The Cost of Recessions Revisited: A Reverse-Liquidationist View

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This Version: March 28, 2004

Abstract

The observation that liquidations are concentrated in recessions has long been the subject of controversy. One view holds that liquidations are beneficial in that they result in increased restructuring. Another view holds that this rise in restructuring is costly since liquidations are privately inefficient and essentially wasteful. This paper proposes an alternative perspective. Based on a combination of theory with empirical evidence on gross job flows and on financial and labor market rents, we find that, *cumulatively*, recessions result in *reduced* rather than *increased* restructuring, and that this is likely to be socially *costly* once we consider inefficiencies on both the creation and destruction margins.

JEL Classification Numbers: E20, E30, G30.

Keywords: Recessions, restructuring, creative-destruction process, hold-up problem, labor and financial market frictions, privately and socially inefficient separations, productivity, under-investment.

*Respectively: MIT and NBER; DELTA (joint research unit, CNRS - ENS - EHESS) and CEPR. We are very grateful to Fernando Broner, Bjoern Bruegemann, Christian Frois, Andrew Hertzberg, Alejandro Neut, Roberto Rigobon, Tanya Rosenblat and Jose Tessada for excellent research assistance; and to Robert Gordon, John Haltiwanger and Glenn Hubbard for providing us with data and references. We have benefited from the comments of Daron Acemoglu, Orazio Attanasio, Steven Davis, Robert Hall, Guido Kuersteiner, Adriano Rampini, Jaume Ventura, Fabrizio Zilibotti, and three anonymous referees; as well as from seminar participants at Columbia, CREST, DELTA, Ente Enaudi, EUI, IGIER, the NBER Summer Institute, MIT, the Minneapolis Fed, Stanford, Toulouse, UCSD, Virginia, Yale, and conference participants at the AFSE, the CEPR ESSIM, and the NBER EFG meetings. Ricardo Caballero thanks the NSF for financial support.

1 Introduction

The concentrated liquidation during recessions of significant segments of the economy's productive structure has been a source of controversy among economists at least since the pre-Keynesian "liquidationist" theses of such economists as Hayek, Schumpeter, and Robbins. These economists saw in the process of liquidation and reallocation of factors of production the main function of recessions. In the words of Schumpeter (1934): "depressions are not simply evils, which we might attempt to suppress, but ... forms of something which has to be done, namely, adjustment to ... change" (p. 16). This led him and others to advocate a passive government attitude at the onset of the Great Depression. (See De Long 1990 for historical survey, and Beaudry and Portier 1998 for a modern formulation of the liquidationist argument).

Although few economists today would take the extreme position of early liquidationists, many see in increased factor reallocation a silver lining to recessions. Although recessions *per se* are undesirable events, they are seen as a time when profitability is low and, therefore, when much needed restructuring can be undertaken at a relatively low opportunity cost. Observed liquidations are considered a prelude for increased restructuring. (See Aghion and Saint-Paul 1998 for a survey of this view of recessions as reorganizations).

At the polar opposite of liquidationism, an alternative perspective holds that concentrated liquidations during recessions — large-scale job losses and financial distress — are associated with significant waste, which we ought to find ways to avoid. Looking more specifically at workers, the recent labor-market literature on the costs of job loss documents the apparently large private losses that result from a significant fraction of separations (see, e.g., Topel 1990; Farber 1993; Jacobson, Lalonde and Sullivan 1993; Anderson and Meyer 1994). As Hall (1995) shows, the product of these private losses with the sharp increase in separations amounts to a substantial cost of recessions.[1] Ramey and Watson (1997) summarize this view in a model where separations during recessions are driven by an inefficient surge in the destruction of contractually fragile relationships.

In this paper we put forth a perspective that amounts to a distinct alternative to these prevalent views. We question the idea shared by both views that restructuring increases as a result of recessions. We point to evidence that suggests, on the contrary, that cumulative restructuring is *lower* following recessions, and develop a model to explore the underlying mechanisms and assess their efficiency implications. Regarding efficiency, we point to limitations in the cost-of-liquidations view, which considers inefficiencies in the decision to

[1] Hall acknowledges that his calculation captures only one aspect of the problem and does not constitute a comprehensive assessment.

destroy production units but not in the decision to create them. A plausible calibration of our model that considers distortions on both margins shows that reduced restructuring following recessions is likely to be socially costly. The view that emerges from our analysis is that recessions result in reduced restructuring, yet — contrary to the cost-of-liquidations view — this stifling of reallocation is *costly.*

In section 2 we examine the basis for the common notion that an aggregate recession increases overall factor reallocation in the economy. This conclusion is inferred from the rise of liquidations during recessions — as documented, for example, in the gross job flow series of Davis and Haltiwanger (1992). However, this inference is only warranted if the increase in liquidations during the recession is followed by an abnormally high level of creation during the cyclical recovery phase. But, in an economy that undergoes continuous restructuring, this is not the only form a recovery can take place. If, for example, the recovery materializes instead through an abnormally low destruction rate, the recession will not result in increased restructuring. To examine this question empirically, we explore the *cumulative* business cycle response of US manufacturing job flows. Although limited in several respects, the evidence is consistent with the notion that, contrary to the prevailing views, recessions result in a *reduction* in cumulative reallocation.

Section 3 presents the model economy we use to explore the relation between recessions and restructuring and its social-cost implications. Our economy must incorporate two main elements. First, it must exhibit a heterogeneous production structure that undergoes a process of creative destruction able to match observed aggregate gross flows and their dynamics. This makes it possible to capture the cumulative impact of a recessionary shock on those flows. Second, it must include the possibility of rents on both the creation and destruction margins, that can be calibrated to match the private rents documented in the financial and labor market literatures. This is needed to assess, in equilibrium, the social waste or benefits associated with the impact of recessions on gross flows.[2]

Section 4 analyzes the equilibrium response of the restructuring process to aggregate shocks in our model and the role played by labor and financial market frictions. The model is able to capture documented labor and financial markets rents, as well as average and cyclical features of gross flows. In particular, reduced reallocation following recessions arises as a

[2] For some aspects of the aggregate implications of each of these features see, e.g., our previous work on creative destruction over the business cycle (Caballero and Hammour 1994, 1996) and on the implications of contracting inefficiencies for macroeconomic equilibrium (Caballero and Hammour 1998a). Aside from integrating these insights the current paper incorporates private rents on both the creation and destruction margins and, in particular, introduces privately inefficient separations due to financial constraints. The presence of rents on both margins forms the basis of our critique of the cost-of-liquidations view of recessions.

natural outcome. We identify two mechanisms that can be responsible for this phenomenon, one financial and the other based on selection across heterogeneous productivities. The financial mechanism results from firms' reduced ability to find financing for creation as they come out of recession. This implies that the recovery cannot take place through a boom in creation but it must happen through a reduction in destruction. The selection mechanism, on the other hand, works through the differential impact across projects of the fall in creation during recessions — which eliminates mostly low-productivity projects subject to a higher-than-average turnover rate and, thus, reduces the economy's average restructuring following a recession.

Turning to social efficiency, we argue that, even when separations are privately inefficient, reduced reallocation following recessions is not necessarily beneficial. The reason is that the same type of contracting failures that are responsible for inefficient destruction are also a well-known source of under-investment, which, in general equilibrium, naturally leads to *insufficient* restructuring (see, e.g., Caballero and Hammour 1998a). This form of "sclerosis" of the productive structure suggests, on the contrary, that it might be beneficial to accelerate restructuring. Therefore, in order to assess the impact of recessions, it is essential to examine which of these two distortions — on the creation and destruction margins — dominates over the business cycle. We show that reasonable calibration assumptions lead to the conclusion that reduced restructuring following recessions is socially costly. Although our specific calibration choices are open to criticism, the conceptual point remains that the partial-equilibrium private cost of liquidations does not necessarily carry over in general equilibrium once we consider rents on the creation margin. Section 5 concludes and is followed by several appendices.

2 Some Evidence from US Manufacturing

2.1 Business Cycles and Cumulative Reallocation

In this section, we question the prevailing view that recessions result in increased reallocation. In much of the available evidence on job flows, the rise in liquidations during recessions is not accompanied by a simultaneous increase in creation (see Davis, Haltiwanger and Shuh 1996, henceforth "DHS"). Therefore, implicit in the view that a rise in job destruction (or the sum of job creation and destruction) is associated to increased job reallocation, is the idea that increased job destruction is followed by a surge in job creation during the recovery phase of the cyclical downturn. This presumption is the only possible outcome in a representative-firm economy, as the representative firm must replace each job it destroys during a recession by creating a new job during the ensuing recovery. This is illustrated in panel (a) of figure 2.1, which depicts the way the employment recession-recovery episode in panel (d) materializes in this case.

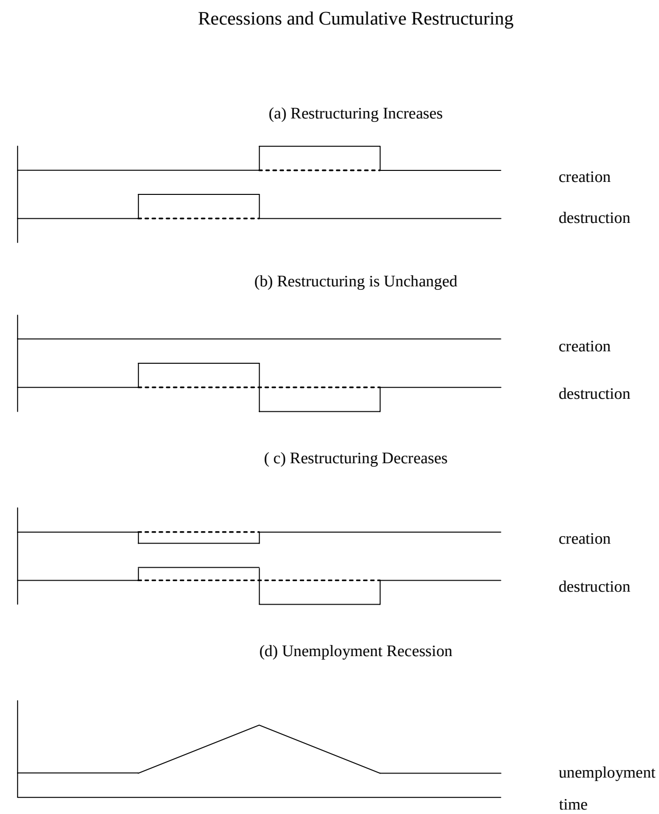

Figure 2.1

However, once we consider a heterogeneous productive structure that experiences ongoing creative destruction, other scenarios are possible. For example, the peak in destruction during the recession may be followed by an equal-sized trough in destruction during the recovery, adding up to a zero cumulative effect. More generally, as illustrated in panels (a)-(c), the cumulative effect of a recession on overall job restructuring may be positive, zero, or even negative, depending not only on how the economy contracts, but also on how it *recovers*. Thus, the relation between recessions and economic restructuring requires us to examine the effect of a recession on aggregate job destruction not only at impact, but *cumulatively* throughout the recession-recovery episode.

2.2 Does Reallocation Rise Following Recessions?

The data

The cumulative impact of "aggregate" business cycle shocks on job flows can be explored using available time series on gross job flows in the US manufacturing sector over the period 1972:1-1993:4. Figure 2.2 presents our data on manufacturing employment and gross flows. The solid line in panel (a) depicts manufacturing employment divided by its mean. For comparison, the dashed line presents the economy-wide unemployment series (rescaled and inverted; source: FRED). The two series clearly present a very similar cyclical pattern, which is consistent with our assumption below on the stationarity of the employment series.[3] Panel (b) reports the path of gross job creation and destruction *flows*, defined as the basic quarterly creation and destruction *rates* reported by DHS multiplied by the aggregate employment series from panel (a).[4] All data are seasonally adjusted using the Census X11 procedure.

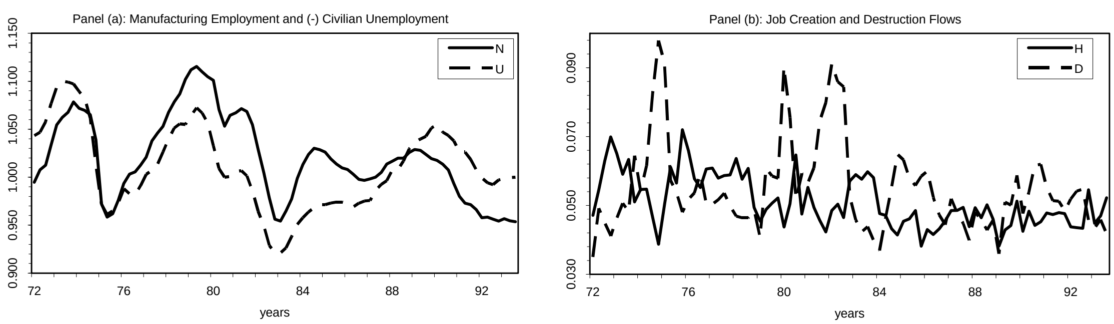

Figure 2.2

Model specification and estimation

We denote the employment, creation, and destruction series in deviation from their mean by $\widehat{N}_t$, $\widehat{H}_t$, and $\widehat{D}_t$, respectively. Up to inconsequential approximation errors, these series are related by the identity:

$$\Delta\widehat{N}_t = \widehat{H}_t - \widehat{D}_t. \tag{1}$$

We assume that employment fluctuations are driven by two types of shocks, an "aggregate" and a "reallocation" shock, and use a semi-structural VAR approach to identify them.

[3] See Appendix A in a working version of this article for a formal test of this stationarity assumption; Caballero and Hammour (2003).

[4] More precisely, DHS calculate their creation and destruction rate series as the ratio of job flows to average employment for plants in their sample. For consistency, we first transform the denominator of the DHS series from average to lagged employment. We then multiply by lagged manufacturing employment, measured in the middle month of the quarter, to obtain our flow series.

Since employment in our sample is stationary, by equation (1), the integral of $\widehat{H} - \widehat{D}$ must be stationary as well. For the latter to be consistent with finding a significant effect of the business cycle on restructuring, which implies that the integrals of $\widehat{H}$ and $\widehat{D}$ must have a unit root, these integrals must be cointegrated with cointegrating vector $(1, -1)$. Using this low-frequency restriction efficiently requires running a VAR with the cointegrating vector (equal to $\widehat{N}$) and one of the integrals first-differenced (e.g., $\widehat{D}$). We write our semi-structural VAR as

$$\begin{bmatrix} \widehat{N}_t \\ \widehat{D}_t \end{bmatrix} = A(L) \begin{bmatrix} \epsilon_t^a \\ \epsilon_t^r \end{bmatrix},$$

where $A(L) = A_0 + A_1 L + A_2 L^2 + ...$ and $(\epsilon_t^a, \epsilon_t^r)$ represent i.i.d. innovations that correspond to aggregate and reallocation shocks, respectively.

Besides normalizations, achieving identification requires two additional restrictions. For this purpose, we assume that the two innovations are independent of each other, and that, at impact, a recessionary shock raises destruction and lowers creation. Based on Davis and Haltiwanger (1996), we set the relative size of the absolute response of destruction compared to creation to 1.6, which is roughly the value that maximizes the contribution of aggregate shocks to net employment fluctuations with their estimates. We experimented with values of the relative response of destruction to creation in the range $[1, 2]$, without a significant change in our main conclusions.

Since we are particularly concerned with medium and low frequency statistics, we used a fairly non-parsimonious representation of the reduced-form VAR and allowed for five lags. The first and second columns of figure 2.3 represent impulse-response functions corresponding to recessionary 2-standard-deviation aggregate and reallocation shocks, respectively, for (minus) employment, gross flows, and cumulative gross flows. Starting with the less central results, the second column depicts responses to reallocation shocks, which, not surprisingly, raise reallocation.[5]

The first column contains our main result: Panels (a) and (c) portray the estimated impulse-response function of (minus) employment and job flows, respectively. Employment naturally falls and, consistent with the findings documented by DHS, at impact job destruction rises sharply and job creation declines to a lesser extent. Less known is what comes next. Along the recovery path, job destruction declines and falls below average for a significant amount of time, more than offsetting its initial peak. On the other hand, job creation recovers but it does not exceed its average level by any significant extent to offset

[5] See Davis and Haltiwanger (1999) for a comprehensive study of the response of job flows to oil shocks, which have a significant reallocation component.

its initial decline. Put together, these patterns indicate that the restructuring process is depressed by an aggregate recessionary shock. This is shown in panel (e), which reports the cumulative responses of job creation and destruction.

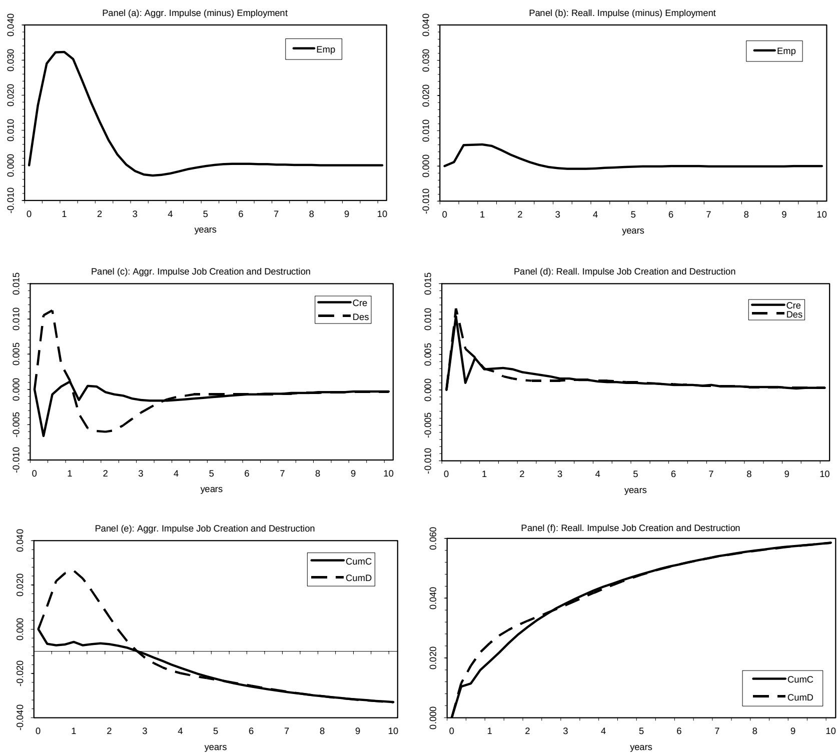

Figure 2.3

We ran 40,000 bootstraps to test the absence of a fall in restructuring following a recession. Figure 2.4 shows the histogram of cumulative destruction (or creation) 20 years after the shock (all but for a very few of the paths converge long before that). We can reject the hypothesis that there is no cumulative destruction following a recession against the alternative that cumulative destruction (hence, restructuring) falls, at significance levels of 2.5% or higher.[6]

Robustness

We performed several robustness checks. In particular, our qualitative results and much of our quantitative results are robust to the number of lags used (we tried between 2 and 6 lags), to whether the 1974-75 recession is excluded, or to estimating the VAR for the logarithms of $(N, D/N)$ rather than (N, D). We also followed an alternative and simpler single-shock procedure and reached similar findings (see Caballero and Hammour 2003).

[6] Also see Caballero and Hammour (2003), appendix A, for a univariate approach that reaches the same conclusion, at significance levels as low as 1 percent.

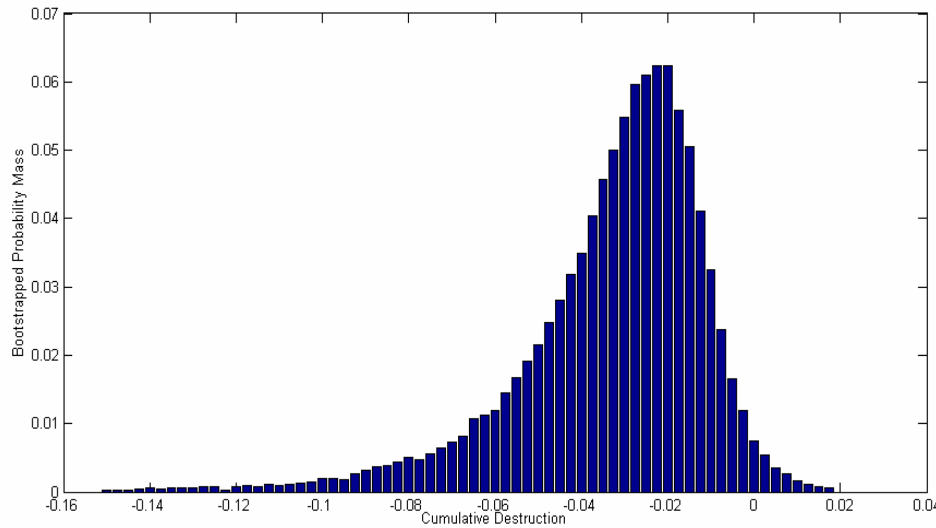

Figure 2.4: Histogram of Cumulative Destruction (20 years horizon)

An important caveat is that data limitations do not allow us to analyze sectors outside manufacturing. In particular, some workers who are laid off from manufacturing may find temporary jobs in other sectors. This may be interpreted as the aggregate economy exhibiting less depressed reallocation than manufacturing. However, the appearance of those temporary jobs — which involve negligible investment — probably does not represent true restructuring.[7] On the other hand, since a significant portion of layoffs in US manufacturing are temporary, the effect is to bias our results against the depressed restructuring finding because the resulting temporary reallocation does not correspond to true restructuring either.

3 A Model of Restructuring and Factor-Market Rents

3.1 General Structure

In this section, we present our theoretical model and solve for equilibrium. We consider an infinite-horizon economy in continuous time, whose general structure is outlined in figure 3.1.

Production units

There is a single good (the numeraire), that can either be consumed or invested. Production takes place within infinitesimal *production units* that combine, in fixed proportions, an entrepreneurial project, a one-time investment of κ units of capital, and a flow input of one

[7] See Barlevy (2002) for evidence on the lower than average quality of the jobs generated during recessions.

unit of labor (see panel (a) of figure 3.1). The output flow of production unit i at time t is made up of three components:

$$\widetilde{y}_t + \nu_i + \widetilde{\epsilon}_{it},$$

where $\widetilde{y}_t$ is a stochastic *aggregate* component; $\nu_i \in [-\overline{\nu}, \overline{\nu}]$ is a *permanent idiosyncratic* component (the unit's "productivity"); and $\widetilde{\epsilon}_{it}$ is a *transitory idiosyncratic* component (the unit's "state"). $\widetilde{\epsilon}_{it}$ transits between two states: $\epsilon > 0$ (the "good" state) and $-\epsilon < 0$ (the "bad" state), with at hazard rate $\lambda > 0$. Finally, production units fail, and their capital destroyed, exogenously at hazard rate $\delta > 0$.

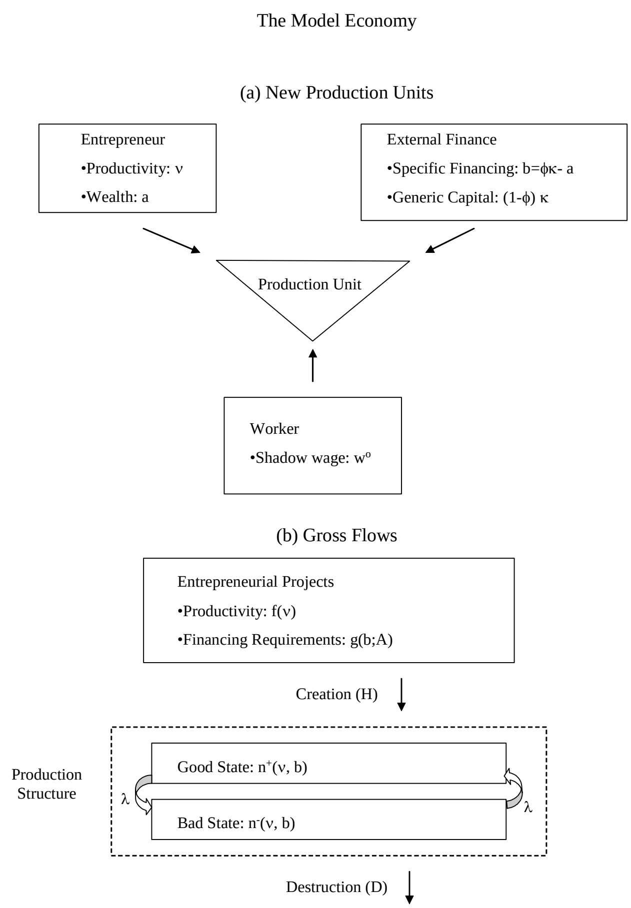

Figure 3.1

Entrepreneurs, workers, and financiers

Each production unit forms a nexus for a trilateral relationship between an entrepreneur-manager, a worker, and external financiers. The entrepreneur brings the project and uses his internal funds to finance it; the worker contributes his labor; and external financiers fill the unit's financing requirements when the entrepreneur has insufficient funds. We characterize each of these three parties, in reverse order.

External finance is intermediated through a non-resource consuming competitive sector. It may be called upon either to finance capital investment at the time a production unit is created, or to finance periods of negative cash flow during the lifetime of the unit. As we discuss below, a production unit finances its capital externally through a combination of capital "rental" and of external "liabilities," b ($b > 0$ corresponds to a positive external liability and $b < 0$ to positive internal funds).

Workers are infinitely-lived agents whose population is represented by a continuum of mass one. Each worker i is endowed with a unit of labor, and maximizes the expected present value of instantaneous utility

$$c_{it} + z(1 - l_{it}), \quad z \geq 0,$$

linear at any time t in consumption c_{it} and labor supply l_{it}, discounted at rate $\rho > 0$.

Entrepreneurs maximize the expected present value of consumption, also discounted at rate ρ. All agents are therefore risk neutral, and the market discount rate will be ρ. Entrepreneurial projects are held by a continuum of non-active entrepreneurs indexed by i. Each has a project for a production unit with known productivity ν_i, and a certain amount of wealth that translates into a financing requirement b_i — equal to the project's investment requirement minus the entrepreneur's wealth. We assume that the distributions of wealth and project productivities are independent in the cross section. At any time t, the density of project productivities is given by $f(\nu)$; and the mass density of project financing requirements is given by $g(b; A_t)$, where A_t is an index of the aggregate wealth of non-active entrepreneurs.[8]

Relationship specificity

The employment and financing relationships within production units suffer from contracting obstacles. We assume that a fraction $\phi \in (0, 1]$ of a production unit's capital is *specific*, in the sense that its productive value disappears if either labor or the manager leaves the unit. Specificity with respect to labor and management is intended to capture the edge that such "insiders" may acquire to appropriate quasi-rents within the nexus of the firm.[9] It creates

[8] By fixing the distributions of project productivities and financing requirements, we avoid having to model the detailed population dynamics of potential entrepreneurs. Implicitly, we assume the process by which potential entrepreneurs invent or lose ideas for projects is such that it results in the assumed distributions.

[9] Investment specificity may result from firm-specific human and organizational capital, or from the ad-

a classic "holdup" problem. Agents' *ex ante* terms of trade need to be protected through a fully contingent contract. However, such contracts may be unenforceable or excessively complex, and specific quasi-rents will instead be divided according to the parties' *ex post* terms of trade. This constrains certain employment and financing relationships from being formed, and results in rent components of wages and profits that we analyze in sub-section 3.2.

The non-specific component of capital, $(1-\phi)\kappa$, has full collateral value, and gives rise to no contracting difficulties. Its owner can withdraw it at any time from the relationship, and use it elsewhere with no loss of value. Without loss of generality, we consider that it is always rented at a cost $r > 0$, which covers the cost of capital and depreciation.

Production structure dynamics

At any time t, the distribution of production units is given by the density $n_t^+(b,\nu)$ of units that operate in the good state with external liability b and permanent productivity ν, and the equivalent density $n_t^-(b,\nu)$ of units in the bad state. These densities can be integrated to yield the total number of units in the good and bad states, and therefore total employment. Since labor supply was normalized to one, aggregate unemployment — voluntary or involuntary — is given by

$$U_t = 1 - \int_{-\overline{\nu}}^{\overline{\nu}} \int_{-\infty}^{+\infty} \left(n_t^+(b,\nu) + n_t^-(b,\nu) \right) db\, d\nu. \tag{2}$$

Aggregate output is

$$Y_t \equiv \int_{-\overline{\nu}}^{\overline{\nu}} \int_{-\infty}^{+\infty} \left[(\widetilde{y}_t + \nu + \epsilon)\, n_t^+(b,\nu) + (\widetilde{y}_t + \nu - \epsilon)\, n_t^-(b,\nu) \right] db\, d\nu.$$

Four factors drive the distributional dynamics of production units (see panel (b) of figure 3.1): *(i)* units are continuously created; *(ii)* units are also continuously destroyed; *(iii)* units decumulate or accumulate b, depending on whether they experience positive or negative cash flows; and *(iv)* units transit between the good and the bad idiosyncratic state at hazard rate λ. The effect of distributional dynamics on aggregate employment is captured by the aggregate gross rates of creation and destruction of production units — which we denote by H_t and D_t, respectively.

Creation of new production units requires two conditions that we derive in sub-section 3.3: the project must be profitable, and it must find financing. At any point in time, all

vantage that a party can gain through government regulation. It is clearly only a simplification to assume that it is the same fraction of capital that is specific to both labor and management. For a discussion of the holdup problem that results from specificity, see, e.g., Klein, Crawford and Alchian (1978) and Hart (1995, chapter 4). For a discussion of its macroeconomic implications, see Caballero and Hammour (1998a).

projects that satisfy both conditions are started. The entrepreneur hires a worker, makes a specific investment of $\phi\kappa$, and rents $(1-\phi)\kappa$ units of generic capital. If the entrepreneur's wealth is a_i, the initial level of external liabilities is $b_i = \phi\kappa - a_i$. We assume that all new production units start in the good state.

Destruction of production units is of two types. It may either be due to a failure of the production unit (at the above-mentioned rate δ), or due to a separation decision within a functioning production unit. In both events, specific capital loses all value once factors separate. The latter type of destruction takes place during periods of negative cash flows, when the entrepreneur stops making the investment that is necessary to cover negative cash flows and continue operations. We restrict ourselves to a range of model parameters such that operating cash flows in the good state are always positive and allow production units to reduce their liabilities, then accumulate internal funds; and such that operating cash flows are always negative in the bad state. Once a production unit transits to the bad state, it must decide whether to interrupt operations or fund negative cash flows with the hope of reverting to the good state. Similarly to creation investment, this continuation investment decision requires two conditions that we also derive in sub-section 3.3: the entrepreneur must find it profitable to cover the unit's negative cash flow, and he must find financing for it. Destruction takes place when one of these two conditions fails to be satisfied. Failure of the profitability condition results in privately efficient separation between factors; failure of the financing condition results in privately inefficient separation.

3.2 Contracting Failures in the Labor and Financial Markets

We now turn to the determination of factor rewards when a fraction ϕ of capital is specific with respect to labor and to the entrepreneur-manager. The contracting problem consists in the assumption that labor and the entrepreneur cannot contractually precommit not to withhold their human capital from the relationship. We analyze the effect of specificity with respect to labor on the employment relationship, and of specificity with respect to the entrepreneur on the financing relationship.

The employment relationship

We consider that labor and capital (held by the entrepreneur and external financiers) transact as two monolithic partners.[10] Because of the contracting problem, specific quasi-rents

[10] One reason why labor may not be able to deal separately with the entrepreneur and external financiers is informational. The entrepreneur may be able to disguise internal funding in the form of external financing. If, however, labor is able to separate between the two, external liabilities can be used as a way to reduce the rents appropriable by labor. See Bronars and Deere (1991) for a discussion and some empirical evidence.

must be divided *ex post*, after investment is sunk. We assume this division is governed by continuous-time Nash bargaining. Labor obtains, in addition to its outside opportunity cost, a share $\beta \in (0,1)$ of the present value S of the unit's specific quasi-rents, s_{it}; and capital obtains a share $(1-\beta)S$.

The specific quasi-rents in production unit i are

$$s_{it} = (\widetilde{y}_t + \nu_i + \widetilde{\epsilon}_{it} - r(1-\phi)\kappa) - w_t^o,$$

which is equal to output net of the rental cost of generic capital minus labor's flow opportunity cost w_t^o of participating in a production unit. In order to give the worker a share βS in present value at any point in time, the wage path for each production unit i must be equal to

$$w_{it} = w_t^o + \beta s_{it}. \tag{3}$$

Profits are therefore equal to

$$\pi_{it} \equiv (\widetilde{y}_t + \nu_i + \widetilde{\epsilon}_{it} - r(1-\phi)\kappa) - w_{it} = (1-\beta)s_{it}. \tag{4}$$

Finally, labor's opportunity cost is given by

$$w_t^o = z + \frac{H_t}{U_t}\beta E_\nu[S_t]. \tag{5}$$

As is standard in equilibrium bargaining models, it is equal to the marginal utility of leisure plus the product of the rate H_t/U_t at which an unemployed worker expects to find employment and the share $\beta E_\nu[S_t]$ he expects to obtain of the surplus from a new job.[11]

A more detailed discussion of the division of specific quasi-rents through continuous-time Nash bargaining is provided in appendix A.

Before turning to the discussion of equilibrium it is useful to consider the behavior of the economy as β goes to zero, that is as the employment friction vanishes. In this limit case the wage is the opportunity cost of labor. As long as new projects are sufficiently productive and well financed, which we assume to be the case, this limit economy features full employment and a wage that exceeds the marginal utility of leisure in order to clear the labor market.[12]

Expression (4) allows us to define profit functions $\pi_{it} = \pi^+(\nu_i)$ in the good idiosyncratic state and $\pi_{it} = \pi^-(\nu_i)$ in the bad state, where

$$\pi^+(\nu) = (1-\beta)\left[(\widetilde{y}_t + \nu + \epsilon - r(1-\phi)\kappa) - w_t^o\right] \tag{6}$$

[11] The expected surplus $E_\nu[S_t]$ depends on the distribution of external liabilities and permanent idiosyncratic productivities in new production units. A precise formula will be given later in equation (16).

[12] The assumption that new projects are sufficiently productive and well financed will be made more precise in footnote 21.

and

$$\pi^{-}(\nu) = (1-\beta)\left[(\widetilde{y}_t + \nu - \epsilon - r(1-\phi)\kappa) - w^o_t\right]. \tag{7}$$

If the unit has external liabilities b_{it} and productivity ν_i, the expected present discounted value of profit flows is a function $\Pi^+_t(b_{it}, \nu_i)$ when the unit is in the good state and $\Pi^-_t(b_{it}, \nu_i)$ when it is in the bad state. These functions are (weakly) decreasing in b_{it}, because, as we argue below, a higher b_{it} generally increases the probability of privately inefficient liquidation.

The financing relationship

The financing relationship is restricted to uncollateralizable investments, because the collateralizable share of capital $(1-\phi)\kappa$ is unproblematic and is considered rented. Specificity with respect to the entrepreneur-manager gives rise to contracting problems similar to those that arise in the employment relationship. The entrepreneur-manager can always threaten *ex post* to withhold his human capital from the production unit, and attempt to renegotiate with the financier on that basis. We assume that Nash bargaining would give a share $\alpha \in (0, 1)$ of the present value Π of profits to the manager, and a share $(1-\alpha)$ to the financier. Therefore, any external claim for the financier above $(1-\alpha)\Pi$ will be renegotiated down. This puts an upper-bound on the external claims a production unit can support.

The inability to find financing may prevent an entrepreneur from starting an otherwise profitable project; or may force him to liquidate a highly productive unit that runs into a period of negative cash flows (see sub-section 3.3). As a consequence, an optimal policy for the entrepreneur that minimizes the risk of inefficient liquidation is not to consume dividends until the production unit fails or is liquidated. This implies, in particular, that repayments to the financier are effectively made at the fastest possible rate.

A contract that minimizes the financial constraint must satisfy the following properties: *(i)* the financier expects to get his money back in present value; *(ii)* the above-mentioned re-negotiation constraint is not violated; and *(iii)* the entrepreneur cannot consume from the project's cash flow before the financier's claim has been fully paid. For the financier to be paid back in expectation, the entrepreneur can only stop repaying the financier until the latter's claim b_{it} — whose dynamics are appropriately defined in what follows — reaches zero. Beyond these requirements, our model does not distinguish between different institutional arrangements — debt-like or equity-like — as long as they result in the same investment decisions and net transfers between the two parties.

3.3 Creation and Continuation

We now derive the conditions under which *creation* and *continuation* investments are undertaken. The former type of investment consists of the specific investment $\phi\kappa$ required to create a production unit. The latter consist of the investments made to cover periods of negative cash flows in order to hoard the unit's specific assets. By its very nature, continuation investment is fully specific and subject to contracting obstacles. Both types of investments are subject to a *profitability* and a *financial* constraint. They will only be undertaken if neither constraint is binding.

Creation investment

Suppose an entrepreneur with wealth a has a project for a production unit with productivity ν. To create the unit, the entrepreneur needs to incur a liability $b = \phi\kappa - a$. The two conditions for undertaking the project are as follows. First, the project must be profitable:

$$\phi\kappa \leq \Pi_t^+ (b, \nu) . \tag{8}$$

Second, the entrepreneur must be able to attract the required financing, which we have seen is limited to the maximum liability:

$$b \leq (1-\alpha)\Pi_t^+(b, \nu). \tag{9}$$

Since $\Pi_t^+(b, \nu)$ is decreasing in b, constraints (8) and (9) can be rewritten as

$$\phi\kappa - a \leq \min\{\overline{b}_t^{p+}(\nu), \overline{b}_t^{f+}(\nu)\}, \tag{10}$$

where $\overline{b}_t^{p+}$ is defined implicitly by taking the *profitability constraint* with equality and $\overline{b}_t^{f+}$ is defined by taking the *financial constraint* with equality (either variable can take value $+\infty$ when the constraint is not binding):

$$\phi\kappa = \Pi_t^+ \left(\overline{b}_t^{p+}(\nu), \nu\right) . \tag{11}$$

$$\overline{b}_t^{f+}(\nu) = (1-\alpha)\Pi_t^+(\overline{b}_t^{f+}(\nu), \nu). \tag{12}$$

One can show that for projects with sufficiently low productivity, it is the profitability constraint that is binding; while for projects with high productivity, it is the financial constraint.

Continuation investment

Given our restriction to parameters such that cash flows are positive in the good state and negative in the bad state — i.e. $\pi_t^+(\nu) > 0$ and $\pi_t^-(\nu) < 0$ — continuation investment is always required in the bad state. It faces profitability and financial constraints, $\overline{b}_t^{p-}(\nu)$ and $\overline{b}_t^{f-}(\nu)$, similar to the constraints on creation.

The *profitability constraint* requires

$$\Pi_t^{-}(b,\nu) \geq 0.$$

In other words, funding continuation in a unit with productivity ν is profitable if $b \leq \overline{b}_t^{p-}(\nu)$, where[13]

$$\overline{b}_t^{p-}(\nu) = \min\{b : \Pi_t^{-}(b,\nu) = 0\}. \tag{13}$$

The *financial constraint* may affect a unit in the bad state with no internal funds to cover its negative cash flow ($b \geq 0$). This can be illustrated most easily in a steady-state setting, where aggregate conditions are invariant. In the absence of financing constraints (i.e., taking the limit $b \to -\infty$), one can show that the value of the option to cover negative cash flows in the bad state is

$$\frac{\pi^{-}(\nu) + \lambda \Pi^{+}(-\infty,\nu)}{\rho + \delta + \lambda}. \tag{14}$$

However, because the manager would renegotiate the debt down to $\overline{b}^{f+}(\nu)$ once in the good state, one can show that the value to the financier of the option to finance negative cash flows is no greater than

$$\frac{\pi^{-}(\nu) + \lambda(1-\alpha)\Pi^{+}\left(\overline{b}^{f+}(\nu),\nu\right)}{\rho + \delta + \lambda},$$

which is obviously smaller than the private value (14) of continuation, since:

$$\overline{b}^{f+}(\nu) = (1-\alpha)\Pi^{+}\left(\overline{b}^{f+}(\nu),\nu\right) < \lambda(1-\alpha)\Pi^{+}(-\infty,\nu) < \lambda\Pi^{+}(-\infty,\nu).$$

It is therefore possible for *privately inefficient liquidation* to take place, where continuation has positive present value but cannot be financed externally.[14]

[13] In steady state, one can show that $\overline{b}^{p-}(\nu) \in \{-\infty, 0\}$. Let $\overline{\nu}^d$ be the level of productivity at which a unit with infinite funds ($b = -\infty$) is indifferent between continuing or liquidating in the bad state, i.e. $\pi^{-}(\overline{\nu}^d) + \lambda\Pi^{+}\left(-\infty,\overline{\nu}^d\right) = 0$. *(i)* When $\nu = \overline{\nu}^d$, the value Π^{-} of a unit in the bad state is zero, irrespective of its level of b (a lower b cannot improve Π^{-} and $\Pi^{-} \geq 0$); which implies that its value Π^{+} in the good state is also independent of b (dependence on b is exclusively the result of what happens in the bad state). Thus, any unit in the bad state will also find that $\pi^{-}(\overline{\nu}^d) + \lambda\Pi^{+}\left(b,\overline{\nu}^d\right) = 0$ irrespective of b, and will be indifferent between continuation and liquidation. *(ii)* When $\nu < \overline{\nu}^d$, it is clear that continuation is undesirable for any unit in the bad state, irrespective of the level of b. *(iii)* When $\nu > \overline{\nu}^d$, continuation is strictly desirable irrespective of b for any unit in the bad state, because it must be strictly more desirable than in the case $\nu = \overline{\nu}^d$. From all of the above, one concludes that, generically, $\overline{b}^{p-}(\nu)$ takes either value $-\infty$ (when $\nu < \overline{\nu}^d$) or 0 (when $\nu > \overline{\nu}^d$).

[14] See Caballero and Hammour (2003), footnote 18, for a discussion of conditions to limit insurance arrangements with financiers and workers.

One can show that if the entrepreneur is able to attract external finance for continuation, he will be able to do so irrespective of the current level of $b \geq 0$.[15] In other words, for any productivity level ν, the maximum liability $\overline{b}^{f-}(\nu)$ for continuation financing to be feasible can take only two values: 0 or $+\infty$. The interesting case for us is when continuation in the bad state cannot be financed. We therefore restrict ourselves to parameters under which negative cash flows in the bad state are significant enough, so that the finance constraint on continuation is *always binding*:

$$\overline{b}_t^{f-}(\nu) = 0, \quad \nu \in [-\overline{\nu}, \overline{\nu}],\, t \geq 0.$$

No unit can obtain external financing for continuation in the bad state.

3.4 Aggregate Dynamics and Equilibrium

We close the model by discussing the dynamics that govern the distribution of production units; the aggregate gross rates of creation and destruction of production units; and the wealth dynamics that determine new projects' financing requirements. This allows us to define the economy's equilibrium.

Distributional dynamics

Appendix B provides the system (32)-(33) of stochastic partial differential equations that governs the dynamics of the distributions $n_t^+(b,\nu)$ and $n_t^-(b,\nu)$ of production units in the good and bad states. These dynamics are determined by flows on the creation and destruction margins as well as by the dynamics of external liabilities. The latter are determined by the required risk-adjusted return. A production unit's external liabilities, b, evolve according to:

$$\dot{b}_t = R(b_t)b_t - \pi_t, \quad \text{where} \quad R(b) \equiv \begin{cases} \rho + \delta + \lambda, & b > 0; \\ \rho, & b \leq 0. \end{cases}$$

Recall that we have restricted ourselves to the case where negative cash flows cannot be financed externally in the bad state. With positive external liabilities ($b_t > 0$) — which, by assumption, only happens in the good state — the external financier requires a return $\rho + \delta + \lambda$, to cover the opportunity cost ρ of capital as well as the hazard $\delta + \lambda$ of failure

[15] Consider two non-negative levels of external liability, $b_{\text{high}} > b_{\text{low}} \geq 0$. If the financier is willing to finance continuation at b_{low}, he has all the more reason to finance it at b_{high}, since his return in that case can only be greater. Conversely, if continuation is financed at b_{high}, the entrepreneur can always find an interest rate path that will attract finance at b_{low}. One such path is to increase the liability instantly to b_{high}, at which level we know that external finance can be induced. This path is preferable for the entrepreneur to inefficient liquidation, although he generally has more favorable alternative paths.

or bad-state liquidation. With positive internal funds ($b_t < 0$), the entrepreneur earns the interest rate ρ (which is equal to $r - \delta$).

Flows on the creation and destruction margins and the dynamics of b also allow us to provide in the appendix the system (34)-(36) of stochastic partial differential equations that governs the distribution of production unit values $\Pi_t^+(b,\nu)$ and $\Pi_t^-(b,\nu)$ in the good and bad states.

Gross Creation

For each productivity ν, we have seen that there is minimum wealth compatible with creation constraints (10), which translates into an upper-bound $b \leq \min\{\overline{b}_t^{p+}(\nu), \overline{b}_t^{f+}(\nu)\}$ on initial liabilities. This allows us to write total gross creation as

$$H_t = \int_{\underline{\nu}}^{\overline{\nu}} \int_{-\infty}^{\min\{\overline{b}_t^{p+}(\nu), \overline{b}_t^{f+}(\nu)\}} g(b; A_t) f(\nu)\, db\, d\nu. \tag{15}$$

With the accounting of the units that are created at any point in time, we can go back to labor's flow opportunity cost (5) and write an explicit expression for the quasi-rents a worker expects to capture in a new job:

$$E_\nu[S_t] = \frac{1}{1-\beta} \int_{\underline{\nu}}^{\overline{\nu}} \int_{-\infty}^{\min\{\overline{b}_t^{p+}(\nu), \overline{b}_t^{f+}(\nu)\}} \Pi_t^+(b,\nu) \frac{g(b; A_t) f(\nu)}{H_t} db\, d\nu. \tag{16}$$

Gross destruction

The number D_t of production units destroyed at any point in time is made up of three components:

$$D_t = D_t^\delta + D_t^s + D_t^f,$$

where

$$\begin{aligned}
D_t^\delta &= \delta(1 - U_t); && (17)\\
D_t^s &= \lambda \int_{-\overline{\nu}}^{\overline{\nu}_t^d} \int_{-\infty}^{\phi\kappa} n_t^+(b,\nu)\, db\, d\nu + \max\{\dot{\overline{\nu}}_t^d, 0\} \int_{-\infty}^{0} n_t^-(b, \nu_t^d)\, db; && (18)\\
D_t^f &= \lambda \int_{\overline{\nu}_t^d}^{\overline{\nu}} \int_{0}^{\phi\kappa} n_t^+(b,\nu)\, db\, d\nu + \int_{-\overline{\nu}}^{\overline{\nu}} n_t^-(0,\nu)\, \dot{b}_t\Big|_{(b,\tilde{\epsilon})=(0,-\epsilon)} d\nu. && (19)
\end{aligned}$$

The three terms correspond, respectively, to exogenous failures, "privately efficient" (or "Schumpeterian") destruction, and "privately inefficient" (or "spurious") destruction. *(i)* The first term, D_t^δ, captures the flow of units that fail for *exogenous* reasons. *(ii)* Privately efficient (or Schumpeterian) destruction D^s captures units destroyed because they hit a *profitability* constraint on continuation. Define $\overline{\nu}_t^d$ as the level of productivity at which a unit with infinite internal funds would be indifferent between continuing or not in the bad state. The first term captures units that turn unprofitable because they enter the bad state with productivity $\nu \leq \overline{\nu}_t^d$; the second, units that turn unprofitable because they cross that threshold while in the bad state due to deteriorating aggregate conditions. This type of destruction is a form of Schumpeterian destruction, by which unproductive components of the economy's productive structure are renovated.[16] *(iii)* Privately inefficient (or spurious) destruction, D_t^f, measures destruction due to *financial* constraints. The first term in D_t^f is the flow of units that turn bad and must be liquidated because of insufficient capitalization; the second term captures the flow of units in the bad state that run out of internal funds.[17]

Initial wealth dynamics

Recall that we specified the mass density $g(b; A_t)$ of new projects' financing requirements as a function of an index A_t of the aggregate wealth of non-active entrepreneurs. In order to allow for an effect of aggregate conditions $\widetilde{y}_t$ on the latter — as emphasized, e.g., by Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) — we assume that A_t follows the process:

$$\dot{A}_t = \psi(\widetilde{y}_t, A_t), \quad \psi_1 \geq 0, \, \psi_2 \leq 0. \tag{20}$$

Our model tracks the internal funds dynamics of production units in operation, but not the population and wealth dynamics of potential entrepreneurs. Although it would be methodologically more sound to track the details of the latter, doing so would add another dimension of complexity. Our specification uses an ad-hoc short-cut designed to capture the observed procyclicality and persistence of available funds.

Equilibrium conditions

Given a stochastic process $\{\widetilde{y}_t\}_{t\geq 0}$ and initial conditions $\left\{\left(n_0^+(b,\nu), n_0^-(b,\nu)\right)\right\}_{b\in\Re,\ \nu\in[-\overline{\nu},\overline{\nu}]}$ and A_0, an equilibrium for this economy is a stochastic process $\Big\{\Big(n_t^+(b,\nu)\,,\ n_t^-(b,\nu),$ $\Pi_t^+(b,\nu), \Pi_t^-(b,\nu), \pi_t^+(\nu), \pi_t^-(\nu), w_t^o, H_t, U_t, \overline{b}_t^{f+}(\nu), \overline{b}_t^{p+}(\nu),\ \overline{b}_t^{p-}(\nu)\Big)\Big\}_{t\geq 0,\ b\in\Re,\ \nu\in[-\overline{\nu},\overline{\nu}],\ \widetilde{\epsilon}\in\{\epsilon,-\epsilon\}}$ that satisfies equations (2), (5)-(7), (11)-(13), (15)-(16), (20), (32)-(36).

[16] This is a rather simplistic view of Schumpeterian destruction. See, e.g., Caballero and Hammour (1994) for a vintage model of creative destruction. In contrasting Schumpeterian with spurious destruction, we do not mean to attribute to Schumpeter the view that separations are privately efficient. What we attribute to him is the idea — central to his "liquidationist" view of recessions — that destruction is highly selective in terms of profitability.

[17] All else being equal, the lower a unit's productivity, the more likely it is to be liquidated due to financial constraints. This "selectivity" of spurious destruction makes the difference with Schumpeterian destruction less stark than may appear at first glance.

4 Inefficient Restructuring and the Cost of Recessions

We now turn to analyzing our model's implications for the effect of recessions on economic restructuring and its social cost implications. In sub-section 4.1, we describe the parameter values we chose to simulate the model. In order to describe the general economic environment where recessions develop, our analysis starts in sub–section 4.2 by characterizing the steady-state implications of factor market rents in an economy that is subject to on-going restructuring. We then analyze in sub-section 4.3 the economy's business cycle dynamics and, in particular, the mechanisms behind the slowdown in restructuring following recessions. Finally, we discuss in sub-section 4.4 the behavior of the different components of restructuring — creation and the different forms of destruction — and the social costs and benefits associated with them.

4.1 Parameter Choice

We start with the choice of parameter values in our model. Our mission is clearly not to resolve the controversies around the empirical literatures we draw on, or to demonstrate that there is only one defensible parametrization. What we argue is that a reasonable reading of the evidence leads to a perspective on the cost of recessions that is surprisingly different from prevailing views.

Six parameters characterize technological aspects of production units: κ, ϵ, λ, δ, ϕ, r; two characterize institutional aspects of rent sharing: α and β; and two characterize preferences: ρ and z. We also need to specificity functional forms with their associated parameters. The joint distribution of project productivities ν and financing requirements b is assumed uniform in ν on the interval $[-\overline{\nu}, \overline{\nu}]$ and uniform in b on $[0, b^{\max}]$, with total mass A_t. The dynamic process $\psi(y, A)$ that governs internal funds available for creation is assumed linear and stationary. Finally, "business cycle" dynamics for the aggregate component $\widetilde{y}_t$ of firm output follows an Ornstein-Uhlenbeck process:

$$d\widetilde{y}_t = -\gamma(\widetilde{y}_t - \overline{y})dt + \sigma dW_t, \quad \gamma, \sigma \geq 0,$$

where W_t is a standard Brownian motion.[18]

[18] Strictly speaking, some realizations of an Ornstein-Uhlenbeck process will violate two assumptions we made in sub-section 3.3 — namely that we restrict ourselves to parameters such that the following properties always hold: *(i)* $\pi_t^+ > 0$ and $\pi_t^- < 0$; and *(ii)* $\overline{b}_t^{f-} = 0$. We therefore need to assume that the process for $\widetilde{y}_t$ is adequately regulated so as to satisfy those two assumptions; and check that they are always satisfied in our simulations.

Another, relatively minor issue is that expression (18) for D_t^s is not compatible with an infinite-variations

Table 1: Model Parameters

Parameter	Value	Parameter	Value
κ	1.940	z	0.000
ϵ	0.283	$\overline{\nu}$	0.106
λ	0.205	$b^{\max}$	0.394
δ	0.060	ψ_0	-0.009
ϕ	0.329	ψ_1	0.558
r	0.135	ψ_2	-1.940
α	0.700	$\overline{y}$	0.899
β	0.333	γ	0.410
ρ	-0.060	σ	0.180

Table 1 summarizes the values we chose for the above parameters, based on observed features of the US economy. Section C of the appendix provides a detailed description of our calibration of steady-state features of our model based on evidence concerning *(i)* general features of the economy that are less central to our argument; *(ii)* factor-market rents; and *(iii)* unemployment and gross flows. In order to calibrate the parameters that drive the economy's cyclical dynamics, we rely on the dynamics of employment and gross flows documented in section 2, and on proxies for available funds. *(i)* Parameters γ and σ in the process for $\widetilde{y}_t$ were set to values that result in unemployment dynamics similar in volatility and persistence to the dynamics documented in section 2. This resulting process implies an annual auto-regressive coefficient for $\widetilde{y}_t$ of about 0.4. *(ii)* In sub-section 4.3, we examine how the fall in restructuring following recessions is potentially related to the effect of aggregate income on funds available for creation in dynamic equation (20). Replacing the process for $\widetilde{y}_t$ into the latter, and using a discrete time approximation (with $dt = 1/4$), yields an AR(2) process for A_t:

$$A_{t+dt} = [(1 + \psi_2 dt) + (1 - \gamma dt)]A_t - (1 + \psi_2 dt)(1 - \gamma dt)A_{t-dt} + \psi_1 \sigma dW_t.$$

Using as proxies detrended series for business loans and deposits in the US during our sample period, we obtain that an AR(2) characterizes these processes well.[19] The autoregressive

specification for $\widetilde{y}$, because term $\dot{\overline{\nu}}_t^d$ is ill-defined. We chose to retain this expression for expositional simplicity. This is of no practical relevance to our simulations, which are based on a discretized version of the model.

[19] Series detrended with an HP-filter with $\lambda = 1600$. Data source: FRED.

coefficients are 1.54 and -0.65 for loans, and 1.27 and -0.39 for deposits. We chose a value of ψ_2 that yields autoregressive coefficients near the middle of the range spanned by these estimates (1.41 and -0.46, respectively). Finally, we calibrated ψ_1 to match the relative volatility of the gross flows documented in section 2.[20]

4.2 Structural Unemployment, Sclerosis and Scrambling

Suppose the economy is in steady state with a constant $\widetilde{y} \equiv \overline{y}$. In order to sort out the effect of labor and financial market rents, we define four different economies: the "efficient" economy, that suffers from no contracting problems; the α-economy, that adds only the financial constraint to the efficient economy ($\alpha > 0$, $\beta = 0$); the β-economy, that adds only the labor market problem ($\alpha = 0$, $\beta > 0$); and the $\alpha\beta$-economy ($\alpha, \beta > 0$), that adds both problems. Our calibration exercise refers to the $\alpha\beta$-economy.

The economy's aggregate performance is summarized by net output (welfare, for short):

$$\mathcal{W} = Y^s - \phi\kappa H, \tag{21}$$

where $Y^s \equiv Y - r(1-\phi)\kappa N - zN$ measures aggregate output *net* of the return on generic capital and the foregone utility of leisure. Table 2 reports, for each of the economies, welfare $\Delta\mathcal{W} \equiv \mathcal{W} - \mathcal{W}^*$ in deviation from its efficient-economy level, as well as its three basic determinants: unemployment, average labor productivity, and creation. It also reports measures of gross flows and the shadow wage. Note that, because gross aggregate output was normalized to one in the calibration process, measures of aggregate welfare can be interpreted as a percentage of GDP in the $\alpha\beta$-economy.

The annual steady state welfare cost of contracting impediments in the $\alpha\beta$-economy corresponds to nearly 8 percent of GDP. This cost is accounted for by several factors. Compared to the efficient economy, the $\alpha\beta$-economy suffers from a 6 percent *structural unemployment* rate. It also suffers from average productivity lower by 8 percent, itself due to two phenomena that we will describe shortly: *sclerosis* of the productive structure, and a *scrambling* of the productivity ranking along which creation and destruction decisions

[20] The constant term ψ_0 in $\psi(y, A)$ has little relation to the economy's cyclical features. It effectively determines the steady-state mass A of potential entrants, which can be calibrated based on the steady-state creation rate H^* that an "efficient" economy — i.e., one with no contracting impediments — would have. This can be most easily seen if we consider the experiment of adding mass to the $g(b, A)$ distribution at the right of $b^{\max}$, in such a way as to increase the efficient creation rate without affecting the inefficient economy. In the absence of an observable counterpart for H^*, we chose a rather arbitrary value for A in the middle of its admissible range that generated an efficient creation rate $H^* = 0.185$.

are made. Those costs are partly alleviated by a reduction in job-creation costs, given the economy's substantially lower restructuring rate.

Table 2: Steady-State Equilibrium

	Efficient Economy	α-economy	β-economy	$\alpha\beta$-economy
$\Delta\mathcal{W}$	-	-0.007	-0.060	-0.077
U	-	-	0.049	0.060
Y^s/N	0.960	0.947	0.886	0.884
H	0.185	0.177	0.094	0.104
D^s	0.125	0.101	0.037	0.024
D^f	-	0.015	-	0.023
w^o	0.745	0.737	0.725	0.697

Structural unemployment

"Structural" unemployment in steady state is intimately tied to a restructuring process that faces impediments in the labor market. In the absence of either restructuring motives (i.e., if $\delta = \lambda = 0$) or labor-market impediments (if $\beta = 0$), steady-state unemployment would be zero.[21] Financial constraints compound with those two factors to cause even higher unemployment. The latter rises to 4.9% due to the labor-market problem, and to 6.0% when we add financial constraints.

Compared to an efficient steady state with full employment, we have seen that contracting impediments in the labor market give rise to wage rents, which break the efficient free-entry condition on the creation margin. Lower creation and higher unemployment are an endogenous response of the economic system. They lead to higher unemployment duration U/H, which reduces labor's outside opportunity cost w^o (see equation 5). This offsets rent appropriation, and helps guarantee the rate of return required by capital markets.

[21] As discussed in section 3.2 we assume that new projects are sufficiently productive and well financed such that the economy with $\beta = 0$ exhibits full employment. It is easy to make this assumption precise for the steady state of the economy. For a given value of the wage w^o one can use equation (15) to compute steady state creation $H(w^o)$. Using the distributional dynamics given in equations (32)-(33) together with the formulas for gross destruction provided in equations (17)-(19) one can compute the steady state level of employment $L^d(w^o)$ induced by a wage w^o. If $L^d(0) \leq 1$, then a wage $w^o = z = 0$ constitutes an equilibrium. We assume $L^d(0) > 1$, so the steady state wage must exceed the marginal utility of leisure in order to clear the labor market.

Note, however, that although the shadow wage w^o falls with labor market frictions, this is not necessarily true of actual wages inclusive of the rent component.[22]

Table 2 shows that financial constraints compound with labor-market constraints to further increase the structural rate of unemployment. This happens as financial constraints reduce the steady-state demand for labor, both because of the financial restrictions on creation and because the profitability of hiring is reduced by the risk of inefficient liquidation.

Sclerosis and scrambling

In addition to unemployment, the economy suffers from distortions in the restructuring process. The inefficiency of this process is characterized by a combination of "sclerosis" and "scrambling," i.e. a slower and less effective restructuring, respectively. Both labor-market and financial-market problems create *sclerosis* — the survival of production units that would not survive in an efficient equilibrium. As illustrated in table 2, sclerosis arises through the low shadow wage w^o associated with lax labor-market conditions (low H/U). This lowers the pressure to scrap low-productivity units in the bad state, which reduces the threshold productivity $\underline{\nu}^d$ at which this is done. The result is a substantial reduction in the Schumpeterian destruction rate D^s. A pure sclerosis effect is exhibited in the β-economy, where the Schumpeterian destruction rate is about one-third the efficient-economy rate while average labor productivity Y^s/N falls by 8 percent. Sclerosis is costly because it leads to an inefficiently low rate of restructuring.

Adding financial constraints to the β-economy worsens the quality of the restructuring process. The $\alpha\beta$-economy has a higher active destruction rate $D^s + D^f$, but slightly lower average productivity Y^s/N. The fact that a higher reinvestment cost is expended to maintain lower average productivity is clearly costly. It is due to a *scrambling* phenomenon on the creation and destruction margins, that reduces the effectiveness of the restructuring process. In the absence of financial constraints, creation and destruction decisions are based on a strict productivity-ranking of production units. When internal funds become a factor in those decisions, some units are financed that have lower productivity than others that are not financed.[23] Given the creation rate H, this tends to lower the productivity of the average unit created. It also tends to increase the productivity of the average unit destroyed, by shifting the composition of destruction from Schumpeterian, D^s, to spurious, D^f.

[22] See Caballero and Hammour (1998b).

[23] See Barlevy (1999) for a related mechanism and supporting evidence.

4.3 Depressed Restructuring following Recessions

We now turn to the economy's cyclical properties. We focus, in particular, on the effect of recessions on cumulative restructuring and the mechanisms that can lower it. To do so, we analyze our economy in two steps. We first remove financial constraints and look at the cyclical properties of the β-economy. Although this economy does not exhibit the financial constraints on creation or the privately inefficient separations discussed in our calibration exercise, analyzing it helps isolate a specific mechanism for the reduced restructuring based on *productivity selection*. We then bring back financial constraints and look at the $\alpha\beta$-economy. The productivity-based mechanism is weakened and replaced by a much costlier fall in restructuring based on a *financial* mechanism.[24]

Figures 4.1 and 4.2 depict the impulse-response functions for a recessionary shock in the β-economy and the $\alpha\beta$-economy, respectively. For comparability, we chose the size of the shock to be such that it yields the same cumulative unemployment in the $\alpha\beta$-economy as a 2-standard-deviation shock in the VAR estimated in section 2. Panels (a) and (b) depict the response of unemployment and job flows. Panel (c) depicts the cumulative response of creation and destruction, $\int_0^t \widehat{H}_s ds$ and $\int_0^t \widehat{D}_s \, ds$. Panel (d) depicts the privately efficient and inefficient components of destruction.

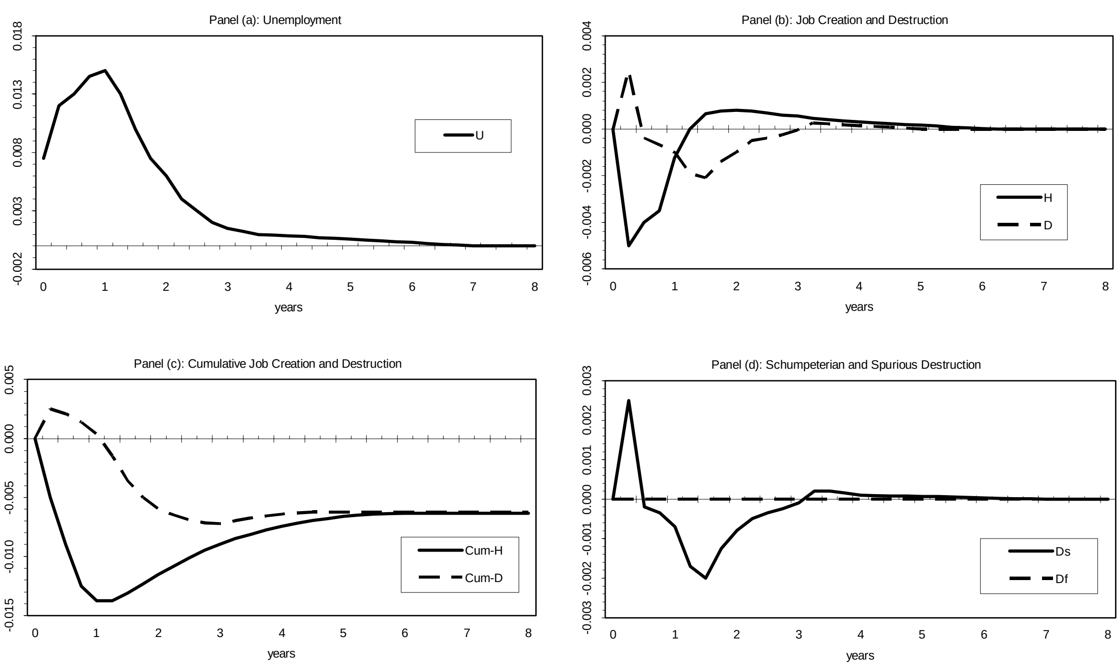

Figure 4.1: β-economy

[24] Our business cycle simulation method is described in section C.1 of the appendix.

The β-economy: productivity-based mechanism

The β-economy in figure 4.1 exhibits a positive unemployment response to the recessionary shock, that returns to steady state over time. The unemployment response is due to the wage "rigidity" brought about by workers' rent-seeking behavior ($\beta > 0$). In the absence of rents ($\beta = 0$), and off-corners, one can show that the shadow wage w^o will absorb all fluctuations in $\widetilde{y}$ with no resulting quantity response. When $\beta > 0$, a central determinant of the shadow wage is the job-finding hazard H/U (see equation 5). In that case, a quantity response in the form of increased unemployment or reduced hiring is required to induce a fall in the shadow wage in response to a contraction in $\widetilde{y}$.

In terms of gross flows, the recession materializes through both an increase in destruction and a decrease in creation. What determines which of those two margins responds to the shock? As we argue in Caballero and Hammour (1994, 1996), the key to this question lies in the "insulation" mechanism by which a fall in creation reduces w^o and insulates destruction from aggregate shocks. If an exclusive response on the creation margin is not costly, the economy will respond on the creation margin only and will fully insulate destruction. In fact, one can show that this is what would happen if all projects in our economy had the same productivity ν. Heterogeneous productivities in the pool of potential entrants is what makes an exclusive response on the creation margin costly. In that case, the average productivity of the entrant pool rises when the rate of creation falls, which makes further reductions in creation increasingly costly and shifts part of the response to destruction.

The recession's effect on cumulative flows depends not only on the response of gross flows at impact, but on the manner in which the economy recovers. As can be seen in panel (c), the economy experiences an increase in destruction at impact, but ultimately ends up with a decrease in cumulative destruction. The reason for the latter is that the recovery takes place essentially through lower-than-normal destruction, while creation simply converges back to its normal level without much overshooting. In addition to the fact that cumulative destruction is lower because employment is lower along the path, a quantitatively more important mechanism that underlies the overall fall in restructuring is due to the selectivity of creation across project productivities. Those units that are not created during the recession are precisely units that have relatively low productivity, and therefore a high destruction rate. Their absence reduces destruction in the ensuing recovery.

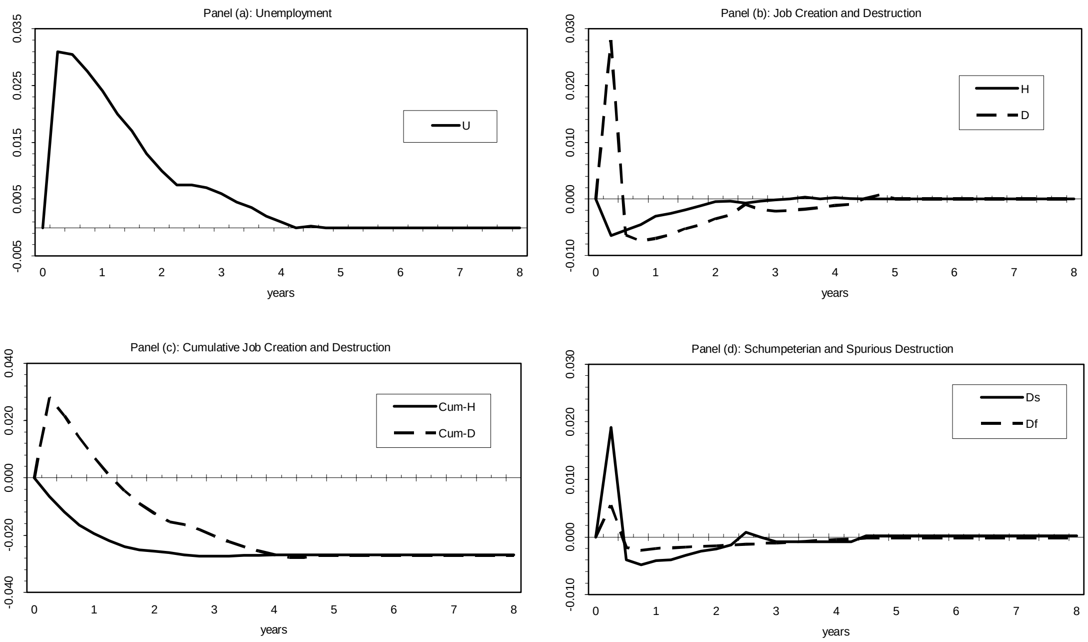

Figure 4.2: $\alpha\beta$-economy

The $\alpha\beta$-economy: finance-based mechanism

Compared to the β-economy, the $\alpha\beta$-economy in figure 4.2 experiences more volatile unemployment, responds much more on the destruction rather than on the creation margin, and exhibits a more significant decline in restructuring. Overall, the $\alpha\beta$-economy is able to match the empirical impulse-response functions of employment, gross flows, and the cumulative restructuring in Section 2.[25]

The introduction of financial constraints:

1. Induces a significant shift in the economy's cyclical responsiveness from the creation to the destruction margin. Since entry for many projects is now determined by the ability of entrepreneurs to finance them, there are financial rents on the creation margin. Those rents allow many projects to absorb negative profitability shocks,

[25] The the $\alpha\beta$-economy exhibits interesting non-linearities as well. Although destruction is nearly four times more responsive to a large negative shock than creation, the ratio of the overall standard deviations of destruction to creation is only 1.5 — roughly the same as in the US manufacturing sector. This is essentially due to a substantial difference in the economy's response to negative versus positive shocks. Relative to creation, destruction responds much more to a negative than to a positive shock. This feature has been documented for US manufacturing gross flows (e.g., Caballero and Hammour 1994, Davis and Haltiwanger 1996). As a result, unemployment responds more to a negative than a positive shock. This asymmetry in net employment fluctuations is reminiscent of features documented for the US economy as a whole (see, e.g., Sichel 1989), and arises out of a fully symmetric shock process.

which renders shifts more of the response to the destruction margin. This dampening effect of financial rents on creation investment goes against the common conclusion that financial constraints increase the volatility of investment.[26] The latter conclusion relies on internal fund dynamics (Bernanke and Gertler, 1989) or cyclical fluctuations in the value of collateral assets (Kiyotaki and Moore, 1997), which we bring into our model in reduced form through the dynamics of funds available for creation (see (20)). As a result of this cyclical financial mechanism, the creation margin regains part of its volatility.

2. The fact that financial constraints dampen creation investment does not mean that it dampens the *net* employment response. On the contrary, employment becomes more volatile as the economy's cyclical response shifts to the destruction margin, which is more sensitive to current conditions because of a shorter expected survival horizon.

3. The decline in restructuring following the recession is of a very different nature than the productivity-based decline in the β-economy. The quantitative significance of the selection mechanism behind the latter is now greatly reduced, as creation becomes much less responsive and the productivity ranking for entry decisions is scrambled by financial constraints. At the core of the decline in restructuring are now the dynamics of financial resources for creation. The procyclical and persistent nature of fund dynamics leads to a natural shift in the margin which responds during the recession and recovery phases. While the reduction in financial resources can accentuate the fall in creation during the recession, it will constrain the recovery from taking place along that margin until resources recover. The result is a shift from the creation to the destruction margin in the recovery phase —that is, a shift from more creation to less destruction— which results in significantly negative cumulative reallocation.

4. On the destruction side, the decline in the importance of the productivity mechanism also implies that the fall in restructuring is not accommodated as much by a (cummulative) decline in Schumpeterian destruction as is by the decline in privately inefficient separations (see below).

[26] An exception is Carlstrom and Fuerst (1997).

4.4 Decomposing Depressed Restructuing and its Costs

In addition to the direct cost associated with unemployment, recessions in our model result in reduced cumulative restructuring. Since in an economy that suffers from structural sclerosis, there are positive gains from increased restructuring, the presumption is that a decline in restructuring adds yet another cost to recessions. However, there are at least two important caveats to this observation. On one hand, if the decline in restructuring is primarily productivity-based, the foregone gains from restructuring are relatively small because the fall in creation affects selectively projects with low productivity. On the other, a finance-based decline in restructuring could in principle be good, since it reduces the number of privately inefficient separations. In what follows we provide a structure to discuss these issues and conclude that the fall in restructuring is indeed likely to represent a cost of recessions, perhaps of the same order of magnitude as the unemployment costs.

Assume the economy starts in stochastic steady state, and experiences a negative aggregate shock to $\widetilde{y}$ at time $t = 0$. If this shock affects "real" productivity, an obvious *direct* social loss results from lower productivity in all units. In order to separate the costs of inefficient restructuring from this direct cost, we assume that the shock to $\widetilde{y}$ is due to an "aggregate distortion" — e.g., due to a distortionary tax on gross output that is redistributed lump-sum. To compare the recession path of any variable X_t with its stochastic steady-state value $\overline{X}$ in the absence of the new shock, we define $\widehat{X}_t \equiv X_t - \overline{X}$ and the resulting present-value operator

$$\mathcal{L}_X \equiv \int_0^\infty \widehat{X}_t e^{-\rho t}\, dt.$$

We also define, for any two variables X_t and Y_t, the interaction operator

$$\mathcal{X}_{X,Y} \equiv \int_0^\infty \widehat{X}_t \widehat{Y}_t e^{-\rho t}\, dt.$$

We measure the social-welfare (net-output) effect of a recession as the present value $\mathcal{L}_\mathcal{W}$ of the shock's effect on flow welfare $\mathcal{W}$, defined in (21). The welfare effect can be decomposed into a component in $\mathcal{L}_U$ that captures an unemployment effect, and a component that captures the productivity effects related to the restructuring process:

$$\begin{aligned} \mathcal{L}_\mathcal{W} \quad = \quad & -(\rho+\delta)\left(\overline{V}^h - \phi\kappa\right)\mathcal{L}_U \\ & + \left(\overline{V}^h - \overline{V}^{ds} - \phi\kappa\right)\mathcal{L}_{D^s+D^f} \\ & - \left(\overline{V}^{df} - \overline{V}^{ds}\right)\mathcal{L}_{D^f} \\ & + \left(\overline{H}\mathcal{L}_{V^h} - \overline{D}^s\mathcal{L}_{V^{ds}} - \overline{D}^f\mathcal{L}_{V^{df}}\right) \\ & + \mathcal{X}. \end{aligned} \tag{22}$$

The term V_t^h measures the average social value of creating a production unit; V_t^{ds} and V_t^{df} measure the average social loss from privately efficient and privately inefficient destruction; and $\mathcal{X}$ is an interaction term.[27]

The "unemployment" effect, which corresponds to the first line in (22), captures the direct social cost of unemployment, adjusted for the passive response of δ-destruction. Formally, it is equal to the cumulative employment effect of the recession, $-\mathcal{L}_U$, multiplied by the flow social value $(\rho+\delta)(\overline{V}^h - \phi\kappa)$ of a production unit.

The "productivity" effect, captured in the next four lines, reflects a potential cost of maladjustment in addition to the unemployment cost. It is essentially a function of the present value $\mathcal{L}_{D^s+D^f}$ of the response of active destruction to the recessionary shock, as well as of the response of the composition of gross flows over time. The terms on lines two to four, respectively, answer the following questions: *(i)* What is the welfare effect of changes in the amount of restructuring, assuming that it affects all productivities in equal proportions and that all destruction is privately efficient (the "restructuring" effect); *(ii)* By how much should that welfare effect be adjusted to account for the fact that some destruction is privately inefficient? (the "spurious destruction" effect); *(iii)* By how much should that effect be adjusted to account for the fact that some productivities are affected more than others by changes in restructuring (the "selection" effect). The last line captures an interaction term. Note that to answer the first question, we value a unit-increase in cumulative reallocation at $(\overline{V}^h - \overline{V}^{ds}) - \phi\kappa$. It is equal to the *private* value increase from updating a production unit, minus the reinvestment cost. Because of private rents on the creation margin, this social value is positive. To answer the second question, one must subtract from this the private loss $\overline{V}^{df} - \overline{V}^{ds}$ that applies to privately inefficient separations.

Tables 3 and 4 report the cumulative responses and the social-welfare decompositions that correspond to the impulse-response functions in figures 4.1 and 4.2 for the β-economy

[27] Formally, we define

$$\begin{aligned} V_t^h &\equiv \frac{\overline{y}^s + \nu_t^h}{\rho+\delta} + \frac{\epsilon}{\rho+\delta+2\lambda}; \\ V_t^{ds} &\equiv \frac{\overline{y}^s + \nu_t^{ds}}{\rho+\delta} - \frac{\epsilon}{\rho+\delta+2\lambda}; \\ V_t^{df} &\equiv \frac{\overline{y}^s + \nu_t^{df}}{\rho+\delta} - \frac{\epsilon}{\rho+\delta+2\lambda}; \end{aligned}$$

where

$$\nu^x \equiv \int_{-\overline{\nu}}^{\overline{\nu}} \frac{x(\nu)}{X} \nu d\nu, \quad X \in \{H, D^s, D^f\};$$

and

$$\mathcal{X} \equiv \mathcal{X}_{H,V^h} - \mathcal{X}_{D^s,V^{ds}} - \mathcal{X}_{D^f,V^{df}}.$$

and the $\alpha\beta$-economy. As explained in sub-section 4.2, social costs can again be interpreted as a percentage of steady-state annual GDP in the $\alpha\beta$-economy.

Table 3: Response to a Recessionary Shock

	β-economy	$\alpha\beta$-economy
$\mathcal{L}_U$	0.022	0.046
$\mathcal{L}_H$	-0.008	-0.024
$\mathcal{L}_{D^s}$	-0.006	-0.003
$\mathcal{L}_{D^f}$	-	-0.015

Table 4: Welfare (net-output) Effect of a Recession

	β-economy	$\alpha\beta$-economy
Unemployment	-0.017	-0.035
Restructuring	-0.003	-0.015
Spurious Destruction	-	0.007
Selection	0.002	-0.002
Interaction	-0.001	-0.001
Productivity	-0.002	-0.011
Total	-0.019	-0.046

The social cost of a two-standard deviations recession in the β-economy is 1.9 percent of a year's GDP. It is essentially due to an unemployment cost of 1.7 percent. Productivity only adds another 0.2 percent. Although a lower cumulative restructuring is harmful in an economy that suffers from sclerosis, it is less so once we consider that units created in a recession have high productivity and present relatively low gains from restructuring. This is why the selection term reduces by nearly a half the social cost of reduced restructuring.

The $\alpha\beta$-economy exhibits larger and more costly employment and depressed restructuring responses. The unemployment cost rises to 3.5 percent, and the depressed restructuring cost adds another 1.1 percent. The recessionary fall in creation is mostly financially driven, hence less selective across productivities than in the β-economy. As a result, the finance-based fall in the pace of restructuring is costlier since it is not offset by a selection effect.

The fact that much of the fall in restructuing occurs in privately inefficient separations reduces the cost of such fall (the spurious destruction term in table 4), but it is not nearly enough to overcome the restructuring cost which arises from the gap between the average *social* value of a newly created unit and that of a unit destroyed, privately efficient or not.

5 Conclusion

The main question in this paper concerns the effect of aggregate shocks in an economy that is subject to on-going restructuring. There is a common presumption among macroeconomists that a recession increases restructuring activity, but controversy about whether this is socially costly or beneficial. A tradition that goes back to the pre-Keynesian "liquidationist" school, views increased liquidations as healthy; another view holds that liquidations are often privately inefficient and wasteful.

First, we showed that the evidence from U.S. manufacturing contradicts the common presumption, and seems to indicate that recessions *reduce* rather than increase the cumulative amount of restructuring in the economy. Second, we argued that a systematic treatment of contracting problems — of which privately inefficient liquidations are only one manifestation — is required to make an assessment of the costs associated to this reduction. In equilibrium, contracting difficulties on the creation margin generally lead to insufficient restructuring, which points to a cost of reduced restructuring. The model we developed provides a useful framework to analyze how recessions affect restructuring activity, and what the costs may be.

We made an effort to quantify our conclusions by drawing on existing empirical evidence. Our mission was clearly not to resolve the controversies that characterize the relevant empirical literatures, or to demonstrate that there is only one defensible parametrization. What we argued is that a reasonable reading of the evidence — not necessarily the only reasonable reading — leads to a perspective on the cost of recessions due to their impact on the restructuring process that is quite different from prevailing views.

Appendix

A Division of Specific Quasi-Rents

The arbitrage equation for the present value of profits of a unit in state $s \in \{+,-\}$ is

$$\begin{aligned}\rho\Pi_t^s(b,\nu) &= [\tilde{y}_t + \nu + \varepsilon^s - r(1-\phi)\kappa - w_t^s(b,\nu)] + \lambda\left[\Pi_t^{\neg s}(b,\nu) - \Pi_t^s(b,\nu)\right] \\ &\quad - \delta\Pi_t^s(b,\nu) + \frac{\partial\Pi_t^s}{\partial b}(b,\nu)\dot{b}_t^+(b,\nu) + \frac{E[d\Pi_t^s(b,\nu)]}{dt}\end{aligned} \tag{23}$$

The term in square brackets captures flow profits. The remaining four terms reflect the capital gains associated with associated with transition to the other state $\neg s$, exogenous destruction, accumulation of external liabilities and changes in aggregate productivity, respectively. The corresponding arbitrage equation for the human wealth of an employed worker is

$$\begin{aligned}\rho W_t^{e,s}(b,\nu) &= w_t^s(b,\nu) + \lambda\left[W_t^{e,\neg s}(b,\nu) - W_t^{e,s}(b,\nu)\right] \\ &\quad + \delta\left[W_t^u - W_t^{e,s}(b,\nu)\right] + \frac{\partial W_t^{e,s}}{\partial b}(b,\nu)\dot{b}_t^+(b,\nu) + \frac{E[dW_t^{e,s}(b,\nu)]}{dt}.\end{aligned} \tag{24}$$

The human wealth of an unemployed worker satisfies the arbitrage equation

$$\rho W_t^u = z + \frac{H_t}{U_t}E_\nu\left[W_t^{e,+} - W_t^u\right] + \frac{E[dW_t^u]}{dt}. \tag{25}$$

In addition to the marginal utility of leisure there are two capital gain terms appearing on the right hand side. The worker finds employment at rate $\frac{H_t}{U_t}$. The expected capital gain from a new job is $E_\nu\left[W_t^{e+} - W_t^u\right]$. Changes in aggregate productivity give rise to the second capital gain term. The present value of the unit's specific quasi rents is defined as

$$S_t^s(b,\nu) \equiv \Pi_t^s(b,\nu) + W_t^{e,s}(b,\nu) - W_t^u. \tag{26}$$

Using the arbitrage equations (23)–(25) the following arbitrage equation for the the present value of specific quasi-rents is obtained:

$$\begin{aligned}\rho S_t^+(b,\nu) &= [\tilde{y}_t + \nu + \varepsilon - r(1-\phi)\kappa - w_t^o] + \lambda\left[S_t^-(b,\nu) - S_t^+(b,\nu)\right] \\ &\quad - \delta S_t^+(b,\nu) + \frac{\partial S_t^+}{\partial b}(b,\nu)\dot{b}_t^+(b,\nu) + \frac{E[dS_t^+(b,\nu)]}{dt}\end{aligned} \tag{27}$$

where labor's flow opportunity cost w_t^o are defined as

$$w_t^o \equiv z + \frac{H_t}{U_t}E_\nu\left[W_t^{e,+} - W_t^u\right]. \tag{28}$$

Specific quasi-rents are divided according to continuous-time Nash bargaining:

$$W_t^{e,s}(b,\nu) = W_t^u + \beta S_t^s(b,\nu) \tag{29}$$

$$\Pi_t^s(b,\nu) = (1-\beta) S_t^s(b,\nu) \tag{30}$$

Multiplying equation (27) by $(1-\beta)$, using equation (30) and subtracting from equation (23) yields the wage path

$$w_t^s(b,\nu) = w_t^o + \beta\left[\tilde{y}_t + \nu + \varepsilon^s - w_t^o\right]. \tag{31}$$

Combining equations (28) and (29) yields the formula for labor's flow opportunity cost given in equation (5) in the main text.

B Distributional Dynamics

This section of the appendix provides the systems of stochastic partial differential equations that govern the dynamics of the distributions of production units and of production unit values in the good and bad states.

The equations that define $n_t^+(b,\nu)$ and $n_t^-(b,\nu)$ are

$$\begin{cases} \dot{n}_t^+(b,\nu) & = & g(b,A_t)f(\nu) + \lambda n_t^-(b,\nu) - (\delta+\lambda+R(b))n_t^+(b,\nu) \\ & & -\frac{\partial n_t^+(b,\nu)}{\partial b}\left(R(b)b - \pi_t^+(\nu)\right), & b \neq 0; \\ \lim\limits_{b\nearrow 0} n_t^+(b,\nu) & = & \lim\limits_{b\searrow 0} n_t^+(b,\nu); \end{cases} \tag{32}$$

and

$$\begin{cases} \dot{n}_t^-(b,\nu) & = & \lambda n_t^+(b,\nu) - (\delta+\lambda+R(b))n_t^-(b,\nu) \\ & & -\frac{\partial n_t^-(b,\nu)}{\partial b}\left(R(b)b - \pi_t^+(\nu)\right), & b<0 \quad \text{and} \quad \nu > \overline{\nu}_t^d; \\ n_t^-(b,\nu) & = & 0, & \text{otherwise}; \end{cases} \tag{33}$$

together with the initial values of $\left\{n_0^+(b,\nu), n_0^-(b,\nu)\right\}_{b\in\Re,\ \nu\in[-\overline{\nu},\overline{\nu}]}$.

The equations that determine $\Pi_t^+(b,\nu)$ and $\Pi_t^-(b,\nu)$ are

$$\begin{cases} (\rho+\delta+\lambda)\Pi_t^+(b,\nu) & = & \pi_t^+(\nu) + \lambda\Pi_t^-(b,\nu) \\ & & +\frac{\partial \Pi_t^+(b,\nu)}{\partial b}\left(R(b)b - \pi_t^+(\nu)\right) + \frac{E\left[d\Pi_t^+(b,\nu)\right]}{dt}, & b < \overline{b}_t^{p+}(\nu); \\ \Pi_t^+(b,\nu) & = & 0, & b > \overline{b}_t^{p+}(\nu); \\ \lim\limits_{b\nearrow 0} \Pi^+(b,\nu) & = & \lim\limits_{b\searrow 0} \Pi_t^+(b,\nu); \end{cases} \tag{34}$$

and

$$
\begin{cases}
(\rho+\delta+\lambda)\Pi_t^-(b,\nu) & = & \pi_t^-(\nu)+\lambda\Pi_t^+(b,\nu) & \\
& & +\frac{\partial\Pi_t^-(b,\nu)}{\partial b}\left(R(b)b-\pi_t^-(\nu)\right)+\frac{E\left[d\Pi_t^-(b,\nu)\right]}{dt}, & b<0 \quad \text{and} \quad \nu\geq\overline{\nu}_t^d; \\
\Pi_t^-(b,\nu) & = & 0, & b>0 \quad \text{or} \quad \nu<\overline{\nu}_t^d; \\
\lim\limits_{b\nearrow 0}\Pi^-(b,\nu) & = & \lim\limits_{b\searrow 0}\Pi_t^-(b,\nu); &
\end{cases}
\tag{35}
$$

together with the transversality conditions

$$
\lim_{t\to\infty}\Pi_t^+(b,\nu)e^{-(\rho+\delta)t}=\lim_{t\to\infty}\Pi_t^-(b,\nu)e^{-(\rho+\delta)t}=0. \tag{36}
$$

C Model Calibration and Simulation Method

This section of the appendix details the parameter choice procedure behind table 1 that we used to calibrate steady state features of the economy. A number of parameters were calibrated by fitting quantities that arise endogenously within our model. Although this amounts to a simultaneous-equations exercise, it will be intuitive to think of it in terms of the assignment of one parameter for each fitted quantity.

General features of the economy

(i) The discount rate was set to $\rho = 0.06$. *(ii)* The gross rental-cost of generic capital was set to $r = 0.135$. Given the discount rate, this means a depreciation rate of 7.5 percent, which falls between the rates of depreciation of structures and equipment (source: BEA). *(iii)* The aggregate component $\overline{y}$ of production-unit output was chosen in such a way as to normalize aggregate output to one. *(iv)* The capital requirement of a production unit was set to $\kappa = 1.94$, which is the value needed to match the observed capital/output ratio (equal to 1.9 for the US business sector in 1995; source: OECD).[28] *(v)* Entrepreneurs' share parameter α determines the return premium on internal funds, and hence the economy's profit rate. We set it to the value $\alpha = 0.7$ that yields a profit rate of 15 percent. *(vi)* For the dispersion of project productivities, we set $\overline{\nu} = 0.106$ near the maximum value compatible with the model's constraint on bad-state financing. This corresponds to ± 10 percent of average productivity.

Factor-market rents

[28] One must distinguish between the amount of capital actually utilized in production units, and capital as measured using national accounts perpetual inventory procedures. In our case, since the separation rate is higher than the depreciation rate of generic capital, the former stock of capital is less than the latter. Our calibrations are aimed at matching measured capital.

Our model exhibits private rents to labor and firms on the creation and spurious destruction margins. *(i)* Abowd and Lemieux (1993) estimate the equivalent of labor's share β of rents to fall in the range [0.23,0.39].[29] Using a value of $\beta = 1/3$ for labor's bargaining share, we obtain an average rent component of wages equal to 8 percent of the average wage.[30] *(ii)* Alderson and Betker (1995) estimate the liquidation value of a firm to be about 2/3 of firm assets. This leads us to set the capital specificity parameter ϕ to about 1/3, which results in an average flow rent on the firm's side equivalent to 6 percent of the average wage. *(iii)* On the destruction side, privately inefficient separations can cause rent losses to labor and to the firm. The literature includes a wide range of estimates for the cost of job loss, that range from less than 2 weeks of wages to substantially more than a year.[31] Using unemployment insurance data, Anderson and Meyer (1994) estimate an average worker loss of 14 weeks of wages. Although this is an estimated average over all permanent separations — including privately efficient ones — we apply it conservatively to the privately inefficient component of separations D^f.[32] The literature on the firm side is much less developed. Hamermesh (1993, pp. 207-209) surveys various estimates, with again a wide range that goes from 3 weeks to 2.5 years of a worker's wage depending on characteristics of the firm. We use the estimate of 20 weeks of wages from one of the more careful studies (Button 1990). The total loss of 34 weeks for the whole production unit is obtained by choosing a value $\epsilon = 0.283$, that determines the output gap between the good and the bad state.

Unemployment and gross flows

We now anchor the following quantities: U, H, and the different types of destruction. *(i)* We use the variable z to calibrate the unemployment rate to $U = 0.06$. The resulting value is very small, which leads us to set $z = 0$. *(ii)* We calibrate the annual restructuring rate to $H/(1-U) = 0.11$ by choosing the appropriate width $b^{\max}$ for the distribution of financing requirements.[33] *(iii)* On the destruction side, the restructuring rate translates into three types of destruction: $H = \delta(1-U) + D^f + D^s$. We set the failure rate of production units to $\delta = 0.06$ to determine the first type, chosen in the lower range of values compatible with the

[29] See Oswald (1996) for a survey of the related literature.

[30] Expressions for private rents on the creation and spurious destruction margins can be found in the working paper version (Caballero and Hammour 1998c).

[31] See, e.g., Ruhm (1987), Topel (1990), Farber (1993), Jacobson, LaLonde and Sullivan (1993), and Whelan (1997).

[32] In fact, the median loss is of only about one week of wages while about 9 percent of workers suffer a loss of more than a year.

[33] This gross restructuring rate is an average value between a sectoral measure of flows in US manufacturing and an economy-wide measure of flows limited to the state of Pennsylvania (see Davis, Haltiwanger and Schuh 1996, p. 21).

parameter restrictions we impose in section 3. *(iv)* Using the Poisson parameter λ, we set the annual rate of privately inefficient separations D^f to about 2.5 percent of employment, which corresponds to the annualized rate of "displacements" as reported by the Displaced Workers Survey for the period 1991-93.[34]

C.1 Model Simulation Method

This section of the appendix describes the method we use to simulate the equilibrium dynamics defined in sub-section 3.4. Our simulation is based on a discrete-time version of the model and a discretized (b, ν)-state space. Appendix B describes the systems of partial differential equations that govern the basic distributions of the model: the distributions $n_t^+(b, \nu)$ and $n_t^-(b, \nu)$ of production units, and the distributions $\Pi_t^+(b, \nu)$ and $\Pi_t^-(b, \nu)$ of production unit values. The evolution of the former is mechanical, and can be computed forward based on the economy's current state. Computation of the latter is more intricate, as it requires forward-looking expectations. In what follows, we describe the method we use to compute the functions $\Pi_t^+(b, \nu)$ and $\Pi_t^-(b, \nu)$. Although our simulation is in discrete time, we present our method in continuous time in order to keep the notation concise.

The only manner in which profits are affected by a production unit's environment is through the aggregate component of profit margins, $p_t \equiv \widetilde{y}_t - w_t^o$. Thus, production unit values $\Pi_t^+(b, \nu)$ and $\Pi_t^-(b, \nu)$ must, in principle, be computed as a function of a state space that contains all variables known at time t that are relevant for forming expectations of the future path of $\{p_s\}_{s>t}$. In principle, this state space is infinite since it contains the distributions $n_t^+(b, \nu)$ and $n_t^-(b, \nu)$. However, the detailed shape of these distributions is unlikely to be important for the present value of profits over an extended horizon. It is plausible that p_t can be forecast reasonably well using only aggregate variables. Practically, we computed expectations of p_t based on an AR(1) model and verified ex post that it captures most of the predictive power of more general ARMA models. This allowed us to approximate the value distributions by $\Pi_t^+(b, \nu) \simeq \Pi^+(b, \nu; p_t)$ and $\Pi_t^-(b, \nu) \simeq \Pi^-(b, \nu; p_t)$. We computed the approximate value distributions using the following iterative procedure.

Iterative procedure

1. *Initialization:* Solve for the steady state functions $\Pi^{+*}(b, \nu; p^*)$ and $\Pi^{-*}(b, \nu; p^*)$

[34] See Hall (1995), table 1, p. 232. This survey was conducted in 1994 and asked whether the respondent had lost a job during the 1991-93 period for plant closing, an abolished shift, insufficient work, or similar reasons. Hall points out that a separation is "more likely to be considered a displacement in a retrospective survey if it has larger personal consequences."

assuming $\widetilde{y}_t = \overline{y}$, for all t. Set $\Pi^{+\langle 0\rangle}(b,\nu;p) = \Pi^{+*}(b,\nu;p^*)$ and $\Pi^{-\langle 0\rangle}(b,\nu;p) = \Pi^{-*}(b,\nu;p^*)$. Set i equal to 1.

2. *Iteration i: (a)* Assuming $\Pi^{+}(b,\nu;p) = \Pi^{+\langle i-1\rangle}(b,\nu;p)$ and $\Pi^{-}(b,\nu;p) = \Pi^{-\langle i-1\rangle}(b,\nu;p)$, simulate a long sample path for the economy and recover the sequence $\{(dp_t, p_t dt)\}_t$. *(b)* Estimate the conditional Normal density $\phi^{\langle i\rangle}(dp|p)$ for the distribution of dp. To do so, run the regression $dp_t = (\alpha_0^{\langle i\rangle} + \alpha_1^{\langle i\rangle} p_t)dt + \varepsilon_t$ and recover the mean $\mu^{\langle i\rangle}(p,\Omega) = \left(\widehat{\alpha}_0^{\langle i\rangle} + \widehat{\alpha}_1^{\langle i\rangle} p\right) dt$ and standard deviation $\sigma_p^{\langle i\rangle} = \sigma_\varepsilon^{\langle i\rangle} dt^{\frac{1}{2}}$ of this distribution. *(c)* Construct new functions $\Pi^{+\langle i\rangle}(b,\nu;p)$ and $\Pi^{-\langle i\rangle}(b,\nu;p)$. To do so, solve the system of partial differential equations (34)-(36) with $\Pi_t^{+}(b,\nu) = \Pi^{+\langle i\rangle}(b,\nu;p_t)$, $\Pi_t^{-}(b,\nu) = \Pi^{+\langle i\rangle}(b,\nu;p_t)$ and $p_t = p$ using

$$\begin{aligned}\frac{E\left[d\Pi_t^{+}(b,\nu)\right]}{dt} &= \frac{E\left[\Pi^{+\langle i\rangle}(b,\nu;p_t+dp_t) - \Pi^{+\langle i\rangle}(b,\nu;p_t)\right]}{dt} \\ &= \frac{\int_{\Delta p} \Pi^{+\langle i\rangle}(b,\nu;p_t+\Delta p_t)\phi^{\langle i\rangle}(\Delta p_t|p_t)d(\Delta p_t) - \Pi^{+\langle i\rangle}(b,\nu;p_t)}{dt}\end{aligned}$$

and

$$\frac{E\left[d\Pi_t^{-}(b,\nu)\right]}{dt} = \frac{\int_{\Delta p_t} \Pi^{-\langle i\rangle}(b,\nu;p_t+\Delta p_t)\phi^{\langle i\rangle}(\Delta p_t|p_t)d(\Delta p_t) - \Pi^{-\langle i\rangle}(b,\nu;p_t)}{dt}.$$

(e) Check for convergence in terms of $\left|U_t^{\langle i\rangle} - U_t^{\langle i-1\rangle}\right|$, $\left|H_t^{\langle i\rangle} - H_t^{\langle i-1\rangle}\right|$ and $\left|w_t^{o\langle i\rangle} - w_t^{o\langle i-1\rangle}\right|$. If the procedure has not converged, increment i by 1 and repeat this iteration. If the procedure has converged, use the current functions $\Pi^{+}(b,\nu;p)$ and $\Pi^{-}(b,\nu;p)$ to simulate the model.

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