t)} ds - (1-\phi)c_0, \qquad t \geq 0. \tag{2}$$

It is equal to the present value of the future revenue θ^* from production minus the worker's shadow wage $\tilde{w}$, after subtracting the protected part of the creation cost c_0. In turn, the opportunity cost $\tilde{w}(s)$ for the worker of holding the job is equal to the instantaneous probability $H(t)/U(t)$ of finding another match times the part $\beta\Pi(t)$ of the match surplus he would get there:

$$\tilde{w}(t) = \frac{H(t)}{U(t)} \beta \Pi(t). \tag{3}$$

Equilibrium Conditions. We assume free entry for new production units. This means

that, as long as entry is taking place, the cost of creating a production unit is equal to the entrant's share of the match surplus plus the part of investment that can be protected.[3] Rearranging this condition, we get

$$\phi c_0 = (1-\beta)\Pi(t). \tag{4}$$

The firm's share of the match surplus must compensate it exactly for the unprotected investments it is called on to make. This shows clearly that, under free entry, a positive match surplus is created if and only if there is an appropriability problem. Otherwise, if $\phi = 0$, the free-entry condition becomes $\Pi(t) = 0$, which by (2) is the standard condition that equates c_0 to the present value of quasi-rents.

Solving out for $\Pi(t)$, equations (3)-(4) imply the following equilibrium conditions for all $t \geq 0$:

$$\tilde{c}(t) = \int_t^{\infty} [\theta^* - \tilde{w}(s)]\, e^{-r(s-t)} ds, \tag{5}$$

$$\begin{cases} L_m(t) = \bar{L_m}, & \text{if } \tilde{w}(t) < 1; \\ 0 \leq L_m(t) \leq \bar{L_m}, & \text{if } \tilde{w}(t) = 1; \\ L_m(t) = 0, & \text{if } \tilde{w}(t) > 1, \end{cases} \tag{6}$$

$$U(t) = \bar{L} - L_x(t) - L_m(t), \tag{7}$$

$$H(t) = dL_x(t)/dt, \tag{8}$$

where

$$\tilde{c}(t) = (1+b)c_0, \tag{9}$$

$$\tilde{w}(t) = \frac{H(t)}{U(t)} b c_0, \tag{10}$$

and

$$b \equiv \frac{\beta}{1-\beta}\phi. \tag{11}$$

The first equation governs free entry in the economy, where the "effective" creation cost $\tilde{c}(t)$ is distorted by a factor b.[4] This distortion is due to the problem of appropriability. In equilibrium, the part of investment whose quasi-rents are appropriated by workers is bc_0. The "appropriation" parameter b given by (11) is increasing in the degree of appropriability

[3] Formally, the free-entry condition is $c_0 = (1-\beta)\Pi(t) + (1-\phi)c_0$.

[4] For creation to be economically sensible, we must assume that the effective creation cost is low enough so as to be covered at least by the present value of revenues — i.e. $(1+b)c_0 < \theta^*/r$.

ϕ and in the bargaining power of workers β. The second equation is the exit condition. It states that production units in the M sector are scrapped or preserved depending on whether their associated quasi-rents are negative or positive, which in turn depends on whether the shadow wage $\widetilde{w}(t)$ is greater or smaller than 1 (productivity in that sector). The latter is given by equation (10), which follows from (3) and (4). The third and fourth equations are accounting equations that define unemployment and hiring.

An attractive feature of the decentralized-bargaining equilibrium in this economy is that it converges to the efficient competitive outcome as the appropriation parameter b goes to zero. In the limit, the effective creation cost in (9) becomes undistorted, and the shadow wage in (10) becomes whatever is needed to clear the labor market and bring unemployment down to zero.[5]

The Nature of Unemployment. The free-entry condition (5) can be differentiated with respect to t and solved for the constant shadow wage that guarantees the required return on investment. Expression (10) can then be used to calculate, for a given level of hiring, the level of unemployment needed to yield the required shadow wage in equilibrium. We get

$$\widetilde{w}(t) = \theta^* - r(1+b)c_0; \tag{12}$$

$$U(t) = \frac{bc_0}{\theta^* - r(1+b)c_0} H(t). \tag{13}$$

It is clear that, in an economy with important needs to restructure and hire workers in new locations, unemployment is the result of the positive match surpluses that result from appropriability. If unemployment were zero, workers would find it infinitely easy to capture the positive surplus of an alternative job. This outside alternative would make their shadow wage infinite (equation 10), which renders job creation prohibitively expensive and generates unemployment. Unemployment is, thus, an equilibrium response of the economic system that restrains the bargaining position of workers in the presence of appropriability and preserves the profitability of investment. As equation (13) makes clear, times of adjustment and intense gross hiring require high transitional unemployment to prevent surges in shadow wages and keep them at a level that makes job creation pay off.

[5]Equation (10) turns into the full-employment equation once we multiply both sides by $U(t)$ and set $b = 0$.

2.2 Sclerosis and Unbalanced Restructuring

Sclerosis. We can now solve for the evolution of this economy. Solution (12) for the shadow wage together with the exit condition (6) defines an *inaction range* in parameter space, in which sector M remains profitable and no adjustment takes place following reform. The inaction range is given by $\theta^* < 1 + r(1+b)c_0$, which clearly indicates that it is not enough for the world relative price θ^* of exportables versus importables to be greater than 1 for restructuring to occur. θ^* must be sufficiently larger than 1 to justify spending the additional creation costs.

Note that there is a segment $\theta^* \in (1 + rc_0, 1 + r(1+b)c_0]$ of the inaction range where the inefficient economy does not adjust, while efficiency would require adjustment. The greater the appropriation parameter b, the larger is this segment of the inaction range. Thus, appropriability can prevent adjustment from taking place altogether in cases when it is efficient to adjust. This is the first manifestation of an effect of appropriability that we term *sclerosis.*

Sclerosis arises in the economy whenever the productive structure does not adjust sufficiently in response to new conditions — by changing the sectoral composition of output, adopting new techniques, changing the capital-labor ratio, etc. In this particular case, appropriability can cause the productive structure to be locked into its past and not adjust in response to the opening of trade, despite the efficiency of doing so. The reason for sclerosis is the high effective creation costs induced by appropriability (equation 9), which reduce the incentive for creation as well as the hiring pressure on wages and destruction (equation 12).

The fact that sclerosis takes the extreme form of fully aborting restructuring is due to the degenerate initial distribution in the M sector. Generally speaking, sclerosis leads to incomplete — rather than fully aborted — restructuring, as is the case in the heterogeneous-technology model analyzed in sub-section 2.4, or when the M-sector exhibits diminishing returns to labor.

Unbalanced Restructuring. Outside the inaction range, the M sector is instantly scrapped and dynamics are governed by equations (7) and (8) with $L_m(t) = 0$:

$$dU(t)/dt = -H(t) \qquad \text{with} \qquad U(0) = L_m^-. \tag{14}$$

Taking (13) into account, the solution to this equation is, for $t \geq 0$:

$$U(t) = L_m^- e^{-\frac{\theta^* - r(1+b)c_0}{bc_0} t}, \tag{15}$$

$$L_x(t) = \overline{L} - U(t),$$

$$L_m(t) = 0.$$

The whole M sector is scrapped instantly following reform, leading to a jump in unemployment. However, creation in the X sector is gradual and can only absorb the unemployed progressively over time. Asymptotically, the economy adjusts fully and reaches full employment.

This path has very inefficient characteristics. As we have seen, the efficient competitive outcome corresponds to the limit when b goes to zero. It is easy to see that adjustment in the efficient economy is instantaneous and complete at time $t = 0$. In contrast, an economy subject to appropriability problems exhibits sluggish creation. This means that creation and destruction are out of balance and lead to transitional unemployment costs. Although instantaneous efficient adjustment is not a very attractive feature of this simple model, we show in the convex model of section 3 that the de-synchronizing effect of appropriability on creation and destruction does not hinge on this. Moreover, we show that, at the outset of reform, appropriability generally leads to *insufficient creation* and *excessive destruction* compared the efficient outcome. The fact that, in the present case, destruction is equal to its efficient level is only due to the maximal, instantaneous rate at which the latter takes place.

2.3 Covert Wage Rigidity

Although this model exhibits the transitional unemployment usually associated with fixed-wage models (e.g., Lapan, 1976; Neary, 1982; Edwards and van Winjbergen, 1989), wages may appear quite flexible. In fact, in the special linear case we are analyzing, wages are the same as what they would be in an efficient economy. To see this, denote by w_x the actual wage paid by exporting firms (the only firms after liberalization). Note that w_x is not equal to the opportunity cost of labor, $\widetilde{w}$, for we need to add the part of the match surplus that goes to the worker, which in flow terms amounts to rbc_0:

$$w_x = \widetilde{w} + rbc_0 = \theta^* - rc_0.$$

This expression is independent of b, and is therefore exactly equal to the wage paid in an efficient economy where $b = 0$.

Although the wage behaves as in the efficient outcome, what is inefficient are the quantity adjustments — in the form of unbalanced restructuring and high transitional unemployment — needed to restrain it from surging beyond that level during times of intensified hiring (see equation 10). In other words, the wage appears adequate, but actually harbors a hidden form of rigidity that manifests itself entirely in the equilibrium quantities that support it. In Caballero and Hammour (1994), we dubbed this phenomenon *covert rigidity*. As we will see in the convex model of section 3, observed wages exhibit, more generally, a mixture of "overt" and "covert" rigidity, which partly keeps them above their efficient level and partly requires quantity adjustments to restrain them from being even higher.[6]

The variability of wages is consistent with the empirical evidence on wages, which generally exhibit a great degree of responsiveness in case studies of adjustment (Fallon and Riveros, 1989; Horton, Kanbur, and Mazumdar, 1994). However, it raises an important caveat for the interpretations of those findings, from which some authors have concluded that adjustment crises are not due to malfunctioning labor markets. In their recent World Bank study of the role of labor markets in the process of adjustment, for example, Horton, Kanbur and Mazumdar (1994) conclude:

> [T]here are three possible explanations as to why unemployment may persist during stabilization. The first is that the labor market is not working well because of real wage rigidity. The evidence presented by the case studies certainly does not favor the view that real wages were rigid, and therefore led to unemployment. Even for Chile, where unemployment was highest and persisted the longest, real wages fell dramatically. [...] [T]his leaves the other two explanations: aggregate demand feedback from declining real wages to output and output market imperfections. (Vol. 1, pp. 19-20)

[6] In the linear model, the shadow wage rises in terms of importables following reform. This is very natural, and is precisely the reason why the M sector contracts. In our convex model, this shadow wage remains unchanged while the M sector is being depleted, and jumps to its long-run value when the process is completed.

For the X sector, the product-wage in both models also generally rises *in the long run*. This effect is only due to the fact that creation costs were assumed fixed in terms of *importables*, thus making it cheaper to create following reform. Had we fixed those costs in terms of exportables instead, the long-run product wage in the X sector would have been unchanged. In the transition, however, the product-wage in the X sector jumps immediately to its long-run value in the linear model, but remains temporarily lower in the convex model to induce intense creation.

Our model clearly shows that looking at the path of real wages in isolation to assess the extent of labor market rigidity — which comes from the practice of modeling wages as exogenously fixed — can be quite misleading. Variable real wages do not necessarily imply that the labor market functions adequately. Other forms of empirical evidence is needed to assess the workings of the labor market. Looking at the degree of segmentation in labor markets — which is preponderant in the developing world (see, e.g., Lopez and Riveros, 1989; Fallon and Riveros, 1989) — may constitute a better test. As we explain in sub-section 2.5, segmentation is a very natural feature of a labor market afflicted by appropriability problems. Another class of evidence can be gleaned from the institutional features of labor markets that characterize the more "visible" aspects of appropriability. Cox-Edwards (1993) gives a careful account of the predominant institutional distortions in Latin American labor markets. These include employment protection laws, payroll taxes, and antagonistic labor-management relations that encourage confrontation and costly settlement procedures. Consistently with the authors cited above, she concludes that minimum wages are not on the list of the most pressing labor market issues in Latin America today.

2.4 Productivity Cleansing During Adjustment

Our structural approach, based on the embodiment of technology, allows us to characterize the adjustment process further, once we allow for heterogeneous technologies. In that case, it is simple to see that the shock of liberalization affects the least efficient productive units the most. Thus, if gives rise to a phenomenon of productive "cleansing" in the economy, which finds growing support in the empirical literature.

To develop this point, we modify the above model and assume that the initial distribution of production units in the X and M sectors is heterogeneous in the technologies in use. For each production unit, we use a as an index for the outdatedness of the technique in use and assume a productivity of $1-a$. Technology available today in both sectors corresponds to $a = 0$.

The distribution of production units across techniques is given by the history of technology adoption (see Caballero and Hammour, 1994) and government intervention. For each sector, we assume a non-degenerate initial distribution over the range $a \in [0, \overline{a}^-]$, where the scrapping margin $\overline{a}^-$ is determined by the zero profit condition

$$1 - \overline{a}^- = \widetilde{w}^-,$$

and the shadow wage

$$\tilde{w}^{-} = 1 - r(1+b)c_0$$

is determined in the same way as in equation (12).[7]

Consider what happens after liberalization. The interesting phenomena here arise inside the old inaction range ($\theta^* < 1 + r(1+b)c_0$), where we assume the economy is, otherwise there is still a complete and instantaneous scrapping of the M sector. Liberalization is followed by instant scrapping of all production units that do not satisfy the new zero-profit condition, which is now different for the two sectors because of the change in their relative price. The new scrapping margins for sectors M and X, respectively, are given by

$$1 - \bar{a}_m = \tilde{w} \tag{16}$$

and

$$\theta^*(1 - \bar{a}_x) = \tilde{w}, \tag{17}$$

where $\tilde{w}$ is still given by the free-entry condition in the X sector (equation 12). Dynamics after the initial scrapping are as before. The unemployed who lost their job after the initial shock of liberalization are hired gradually into the expanding X sector, while production units in both sectors that were not scrapped initially subsist in the long run.

Following liberalization, the scrapping margins (16)-(17) tighten in both sectors by the amount of increase in the product wage. This phenomenon of "cleansing" of the productive structure following reform, that results in an improvement in average productivity, finds empirical support in the recent literature (see, e.g., Liu's 1993 study of Chilean manufacturing plants during the 1979-86 period). It is also immediate from (16)-(17) that the scrapping margin tightens more markedly for the M sector than for the X sector ($\bar{a}_m < \bar{a}_x$).[8] This implies that productivity cleansing following reform is likely to be more extensive in importables than in exportables, which also finds empirical support (see, e.g., Tybout, De Melo and Corbo, 1991; Haddad, 1993; Corbo and Sanchez, 1992; Marshall, 1992).

With heterogeneous technologies, the problem of sclerosis discussed in sub-section 2.2

[7] The shadow wage is determined by the free-entry condition, even though we assume that the economy at time zero is in long-run equilibrium with zero entry. This is because the threat point of a worker is still to find a potential entrant, even if such a threat is not realized in equilibrium.

[8] In fact, the only reason the scrapping margin tightens and the product wage rises in the X sector is because we have assumed that creation costs are fixed in terms of *importables*. Had we assumed them fixed in terms of exportables, the product wage in the X sector would have remained unchanged. Had we also assumed convex adjustment costs, the X-sector wage would have fallen in the transition.

gains a technological dimension. One can see from equations (12) and (16) that a greater degree of appropriation b lowers the shadow wage and loosens the scrapping margin $\bar{a}_m$ in the M sector. All production units with $a \in [rc_0 - (\theta^* - 1), r(1+b)c_0 - (\theta^* - 1)]$ subsist despite the fact that they ought to be scrapped in an efficient world. Sclerosis is now not just a problem of producing the wrong goods, but also of producing all goods with inefficient technology.

2.5 Unemployment, the Informal Sector and Segmented Labor Markets

In developing countries, where unemployment benefits are sparse at best, unemployment is typically "hidden" in the form of participation in low-productivity informal-sector activities. Instead of a surge in open unemployment, the transitional employment problem may take the form of a surge in informal sector employment.

The segmentation of labor markets between the formal and informal sector arises very naturally in our context, if informal-sector technology requires less asset specificity or allows workers to avoid entering into a bilateral transaction with capital owners.[9] The simplest case in which this happens is when the technology requires no capital. We modify our model and assume that, in the informal sector, workers can become self-employed in an activity that requires no capital and yields a — possibly quite low — productivity $\pi < 1$. To stay as close as possible to the above model, we denote total informal sector employment by U, and assume that all workers hired in the formal sector come from the informal one.

The only modification to equilibrium conditions (5)-(11) comes from the fact that we must add the productivity of informal-sector activity to the opportunity cost of labor in (10):

$$\tilde{w}(t) = \frac{H(t)}{U(t)} bc_0 + \pi.$$

This means that the level of informal sector employment $U(t)$ needed for a given level of hiring is now higher than in equation (13), and equal to

$$U(t) = \frac{bc_0}{(\theta^* - \pi) - r(1+b)c_0} H(t).$$

The possibility of engaging in informal-sector activity strengthens workers' threat point, which must therefore be offset by an even higher level of U to maintain firm profitability.

[9] For an analysis of some of the consequences of labor market segmentation in small open economies, see, e.g., Agenor and Aizenman (1994).

The dynamic equation (15) characterizing $U(t)$ becomes

$$U(t) = L_m^- e^{-\frac{(\theta^* - \pi) - r(1+b)c_0}{bc_0} t}.$$

A more productive informal sector further slows down the adjustment process.[10]

The divide between the formal and informal sector is only one aspect of the segmentation that can arise in the presence of appropriable investment. Naturally, as we mentioned above, any sectoral differences in the degree of asset specificity can cause segmentation. Moreover, many differences in the determinants of profitability that arise *after* some investment is sunk can interact with appropriability and lead to wage differentials — as is the case, for example, of the model with heterogeneous technologies developed in the previous sub-section.[11]

3 Gradualism

Our approach to adjustment crises provides us with a framework for the study of alternative policy responses. In this section we concentrate on the popular prespcription of *gradualism*, and in the next we turn to the question of optimal policy design. Our analysis of gradualism provides an opportunity to generalize to a convex model of adjustment the central results we obtained for the linear model of the previous section.

We have seen that appropriability induces two distortions in the transition: depressed creation and excessive destruction. The wedge between the two gives rise to an employment crisis. Much of the popularity of gradualism derives from the idea that it can relieve the transitional employment crisis by slowing down destruction, presumably under the implicit assumption that creation is little affected. In fact, there is little reason why slowing down the transition will not also exacerbate the sluggishness of creation. The net efficiency effect of slowing down *both* creation and destruction — and of delaying the net benefits of adjustment in the process — are ambiguous, and likely to depend on the specifics of the situation.[12]

[10] Note that exactly the same effect would arise from the introduction of unemployment benefits.

[11] To calculate the actual wage differentials, we need to make additional assumptions about the out-of-equilibrium uses of the non-appropriable component of capital, including the relation between those uses and current productivity and location. Most reasonable scenarios, however, lead to wage differentials that are related to the relative profitability of the production units being compared.

[12] There is a class of models characterized by *over-investment*, where the pace of *both* creation and destruction are excessive, and where the welfare-improving properties of gradualism are therefore unambiguous. A good example can be found in Gavin (1993), who advocates gradualism based on a congestion model of search. His assumption, that the matching function is a concave function of unemployment only, implies

To uncover the tension between the effects of gradualism on the creation and destruction margins, we analyze two extreme cases. The first extreme highlights the distortion in the creation margin and corresponds to the simple linear model presented above. Because destruction in that model is instantaneous in both the efficient and inefficient case, the only problem with transitional dynamics is sluggish creation. Since gradualism can only slow down creation further, its efficiency effect is unambiguously negative. In that case, what would be required instead is "accelerationism."

The other extreme we analyze highlights the distortion on the destruction margin. It consist of the same simple model analyzed above, but now with a special form of *convex* creation costs. Convex creation costs lead to non-degenerate destruction dynamics, and the special assumptions we make imply that the dominant distortion is always on the destruction side. In that case, gradualism is always beneficial.

Those two extreme cases reveal the limitations of gradualism when the goal is to simultaneously slow down destruction and accelerate creation. Because it slows down both margins simultaneously, gradualism is unlikely to be an effective "synchronizer" of creation and destruction. Its main effect will be to spread out transitional underemployment costs over time, but is unlikely to reduce them effectively. In a more general setting, the economy will present a mixture of the two extremes we analyze, with phases of adjustment where gradualism is beneficial, and phases where accelerationism is. This alternation between gradualism and its opposite, depending on which of the creation- or destruction-margin distortions is dominant, shows more generally the limitation of using a single policy instrument to address distortions on the two margins. Policy analysis should go beyond the gradualism versus cold-turkey dichotomy, to the design of managed adjustment programs with multiple policy instruments. This we proceed to examine in the next section.

Throughout this section, we model a gradualist reform as the temporary introduction of a path of tariffs $\{\tau(t)\}_{t\geq 0}$ following reform to protect the importables sector. We assume the tariff is small enough so the domestic relative price of exportables $\theta(t)$ remains above one:

$$\theta(t) = \frac{\theta^*}{(1+\tau(t))} \geq 1, \qquad t \geq 0.$$

In order to reduce technical complications in the analysis, we assume from here on that the capital account is closed and that the interest rate r is given by the subjective discount rate

that high unemployment, by facilitating matching, pushes creation above its socially efficient level.

in the utility function (1).[13] We assume parameters are such that the balance-of-payments constraint is not binding (i.e., desired domestic investment does not exceed desired domestic saving).

3.1 Gradualism with Sluggish Creation

In this sub-section, we turn to gradual opening-up in one extreme case that corresponds to the simple linear model of sub-section 2.1. It is easy to see how equations (5)-(14) remain the same when a tariff is introduced at time $t = 0$, except that the world relative price θ^* must now be replaced by the distorted domestic price $\theta(t)$. In particular, the shadow wage is now given by

$$\widetilde{w}(t) = \theta(t) - r(1+b)c_0. \tag{18}$$

Assuming model parameters are such that even with gradualism the economy does not fall inside the inaction range (i.e. that $\theta(t) > 1 + r(1+b)c_0$, for all $t \geq 0$), the path of unemployment is now given by

$$U(t) = L_m^- e^{-\int_0^t \frac{\theta(s)-r(1+b)c_0}{bc_0} ds}, \qquad t \geq 0. \tag{19}$$

We define two paths of reform. The *gradualist* path $\{\theta^g(t)\}_{t=0}^{\infty}$ is characterized by an increasing $\theta^g(t)$ that reaches θ^* asymptotically. The *cold-turkey* path $\{\theta^c(t)\}_{t=0}^{\infty}$ is simply given by $\theta^c(t) = \theta^*$ for all $t \geq 0$. It is clear from equations (18)-(19) that the gradualist path is characterized by lower shadow wages, higher unemployment, more sluggish creation and a smaller X sector. Since we have assumed that we remain outside the inaction range, destruction is the same in both scenarios. Gradualism in this case has one effect, which is to reduce the relative-price incentives to create in the exportables sector. It leads to reduced creation and, given complete destruction in importables, higher unemployment.

We analyze *welfare* in this economy from the point of view of allocational efficiency, and define it as the present value of aggregate domestic income net of investment expenses:

$$W(t) = \int_t^{\infty} \left[\theta^* L_x(s) + L_m(s) - c_0 H(s)\right] e^{-r(s-t)} ds. \tag{20}$$

[13]The difficulty comes from the change in the relative price of importables delivered domestically and importables delivered overseas that results from a gradual change in the tariff rate. This means that a world interest rate that is constant in terms of the M good delivered overseas, will not be so in terms of that good delivered domestically. To avoid changes in the interest rate, we close the capital account and equate the interest rate to the subjective discount rate.

Although, in principle, with linear utility the allocational and distributional problems are separable, we do not derive much comfort from this, given the severe limitation of governments' ability to redistribute income in a non-distortionary way. It does seem to us, however, that, *once reform has been decided*, an adjustment path that ranks high on allocational grounds will have to avoid wasted resources in the form of open or hidden unemployment, and will therefore potentially rank high on distributional and poverty-alleviation grounds as well.

The appendix calculates welfare for three scenarios: cold-turkey adjustment (W^c), gradualist adjustment (W^g), and no adjustment (W^n, which corresponds to keeping the old productive structure intact). First we show that, notwithstanding the disruptions due to appropriability problems, if cold-turkey adjustment is desirable from the point of view of private incentives, it will also be desirable from a social point of view:

$$W^c(0) - W^n(0) = \frac{1}{r}\left[(\theta^* - 1) - r(1+b)c_0\right] L_m^-,$$

which is clearly positive outside the inaction range.[14]

Turning to gradual adjustment, we show that

$$W^g(0) - W^c(0) = -\int_0^\infty \left[\theta^* - \theta^g(s)\right] U^g(s) e^{-r(s-t)} ds,$$

where $U^g(t)$ designates unemployment along the gradualist path. It is clear that this expression is negative when $\theta^g(t)$ stays below θ^*, and that gradualism is inferior to cold-turkey adjustment. In this extreme linear case, gradualist adjustment can only affect the creation margin. It slows down an already depressed creation rate, and results in increased unemployment as well as a delay in the net benefits of adjustment.

3.2 Gradualism with Excessive Destruction

The reason why gradualism fails to have any beneficial effect in the linear model is that destruction is degenerate and happens instantaneously. The gradualist argument hinges precisely on the idea that, by slowing down the destruction of the old structure, a gradu-

[14]The reason for this is that, outside the inaction range, the private distortion bc_0 to creation costs exceeds the social cost of the additional unemployment that results from creating an additional unit (equal to $U/H = bc_0/\widetilde{w}$ by equation 13, which is less than bc_0 outside the inaction range), while the private value of a new unit created in the X sector is less than its social value (because the private shadow wage exceeds the social shadow wage of zero in the presence of unemployment). Thus, a private decision to create is both cheaper and yields greater value from a social perspective.

alist approach can give more time for creation to build up the new one, and thus reduce transitional under-employment.

To capture this effect, we drop the assumption of linear creation costs and assume instead that fast creation is costly. The shadow wage no longer jumps to its long-run value following reform, precipitating all destruction at that point, but converges over time to its long-term value and brings about a progressive destruction of the M sector.

In order to highlight the beneficial effects of gradualism on destruction in as simple a setting as possible, we make special assumptions — on the form of creation costs and on the initial distribution of production units — that greatly simplify the analysis and imply that the destruction-margin distortion always dominates. In this extreme case, gradualism is always a beneficial — albeit far from optimal — policy response. At the end of this sub-section, we discuss the implications of more general assumptions.

The model. There are many reasons why an economy cannot instantly create a new productive structure: time to build, slow learning and technology adoption, limited savings, uncertainty, etc. To capture some of those effects, we modify the model in sub-section 2.1 and assume that the unit creation cost is increasing with the rate of creation $H(t)$. This can be due to standard convex capital installation and learning costs. It can also be due to a non-degenerate distribution of potential entrants (see Diamond 1994, chapter 1). For the reasons explained above, we choose for the marginal creation cost the special functional form $c_1 H(t)$, $c_1 > 0$.

Equilibrium conditions (5)-(11) must be modified.[15] The change in the specification of creation costs means that the shadow price signals (9)-(10) are now given by

$$\tilde{c}(t) = (1+b)c_1 H(t) \tag{21}$$

and

$$\tilde{w}(t) = \frac{H(t)}{U(t)} b c_1 H(t). \tag{22}$$

Let us first characterize adjustment in this economy without government intervention. We show by construction that, as long as θ^* is not too large, the transition ends in finite time $\overline{T}$ — creation, destruction and unemployment being positive before $\overline{T}$, and zero afterwards.

Ongoing destruction requires that wages rise to exactly eliminate all quasi-rents in sector M. By exit condition (6), the shadow wage will have to be 1 for $t < \overline{T}$, and θ^* afterwards

[15] Naturally, as in sub-section 3.1, θ^* must be replaced by the distorted price $\theta(t)$ in those equations.

to prevent further creation:[16]

$$\tilde{w}(t) = \begin{cases} 1, & 0 \leq t < \overline{T}; \\ \theta^*, & t \geq \overline{T}. \end{cases} \tag{23}$$

We use (5), (21) and (23) to solve for the creation rate

$$H(t) = \begin{cases} \frac{\theta^*-1}{r(1+b)c_1}\left[1 - e^{-r(\overline{T}-t)}\right], & 0 \leq t < \overline{T}; \\ 0, & t \geq \overline{T}. \end{cases} \tag{24}$$

This can be used to integrate the dynamic equation (8) using the boundary condition $L_x(0) = L_x^-$:

$$L_x(t) = \begin{cases} L_x^- + \frac{\theta^*-1}{r(1+b)c_1}\left[t - \frac{e^{-r\overline{T}}}{r}\left(e^{rt}-1\right)\right], & 0 \leq t < \overline{T}; \\ \overline{L}, & t \geq \overline{T}. \end{cases} \tag{25}$$

The unemployment rate along this path can be obtained from (23) and (22), taking (24) into account:

$$U(t) = \begin{cases} bc_1 H(t)^2, & 0 \leq t < \overline{T}; \\ 0, & t \geq \overline{T}, \end{cases} \tag{26}$$

with the destruction margin adjusting to generate the required unemployment. One can check that, provided that the technical condition $(\theta^* - 1) < \frac{1}{2}(1 + \frac{1}{b})$ holds, M-sector employment $L_m = \overline{L} - L_x - U$ initially jumps down by $U(0)$ and then falls monotonically to reach zero at time $\overline{T}$.[17]

Finally, the length $\overline{T}$ of the transition is determined from equation (25) by the requirement that the transition be complete at $\overline{T}$, i.e. $L_x(\overline{T}) = \overline{L}$. It is implicitly determined by the following equation:

$$\overline{T} - \frac{1 - e^{-r\overline{T}}}{r} = \frac{r(1+b)c_1}{\theta^* - 1}(\overline{L} - L_x^-). \tag{27}$$

[16]Note that, unlike the linear model, the shadow wage initially *falls* in terms of exportables (it drops from 1 to $1/\theta^*$). The same holds for the actual product wage w_x/θ^* in the X sector, which must fall below 1 to encourage intense job creation. In fact one can show that, for $t < \overline{T}$, $w_x/\theta^* = 1 - \frac{(\theta^*-1)}{(1+b)\theta^*}$. Thus, although the product wage falls in the transition, it falls by less — and exhibits more "overt" rigidity — the greater the appropriability parameter b is.

[17]We need to check that $dL_m/dt < 0$ for $t < \overline{T}$. Using (8), (24) and (26) to differentiate $L_m = \overline{L} - L_x - U$, we get $dL_m/dt = -H\left[1 - \frac{2b}{1+b}(\theta^* - 1)e^{-r(\overline{T}-t)}\right]$. Our condition is satisfied if and only if $(\theta^* - 1) < \frac{1}{2}(1+\frac{1}{b})$.

This model with progressive destruction adds realism and insight, and allows us to generalize to a convex setting our previous conclusions concerning unbalanced restructuring and sclerosis in the presence of appropriability. The path of adjustment in this economy and the disruptive effect of appropriability problems are illustrated in figure 1. The dashed lines correspond to an economy that suffers from appropriability problems ($b = 1$), while the solid lines correspond to an efficient economy (the limit as $b \to 0$).[18]

To characterize adjustment in an efficient economy we set $b = 0$ in equations (23)-(27). Because fast creation is costly, creation and destruction in that economy are progressive. More importantly, they go hand in hand and therefore generate no unemployment in the process (equation 26). Turning to an inefficient economy with $b > 0$, we obtain the following results: *(i)* $\overline{T} > \overline{T}^e$ (where the superscript "e" refers to the efficient-economy benchmark), i.e. transition takes longer than efficient, as measured by $\overline{T}$, which can be seen by differentiating $d\overline{T}/db > 0$ in equation (27); *(ii)* $L_x(t) < L_x^e(t)$ for all $t \in (0, \overline{T}^e]$, which means that creation in the X sector is slower that efficient, because of the high effective creation costs induced by appropriability;[19] *(iii)* Sector M suffers excessive destruction at the outset of reform. To see this, note that, unlike the efficient economy, equations (24) and (26) taken at $t = 0$ show that a segment of the M sector is destroyed instantly after reform to generate the unemployment required to prevent wage surges in response to increased hiring. This is followed by a more progressive destruction that depletes that sector over time; *(iv)* The wedge created between slow creation and excessive destruction gives rise to a wasteful surge in unemployment during the transition (equation 26).

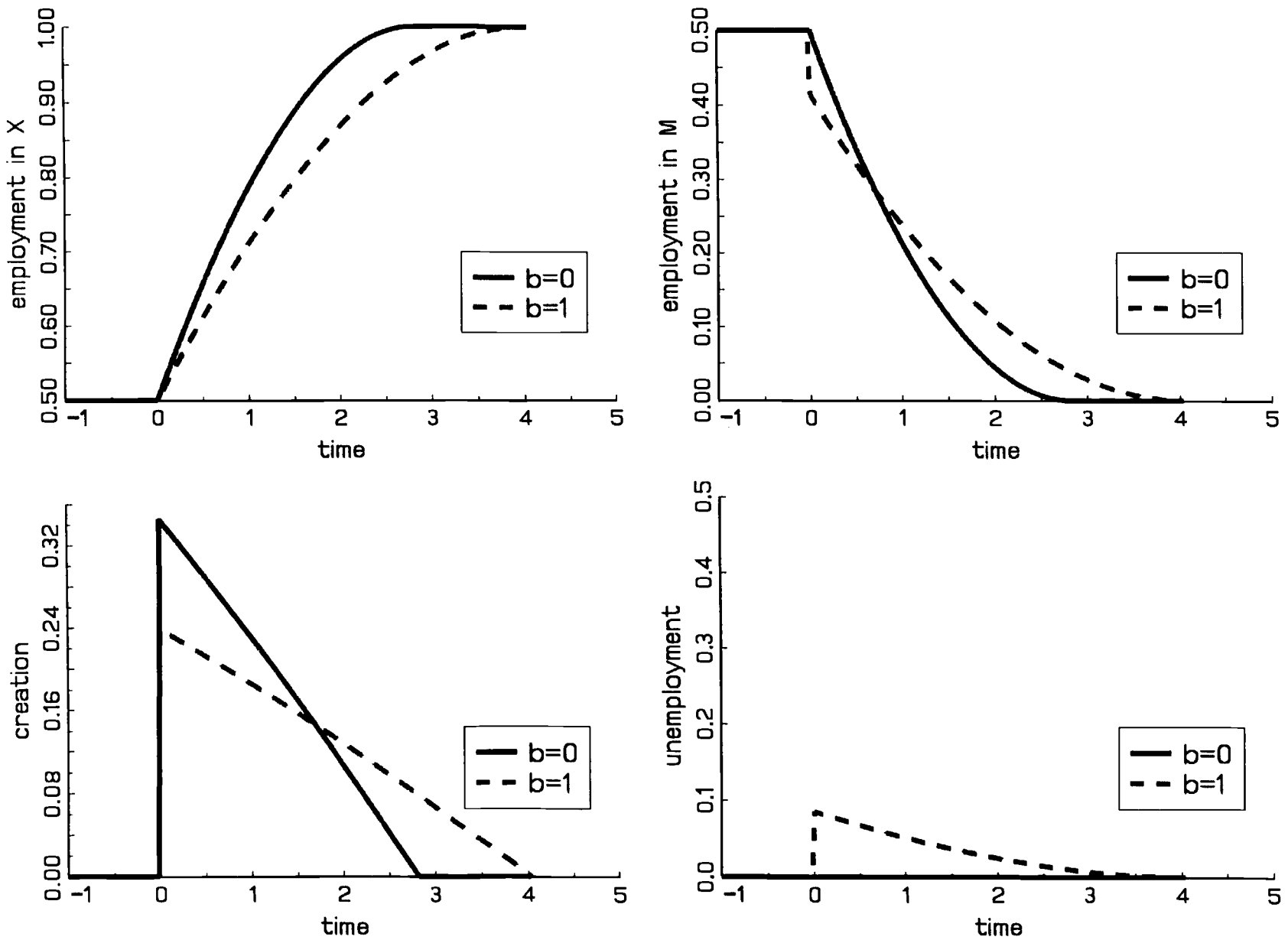
Gradualism. This model with non-degenerate destruction dynamics adds a new dimension to the welfare-analysis of gradualism. We have seen that the inefficient economy exhibits sluggish creation and excessive destruction. Although gradualism will slow down creation even further, it may help by reducing destruction. Could the latter effect overcome

[18] To generate the figure we used the following parameter values: $r = 0.06$, $\theta^* = 1.2$, $c_1 = 1.5$, and $L_x^- = L_m^- = 0.5$.

[19] To prove this we first show that $H(0) < H^e(0)$. Differentiate free-entry condition (5) with respect to time, taking (21), (23) and $\overline{T} > \overline{T}^e$ into account: $dH/dt = -\frac{(\theta^*-1)}{(1+b)c_1} + rH$, $t < \overline{T}^e$. By contradiction we must have $H(0) < H^e(0)$, otherwise we would have $H(t) > H^e(t)$ over the interval $[0, \overline{T}^e]$ because of the smaller (negative) slope dH/dt than in the efficient case. But $H(t)$ cannot exceed $H^e(t)$ over the whole interval $[0, \overline{T}^e]$, because that would contradict the fact that $\overline{T} > \overline{T}^e$.

Since $H(t)$ is decreasing, the fact that $H(0) < H^e(0)$ together with $H(\overline{T}^e) > H^e(\overline{T}^e) = 0$ implies that the inefficient path $\{H(t)\}$ crosses the efficient path $\{H^e(t)\}$ from below at a point $t^* \in (0, \overline{T}^e)$. This proves that $L_x(t) < L_x^e(t)$ for all $t^* \in (0, \overline{T}^e]$, for if L_x were to exceed L_x^e at some point, that point would have to be after t^* and would mean that $L_x(t) > L_x^e(t)$ from then on. But that contradicts the fact that $L_x(\overline{T}^e) < L_x^e(\overline{T}^e) = \overline{L}$.

FIGURE 1: ADJUSTMENT IN A CONVEX ECONOMY



the former, making gradualism a useful remedy?

To address this question, we write aggregate welfare in this economy as

$$W(0) = \frac{L_m^- + \theta^* L_x^-}{r} + \int_0^\infty \left[(\theta^* - 1)(L_x(t) - L_x^-) - U(t) - \frac{1}{2} c_1 H(t)^2 \right] e^{-rt}\, dt.$$

The first term corresponds to welfare if no adjustment takes place. The second term is equal to the improvement in welfare due to adjustment: the increase in the output of units that are reallocated from the M to the X sector, minus the loss of M-sector output due to transitional unemployment, minus total creation costs.

The loss of output due to unemployment can be considered an "unemployment-cost" of creation. That is because, by (26), lost output per unit-flow of creation is given by

$$\frac{U(t)}{H(t)} = bc_1 H(t), \qquad t < \overline{T}. \tag{28}$$

Note that this average unit-cost is exactly equal to the distortion to marginal creation costs introduced by appropriability. In other words, the appropriability distortion gives an adequate private signal of the unemployment-cost of creation that appears at the social level, up to one caveat: the left-hand side of (28) is an average cost, whereas the right-hand side is a marginal cost. Because of that subtle difference, private signals do not reflect the full social costs of creation.

To explore the advisability of a gradualist path of $\{\theta(t)\}$, we look for the path $\{\theta^o(t)\}$ that maximizes aggregate welfare. The first-order condition to the problem of finding the optimal path $\{H^o(t)\}$ of creation as driven by the optimal policy $\{\theta^o(t)\}$ is

$$\widetilde{c}(t) + bc_1 H(t) = \int_t^{\overline{T}^o} [\theta^* - 1]\, e^{-r(s-t)} ds, \qquad t < \overline{T}^o.$$

Compared with the decentralized free-entry condition (5), the social effective marginal creation cost exceeds the private cost by a term $bc_1 H(t)$ which precisely reflects the difference between marginal and average costs discussed above.

The fact that the social effective cost of creation is higher than the private one, implies that slowing down creation is beneficial. One can show that the optimal gradualist path is

$$\theta^o(t) = \begin{cases} \theta^* - \frac{b}{1+2b}(\theta^* - 1), & 0 \le t < \overline{T}^o; \\ \theta^*, & t \ge \overline{T}^o, \end{cases}$$

which is clearly less than θ^* during the adjustment period.

In this specific model gradualism helps because, through a subtle difference between average and marginal costs, it can reduce the unemployment-cost of creation along the best feasible path. But gradualism by itself cannot eliminate unemployment altogether. Put in other words, it is not an effective synchronizer of creation and destruction, because it requires reducing the former in order to reduce the latter. If we could reduce unemployment by reducing destruction independently, the optimal policy on the creation margin would be to *accelerate* creation up to the efficient rate.

In more general models, with creation costs $c_0 + c_1 H$ and a non-generic initial productivity distribution in the M sector, one can show that adjustment will be a mixture of the two extremes we have analyzed in this section. There will be phases of the transition when gradualism is beneficial, and others when "accelerationism" is. This highlights the limitation of using a single policy tool to address distortions in two margins, and points to the need for the dual policy tools approach we study next.

4 Managed Adjustment

Even if it is the case that gradualism is, at best, of limited use in restoring efficiency, that does not mean that other forms of managed adjustment cannot be more effective. In this section, we turn to the problem of constructing a set of policies that can restore efficiency to the adjustment process.

4.1 Introducing Frictional Unemployment

Up to now we have considered no role for unemployment in the *efficient* economy's transition, mostly in order to sharpen our focus on the disruptions that result from appropriability problems. This simplification is inconvenient when designing optimal policies, for the limit of zero unemployment can be achieved in an inefficient economy only by means of infinite subsidies and taxes. We must therefore start by introducing some efficiency-role for frictional unemployment by assuming that it facilitates reallocation during the transition.

We modify our basic model by introducing a search cost $c_2(H/U)$ that firms have to pay per production unit created in addition to the previous investment cost $(c_0 + c_1 H)$. Such a cost can be derived from a standard constant returns Cobb-Douglas matching function with equal elasticities for unemployment and vacancies, together with a constant vacancy

posting cost.[20]

Since our concern is with inefficiencies that result from appropriability rather than externalities in the search process, we assume the standard efficiency condition that the worker's bargaining share parameter β is equal to the unemployment elasticity of the matching function, which is 1/2 in our case (see, e.g., Hosios 1990). This condition guarantees that the thick-market and congestion externalities associated with search cancel out, and that the decentralized search process is efficient.

What appropriation parameter should we apply to the search-cost component of creation costs? Note that since search costs are incurred *before* bargaining, they are fully appropriable.[21] From (11), this entails an appropriation parameter equal to $\beta/(1-\beta) = 0.5/(1-0.5) = 1$. The shadow prices in equilibrium conditions (5)-(11) are now given by

$$\tilde{w}(t) = \frac{H(t)}{U(t)}\left[b(c_0 + c_1 H(t)) + c_2 \frac{H(t)}{U(t)}\right] \tag{29}$$

and

$$\tilde{c}(t) = (1+b)(c_0 + c_1 H(t)) + 2c_2 \frac{H(t)}{U(t)}. \tag{30}$$

It is clear from (29) that, even in the efficient case $b = 0$, the presence of search costs gives rise to positive unemployment as long as creation $H(t)$ is positive.

4.2 Distorted Margins and Policy

The distortions that result from appropriability problems in this economy are reflected in the two shadow price signals, (30) and (29). Their social counterparts, the social shadow cost of creation and social shadow wage, correspond to the limit case when b goes to 0:

$$\tilde{w}^S(t) \equiv c_2 \left(\frac{H(t)}{U(t)}\right)^2, \tag{31}$$

$$\tilde{c}^S(t) \equiv c_0 + c_1 H(t) + 2c_2 \frac{H(t)}{U(t)}. \tag{32}$$

The social shadow wage is given by the social value of an unemployed worker, which is now positive because unemployment reduces search costs. What is the direction of distortion in

[20] See, e.g., Caballero and Hammour (1994).

[21] By the nature of their timing, search costs are a prime example of appropriability, although their dependence on unemployment and their relatively small empirical magnitude make them a rather special case that we did not choose to emphasize.

those two signals? It is easy to see that both are inflated in the presence of appropriability:

$$\tilde{w}(t) > \tilde{w}^S(t) \qquad \text{and} \qquad \tilde{c}(t) > \tilde{c}^S(t), \qquad \text{for} \quad b > 0.$$

It is no surprising, then, that the inefficient economy exhibits sluggish creation and excessive destruction following reform.

What policies can offset the distortions on each of the destruction and creation margins and improve allocational efficiency in this economy? Along the destruction margin, since the private shadow wage is excessively high and the economy is inefficiently shedding labor, job protection measures in sector M may help. In particular, let $e(t)$ denote a production or employment subsidy to sector M, so that the effective shadow wage in exit condition (6) becomes $\tilde{w}(t) - e(t)$. It is clear from (29) and (31) that by selecting

$$e(t) = \tilde{w}(t) - \tilde{w}^S(t) = b(c_0 + c_1 H(t))\frac{H(t)}{U(t)},$$

the efficient exit condition is restored. However, such a measure cannot restore full efficiency to the economy for it depresses creation by raising the opportunity cost of labor employed in sector X (see free-entry condition 5).

Turning to the creation margin, the excessively high effective creation costs can be offset by providing sector X with a creation incentive $i(t)$, so effective creation costs after the subsidy in the free-entry condition (5) become $\tilde{c}(t) - i(t)$.[22] In isolation (i.e. when $e(t) = 0$), this restores the efficient entry condition when

$$i(t) = \tilde{c}(t) - \tilde{c}^S(t) = b(c_0 + c_1 H(t)).$$

The drawback is that by increasing hiring, creation incentives build up additional pressure on the shadow wage (29), and therefore intensify an already high level of job destruction in the contracting sector.

4.3 Optimal Policies

It should be clear that a combination of job-protection measures e_c in sector M and creation incentives i_c in sector X is likely to remedy the economy's ills. It is straightforward to show,

[22] We could assume the creation incentive $i(t)$ to be either appropriable or not. Our formulation implicitly assumes the former.

by replacing those incentives into the entry and exit conditions, that efficient and inefficient equilibrium conditions coincide for the following canonical policies

$$e_c(t) = \tilde{w}(t) - \tilde{w}^S(t)$$

and

$$i_c(t) = \tilde{c}(t) - \tilde{c}^S(t) + \int_t^\infty e_c(s) \exp(-r(s-t))\, ds.$$

The first term in the optimal creation incentive i_c solves the direct appropriability problem, while the second one — only positive while sector M employment is positive and needs to be protected — offsets the increase in labor costs due to the job protection measure in sector M.[23]

As an illustration, figure 2 simulates an example of those canonical policies.[24] Policies are at their maximum at the outset of the transition, when the need for creation and the costs of excessive destruction are highest. They then decline monotonically as reallocation slows down and unemployed workers are incorporated into the new productive structure.

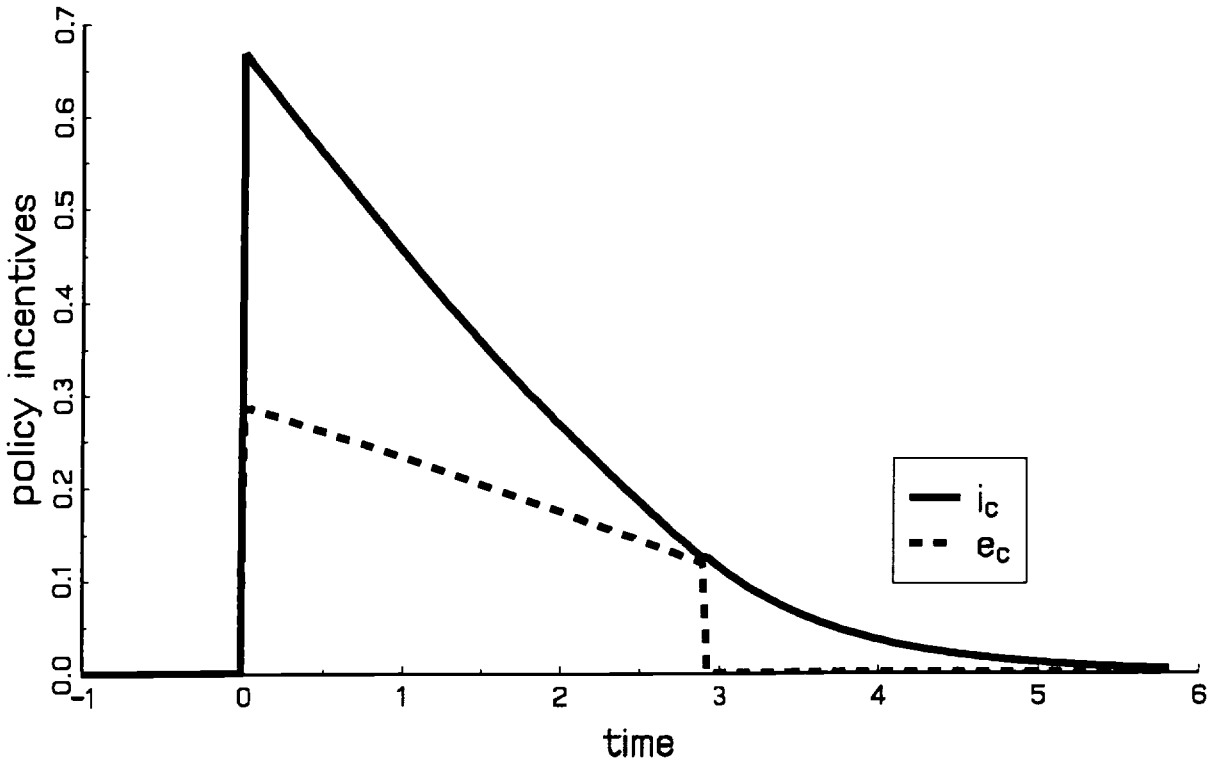
The canonical policies $e_c(t)$ and $i_c(t)$ capture the essential elements of the incentive structure that a managed-adjustment program should target. The art of the practitioner is to incorporate such incentives in a program that takes into account institutional and political constraints as well as the existing policy environment. Consideration should be given to the distortionary effects of implementing and financing the program. The choice between encouraging capital investment or job creation, for example, has important implications for the resulting capital-labor ratio. And the existing policy environment may incorporate elements — e.g., employment-protection legislation, a heavy corporate fiscal burden, or ongoing macroeconomic stabilization — that either reinforce or offset the targeted incentives.[25]

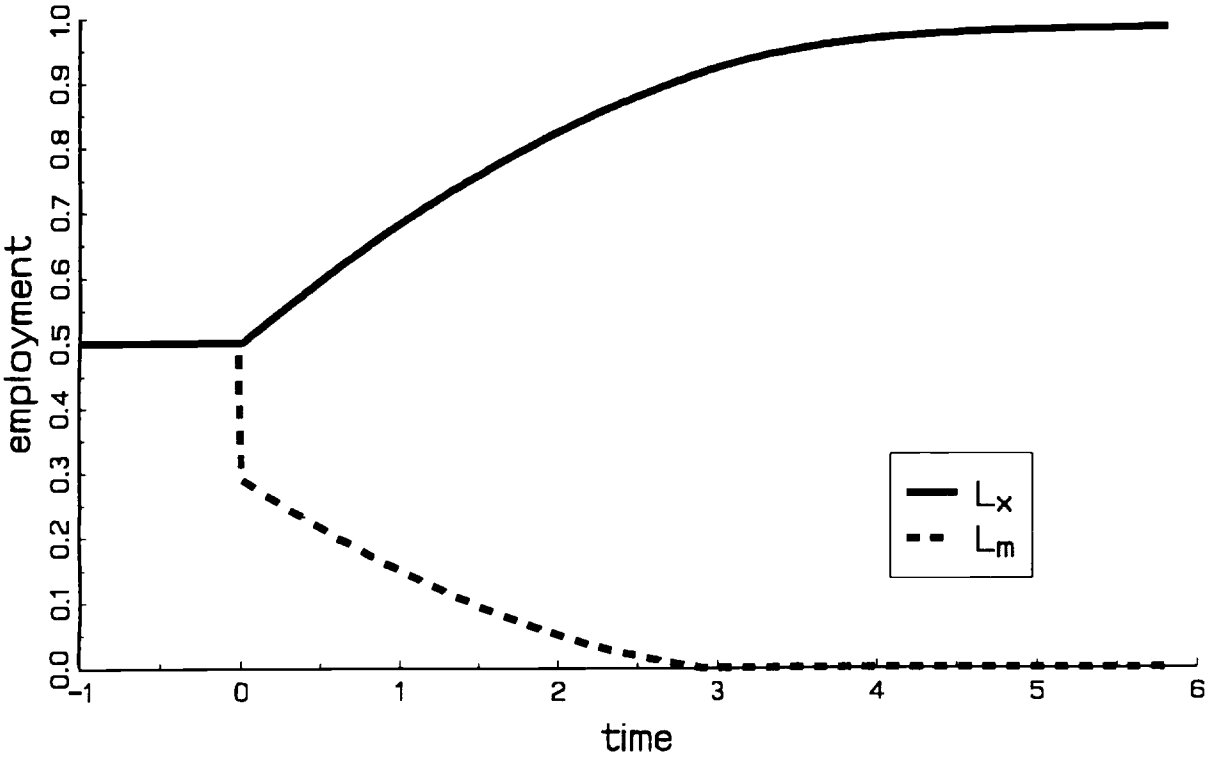
[23] It may be puzzling that, in a two-sector model such as ours, the effect of our dual policy approach extends beyond the relative subsidy it offers to the X sector. To answer this question, one must think of investment and hiring out of U — which can be thought of as part of the informal sector — as originating from a third, "reallocation" sector, at the expense of which the X and M sectors are encouraged.

[24] The figure uses the following parameters: $r = 0.06$, $\theta^* = 1.2$, $b = 1$, $c_0 = 0$, $c_1 = 1.5$, $c_2 = 1.5$, and $L_x^- = L_m^- = 0.5$. Simulation details are available from the authors upon request.

[25] Wage controls, for example, may be in place as part of a heterodox stabilization program, but they may also help in reducing the bite of appropriability over the transition, when full-steam creation is necessary.

FIGURE 2: OPTIMAL CANONICAL POLICIES





5 Concluding Remarks

The problem of appropriability arises naturally whenever different parties join into a common undertaking where the contribution of some is specific. When those contributions are not perfectly synchronized, the possibility of ex-post opportunistic behavior arises. Contracts are precisely mechanisms by which the problem of synchronization is managed, but their completeness is more a methodological benchmark than a description of reality.

The joint use of factors in production provides fertile ground for appropriability. Although joint-ownership may be a solution, it is prevented by the inalienability of human capital when labor is concerned. The resulting transactional difficulties between capital and labor have disruptive consequences on the economy. The problem is particularly acute during times of adjustment, when a broad range of new investments are needed and new contracts must be entered into. When appropriability problems cannot be overcome at the microeconomic level, they receive a highly inefficient macroeconomic "solution" in the form of depressed investment and thus more difficult employment opportunities for workers. By restraining the bargaining position of workers in their transactions with firms, this endogenous response allows the economic system to guarantee the required return on investment.

Appropriability results in many of the features thought to characterize adjustment crises. Massive job destruction in the contracting sectors is accompanied by only a timid response in the expanding ones. This lack of balance between creation and destruction not only results in wasted resources, but also prolongs the transition unnecessarily. Since appropriability leads to distortions in opposite directions on the creation and destruction margins, a gradualist policy approach can only relieve excess destruction by further depressing creation. An adequate policy response combines vigorous creation incentives in the expanding sectors, with job-protection measures in the contracting ones. This combination of incentives was, to some extent, present in the activist restructuring path followed by South Korea in the 1961-73 period — with its aggressive promotion of investment in the export sector combined with classic protection of domestic markets (see, e.g., Amsden 1989) — and has arguably contributed to its success.[26]

[26]It may be argued that the key to Korea's success is flexible labor markets rather than intervention (Krueger, 1983). The fact of the matter is that there *was* intervention, consisting of protection of the contracting sectors (primarily agriculture) and various creation incentives in the export sectors (manufacturing). Intervention also affected the labor market, where the government took an active role in the wage-setting process to ensure that wages did not move ahead of productivity and, at the same time, that workers

A Appendix

In this appendix we compute for the linear model of section 2 *(i)* the value of welfare $W^n(0)$ if no adjustment takes place; *(ii)* the welfare gain $W^c(0) - W^n(0)$ from cold-turkey adjustment; and *(iii)* the welfare loss $W^g(0) - W^n(0)$ from gradualist adjustment.

(i) The value of $W^n(0)$ is obtained from the definition of welfare (20) assuming that the initial full-employment allocation of labor $\bar{L} = L_m^- + L_x^-$ between the M and the X sectors is preserved and no investment takes place:

$$W^n(0) = \frac{\theta^* L_x^- + L_m^-}{r} = \frac{\theta^* \bar{L}}{r} - \frac{\theta^* - 1}{r} L_m^-.$$

(ii) If adjustment does take place, we have $L_m(t) = 0$ for all $t \geq 0$, and the flow of welfare becomes $\theta^* L_x(t) - c_0 H(t)$. Since (7) implies $L_x(t) = \bar{L} - U(t)$, and (10) implies $H(t) = \tilde{w}(t)U(t)/bc_0$, we can write the present value of this flow as

$$W(0) = \frac{\theta^* \bar{L}}{r} - \int_0^\infty \left(\theta^* + \frac{\tilde{w}(t)}{b}\right) U(t) e^{-rt}\, dt. \tag{33}$$

To compute welfare under cold-turkey adjustment, we substitute expressions (12) and (15) for $\tilde{w}(t)$ and $U(t)$:

$$W^c(0) = \frac{\theta^* \bar{L}}{r} - c_0(1+b)L_m^-.$$

Subtracting $W^n(0)$ from $W^c(0)$ yields the gain from cold-turkey adjustment:

$$W^c(0) - W^n(0) = (\theta^* - 1 - rc_0(1+b))\frac{L_m^-}{r}.$$

(iii) Turning to welfare under gradualism, note that, by (18), the integrand in expression (33) can be written as

$$\left(\theta^* + \frac{\tilde{w}(t)}{b}\right) U(t) e^{-rt} = (\theta^* - \theta(t))U(t)e^{-rt} + \frac{(1+b)}{b}(\theta(t) - rc_0)U(t)e^{-rt}.$$

shared in the fruits of higher productivity (e.g., Mazumdar, 1994). Moreover, the large negative response of employment during the stabilization episode of the early eighties suggests that Korean labor markets may not be that flexible. (This effect on employment was reflected only mildly in official unemployment figures, mostly because of the dramatic fall in the participation rate. See Castañeda and Park, 1992).

Replacing this into (33), we get

$$(34) \qquad \begin{aligned} W^g(0) - W^c(0) = \; & -\int_0^\infty (\theta^* - \theta^g(t))\, U^g(t) e^{-rt}\, dt \\ & -\tfrac{(1+b)}{b} \int_0^\infty \left[(\theta^g(t) - rc_0)\, U^g(t) - (\theta^* - rc_0)\, U^c(t)\right] e^{-rt}\, dt, \end{aligned}$$

where U^c and U^g denote unemployment under cold-turkey and gradualist adjustment, respectively. We can show that the second term in the above expression is negative by noting that

$$\begin{aligned} (\theta(t) - rc_0)\, \tfrac{U(t)}{b} \; & = \tilde{w}(t) \tfrac{U(t)}{b} + rc_0 U(t) && \text{by (18);} \\ & = c_0 \left(H(t) + rU(t)\right) && \text{by (10);} \\ & = -c_0 e^{rt} \tfrac{d(U(t)e^{-rt})}{dt} && \text{by (14).} \end{aligned}$$

Multiplying both sides by e^{-rt} and integrating over time, yields

$$\int_0^\infty (\theta(t) - rc_0)\, \frac{U(t)}{b} e^{-rt}\, dt = -c_0 \int_0^\infty \frac{d(U(t)e^{-rt})}{dt} dt = c_0 U(0) = c_0 L_m^-.$$

Since the value of above expression is constant for both the cold-turkey and the gradualist paths of $\theta(t)$, the second term in (34) is equal to zero. Thus,

$$W^g(0) - W^c(0) = -\int_0^\infty (\theta^* - \theta^g(t))\, U^g(t) e^{-rt}\, dt.$$

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