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ABSTRACT

We study the general equilibrium effects of social insurance on the transition in a model in which the process of moving workers from matches in the state sector to new matches in the private sector takes time and involves uncertainty. We find that adding social insurance may slow transition. When there are incentive problems in this rematching process, the optimal social insurance scheme may involve forced layoffs and involuntary unemployment.

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Introduction:

In the long run, the process of transition in the former communist countries of Eastern Europe and the Soviet Union will involve moving large numbers of agents from old production activities in the state sector into new production activities in the emerging private sector. We imagine that, for the individual worker, this is a turbulent process. During transition, a worker who leaves the state sector abandons old production activities and the specific skills attached to them and must spend some time trying to find a good match with new skills and a new activity in the private sector. Even in the United States, for example, for workers trying out new production activities, the process of finding a productive match in a lifetime job can require several attempts and substantial amounts of time. (See Hall (1982)).

In this paper, we study a simple general equilibrium model of this process of transition which, at the micro level, emphasizes that the process of matching workers to new activities takes time and involves uncertainty. We use the model to study the general equilibrium effects that social insurance has on the transition process. We focus on social insurance that protects workers against the income risk that they face while they search for a new match in the private sector. We begin with a model in which there are no incentive problems created by social insurance. Somewhat surprisingly, we find that, even when there are no incentive problems created by social insurance, adding complete social insurance may actually *slow* transition. We then consider a model with incentive problems in the design of social insurance by supposing that agents must exert unobserved effort to search for a new production activity. Complete social insurance equalizes consumption across agents and, with such incentive problems, not only slows the transition, but actually prevents it. To encourage agents to exert effort in search during the transition, it is necessary to spread the distribution of consumption. Interestingly, though, even the optimal, incentive compatible social insurance scheme may actually slow transition. Furthermore, this optimal incentive compatible scheme may involve forced layoffs and involuntary unemployment in the sense that agents who are required to leave their old matches and search for new matches are made strictly worse off than agents who are allowed to remain in their old matches.

We offer two interpretations of this model and the reason for the transition. The first is a major tax reform in a closed economy. Under the original policy, the government taxed the returns in the private sector activities at such a high rate that it was optimal for agents to work in the state sector. The government then undertakes a major tax reform which reduces the taxes on the private sector activities. The second interpretation is one of a small economy opening up to trade in goods. Under the original policy barring trade, domestic prices differed substantially from world prices and induced agents to enter activities which had low productivity when productivity is measured at world prices. The government then opens the economy to balanced trade in goods at world prices.

The basic structure of the model draws on elements of the search literature (for a comprehensive discussion see Mortensen (1986) and Pissarides (1990)). More specifically, our model is related to models of sectoral reallocation in the labor market (see, for example, Rogerson (1987)). Recently, several authors have used sectoral reallocation models to study the dynamics of transition, including Blanchard (1991), Dixit and Rob (1991), and Fernandez and Rodrik (1992). Blanchard presents a model of the dynamics of the transition of the labor force from the state sector to the private sector which builds in several market imperfections. He then analyzes the effect of unemployment benefits and incomes policy on the transition. Fernandez and Rodrik consider a model of sectoral adjustment following trade reform that focuses on agents' incentives to block the reform when they face idiosyncratic uncertainty about the cost of the reform. The most closely related paper is Dixit and Rob. They consider a model of sectoral adjustment and they study the impact of social insurance on agents' incentives to move between sectors. Their model, however, focuses on the properties of the stochastic steady state and the impact of social insurance on the hysteresis bands.

In terms of the general equilibrium effects of alternative social insurance schemes, our work is related to the work of Greenwood and Jovanovic (1990) and Bencivenga and Smith (1991). Both of these papers present models of financial intermediation and growth in which financial intermediaries provide a risk pooling role for investor which is somewhat analogous to social insurance in our model. In contrast to our work, however, these papers focus on the implications of financial intermediation for steady state growth rather than transition.

One interpretation of our results is that alternative financial and institutional arrangements interact with the speed and nature of the transition. In several recent papers, Calvo and Coricelli (1992) have analyzed how various imperfections in credit markets interact with the nature of transition. They emphasize the contractionary effects that arise from freeing nominal prices in an environment with restrictions on credit to enterprises.

In the model with unobserved effort in search, we show that the optimal incentive compatible social insurance scheme may involve involuntary unemployment. There is a body of work that investigates a type of involuntary unemployment that arises as part of the optimal contracts designed to solve the incentive problems that arise when the employer has private information about the workers' productivity. (See, for example, Chari(1983), Cooper (1987), and Green and Kahn (1983)). There is also a literature that investigates a type of involuntary unemployment that arises in models with non-convexities such as indivisibilities in hours worked. (See, for example, Rogerson and Wright (1988)). Our model is different from these both in the conditions under which there is involuntary unemployment and in the interpretation. In these previous literatures, the conditions involve the normality of leisure, while ours involve derivatives of the utility for goods. In these other models, the optimal contracts are between private firms and workers. Here we interpret the social insurance problem as that of a state which both employs the workers in their old matches and pays their social insurance when they search.

In the paper, we begin with a presentation of our main result in a two period version of the model without incentive problems. Next, we extend this result to the infinite horizon and also show that social insurance affects not only the transition process but also the steady state level of output and employment in the new sector. Finally, we consider the model with unobserved effort in search, show that the main result holds, and also show there can be involuntary unemployment.

1. The Environment and Interpretation

We consider an economy that lasts two time periods, has a continuum of agents, and two sectors in which production takes place. Each agent is endowed with one unit of time at each date $t = 0, 1$ and has preferences over consumption characterized by the utility function $U(c_0) + \beta EU(c_1)$. The two production sectors are labelled sector 1 and sector A. An agent who works in sector 1 produces 1 unit of output each period he works in that sector. An agent who works in sector A produces either A_1 or A_2 units of output. We assume $A_1 > 1$ and $A_1 > A_2$. All agents are assumed to be in sector 1 at date 0. At this time, agents can either work in sector 1 or move to sector A. To move to sector A, an agent must spend one period searching for a good match with an activity in that sector. Agents who move to sector A either find a good match with an activity in that sector with probability π and produce A_1 at date 1, or they fail to find a good match with probability $(1 - \pi)$ and produce A_2 at date 1.

Let $z \in [0, 1]$ denote the fraction of agents who search for an activity in sector A at date 0. Let c_0^s denote the consumption at date 0 of an agent who searches for an activity in sector A and c_0^1 denote the consumption at date 0 of an agent who works in sector 1. Let $c_1^{A_1}$ denote the consumption at date 1 of an agent who searches at date 0 and finds a high productivity activity in sector A, $c_1^{A_2}$ the consumption at date 1 of an agent who searches at date 0 and fails to find a high productivity activity in sector A, and c_1^1 the consumption at date 1 of an agent who works both periods in sector 1. The resource constraints for this economy are given by

$$(1-z)c_0^1 + zc_0^z \leq (1-z) \tag{1}$$

$$(1-z)c_1^1 + z\pi c_1^{A_1} + z(1-\pi)c_1^{A_2} \leq (1-z) + z\pi A_1 + z(1-\pi)A_2 \tag{2}$$

$z \in [0,1]$ and $c_0^1, c_1^1, c_0^z, c_1^{A_1}, c_1^{A_2} \geq 0$.

We offer two interpretations of this model of transition: a closed economy that undergoes a major tax reform and a small economy that opens to trade. First consider the tax reform interpretation of the model. Under this interpretation, we assume that the production activities in sector 1 and the production activities in sector A require different types of labor. The production activities in sector 1 each require one unit of raw, homogeneous labor. The production activities in sector A each require one unit of task-specific skilled labor. The are many different types of production activities in sector A. Agents are endowed with raw, homogeneous labor and an inherent ability in a subset of the many different task-specific skills. Ex-ante, agents do not know the skills in which they have inherent ability. For an agent to work in sector A, he first must spend a period acquiring one task-specific skill. If an agent has acquired the skill which matches his inherent ability, his output in that activity is A_1. If he acquires a skill which does not match his ability, his output is A_2. We suppose that, under the original tax system, the effective rate on skilled activities is so high that all agents choose to work in unskilled activities. This effective tax rate is meant to capture the full range of distortionary policies which discourage enterprising agents from investing the time necessary to find a good match for their skills. The tax reform corresponds to changes in policies which lower this effective tax rate enough to encourage agents to attempt to find good matches in skilled activities. Alternatively, if we assume that $A_2 = 1$, we can interpret workers in sector 1 as working in activities in which they are badly matched. In this case, the movement of workers into sector A in the model can be interpreted as workers attempting to find good matches. In either case, we think of this model as capturing in a simple way the idea that the old system did not lead workers to find good matches with their production activities, whereas the new system does.

Now consider the trade reform interpretation. In this interpretation, we assume that the activities in both sectors require task-specific skilled labor but differ in that they produce different goods. The production activities in sector 1 all produce one final consumption good x and the activities in sector A all produce another final consumption good y. In sector 1, agents who are matched to their activity produce B_1 (equal to 1 in the model) units of good x and agents who are not matched produce B_2 (not observed in the model) units of good x. In sector A, agents who are matched to their activity produce A_1 units of good y and agents who are not matched produce A_2 units of good y. Agents who leave either sector have a probability π of finding a good match in the other sector on any given attempt to find a match. Agents have period utility for these two goods $v(x, y)$. Let q be the price of y in terms of x. Then agents have indirect utility $\hat{u}(c, q)$ defined by

$$\hat{u}(c, q) = \max_{x,y} v(x, y) \quad \text{subject to} \quad x + qy \leq c$$

When the economy is closed to trade, the relative price q that prevails when every agent has found a good match is $q = \frac{A_1}{B_1}$. We assume that preferences are such that most of the labor force produces good x. (For instance, let $v(x, y) = \alpha \log(x) + (1 - \alpha) \log(y)$ with α close to one.) When this small economy opens to trade, it is faced with world price $q = 1$. To take advantage of its comparative advantage in good y, agents move from producing x to producing y. The period utility function in the model $u(c)$ corresponds in this case to the indirect utility function $\hat{u}(c, 1)$. The resource constraints (1) and (2) then correspond to the condition that trade be balanced each period and thus we abstract from international borrowing and lending. Here, we interpret the initial conditions with all workers well-matched in sector 1 as arising as the steady state outcome of the old trade regime. In this old steady state, all bad matches have been dissolved and are thus not observed.

In terms of the empirical implications of the model, it is important to note that under both of these interpretations the shifts across activities may well not show up as shifts across sectors as conventionally measured. For example, in the tax reform interpretation, imagine workers in a state restaurant in Russia just after privatization. They may well "search" across restaurant types to find a good match, where types are characterized by, say, ethnicity, price range, and location. Moreover, even within a given restaurant a worker that had a certain position under the old regime may "search" for a new position which involves new responsibilities in the new economic environment for which the previous experience provides little guidance. Under the trade reform interpretation an example might be Polish producers who under the CMEA trading system manufactured mediocre goods, which after the reform were unprofitable at the world prices. These producers may search for new types of goods to manufacture that will be profitable at world prices. In both of these interpretations this search process will not involve movements across sectors as defined in GNP accounts but rather across activities within the same sector and perhaps even within the same firm. Much of this search may be done while workers still officially retain their old jobs. If so, then this search will show up not as a rise in unemployment but as a drop in productivity of existing firms.

2. The Impact of Social Insurance

In this section we show that adding social insurance to protect agents against the risk that they may fail to find a good match in sector A will actually slow transition if agents have a strong enough precautionary demand for saving and are not very risk averse. We begin by considering an environment in which there are no private markets for insuring away the idiosyncratic risk experienced by agents who search, agents who work are paid their marginal product each period, and the only asset that agents trade at date 0 is a bond which pays off one unit of consumption for sure at date 1. At date 0, agents choose whether to work in sector 1 or to search. Clearly, if an agent works in sector 1 at date 0, he will find it optimal to work in sector 1 again at date 1.

An agent who works both periods in sector 1 earns one unit of wages at each date. If we let p denote the price at date 0 of a sure bond paying one unit of consumption at date 1 and b the quantity of such bonds purchased, an agent who works both periods in sector 1 faces budget constraints $c_0^1 + pb \leq 1$ and $c_1^1 \leq 1 + b$. Such an agent maximizes utility $U(c_0^1) + \beta U(c_1^1)$ subject to these budget constraints. Let $V_I^1(p)$ denote the indirect utility of an agent works in sector 1. The subscript i stands for "incomplete". Let $c_I^1(p)$ denote that agent's demand for first period consumption. An agent who searches earns no wages at date 0 and at date 1 earns A_1 with probability π and A_2 with probability $(1-\pi)$. This agent faces budget constraints $c_0^z + pb \leq 0$, $c_1^{A_1} \leq A_1 + b$, and $c_1^{A_2} \leq A_2 + b$. This agent maximizes utility $U(c_0^z) + \beta(\pi U(c_1^{A_1}) + (1-\pi)U(c_1^{A_2}))$ subject to these budget constraints. Note that we can write the budget constraints for this agent as

$$c_0^z + p(\pi c_1^{A_1} + (1-\pi)c_1^{A_2}) \leq p(\pi A_1 + (1-\pi)A_2) \qquad (3)$$

$$c_1^{A_1} \geq c_1^{A_2} + (A_1 - A_2). \qquad (4)$$

Let $V_I^z(p)$ denote the indirect utility of an agent who searches and $c_I^z(p)$ denote his first period demand.

An *equilibrium without social insurance* is an allocation $(z, c_0^1, c_1^1, c_0^z, c_1^{A_1}, c_1^{A_2})$ and a bond price p such that (c_0^1, c_1^1) is optimal for an agent who works both periods in sector 1, $(c_0^z, c_1^{A_1}, c_1^{A_2})$ is optimal for agent who searches, resource constraints (1) and (2) are satisfied, and either $z = 0$ and $V_I^1(p) \geq V_I^z(p)$ or $z \geq 0$ and $V_I^1(p) = V_I^z(p)$. In the appendix we show that there is a unique equilibrium without social insurance.

Consider next the equilibrium when we add social insurance that completely eliminates idiosyncratic risk. This equilibrium allocation is the ex-ante optimal allocation and can be decentralized in many ways. In one decentralization the only private financial markets are for risk free bonds and the government provides social insurance through taxes and transfers. In order to facilitate comparison to the equilibrium without social insurance, we focus on this decentralization. In this decentralization, workers are paid their marginal product. The income of an agent who works both periods in sector 1 is one unit each period. The income of an agent who searches is zero at date 0 and A_1 with probability π and A_2 with probability $(1-\pi)$ at date 1. This agent receives social insurance transfers $[\pi A_1 + (1-\pi)A_2] - A_1$ if he produces A_1 and transfers $[\pi A_1 + (1-\pi)A_2] - A_2$ if he produces A_2. With such transfers, an agent who searches receives after-transfer income equal to $[\pi A_1 + (1-\pi)A_2]$ whether or not he succeeds in search. Since this social insurance scheme simply pools the risk among those who search, it is self financing and thus involves no taxes on or transfers to the agents who work both periods in sector 1.

Denote the indirect utility functions and first period demand functions for agents who stay in sector 1 by $V_c^1(p)$ and $c_c^1(p)$. The subscript c stands for "complete". Since agents who work both periods in sector 1 face the same budget constraints with and without social insurance, $V_c^1(p) = V_I^1(p)$ and $c_c^1(p) = c_I^1(p)$. Denote the indirect utility functions and first period demand functions for agents who search by $V_c^z(p)$ and $c_c^z(p)$. These agents face a lifetime budget constraint (3). Note that the constraint (4) no longer applies. The definition of an *equilibrium with social insurance* is identical to that of an equilibrium without social insurance except that constraint (4) no longer binds. We show in the appendix that there is a unique equilibrium with social insurance.

The calculation of equilibrium with and without social insurance is illustrated with a parametric example in Figure 1. We set $A_1 = 6$, $A_2 = 1$, $\beta = 1$, $\pi = .9$, and assume agents have $CRRA$ utility of the form $u(c) = c^\gamma/\gamma$ with $\gamma = -.5$. We plot the indirect utility functions $V^1(p)$, $V_c^z(p)$, and $V_I^z(p)$ in the upper panel. The equilibrium bond price without social insurance is found at the point $\bar{p}_I$ such that $V^1(\bar{p}_I) = V_I^z(\bar{p}_I)$. The equilibrium bond price without social insurance is found at the point $\bar{p}_c$ such that $V^1(\bar{p}_c) = V_c^z(\bar{p}_c)$. The equilibrium number of searchers z in each case can then be found from the condition (1) that the goods market clears at date 0. From this condition, we write z_I as a function of the bond price p:

$$z_I(p) = \frac{1 - c^1(p)}{1 - c^1(p) + c_I^z(p)} \tag{5}$$

and similarly for z_c

$$z_c(p) = \frac{1 - c^1(p)}{1 - c^1(p) + c_c^z(p)} \tag{6}$$

Observe that as long as $p \leq \beta$, $c_I^1(p) \leq 1$, so that $z_I(p)$ and $z_c(p)$ are decreasing in p. We plot the functions $z_I(p)$ and $z_c(p)$ in the lower panel. The equilibrium number of searchers in each case is then found at $z_I(\bar{p}_I)$ and $z_c(\bar{p}_c)$ respectively. We see in this figure that the addition of social insurance raises the number of searchers in equilibrium in this case. In figure 2, we present the same illustration of the determination of equilibrium in a parametric example in which the addition of social insurance reduces the number of searchers in equilibrium. In this case we set $A_1 = 6$, $A_2 = 1$, $\beta = 1$, $\pi = .9$, and assume agents have $CRRA$ utility of the form $u(c) = c^\gamma/\gamma$ with $\gamma = .2$.

The fact that social insurance has an ambiguous impact on the speed of transition can be understood as follows. Since by definition $V_c^z(p) > V_I^z(p)$ for all p, if there is search in equilibrium with social insurance, then the equilibrium bond price $\bar{p}_c$ is strictly less than the bond price $\bar{p}_I$ in the equilibrium without social insurance. The difference $\bar{p}_I - \bar{p}_c$ is larger the greater is agents' (absolute) risk aversion. To determine whether the drop in the bond price (increase in the interest rate) induced by insurance raises the number of searchers, it is necessary to compare $z_I(\bar{p}_I)$ and $z_c(\bar{p}_c)$. This ranking depends both on agents' risk aversion and on whether agents have a precautionary demand for saving.

Following Leland (1968), we say that agents have *precautionary demand for saving* at price p if $c_I^z(p) < c_c^z(p)$. (For other work on the precautionary demand for saving, see Kimball (19??), and Zeldes (19??).) As Leland shows, if agents are risk averse and U' is a strictly convex function, then agents have precautionary demand for saving for all p. These conditions are satisfied when utility takes the $CRRA$ or $CARA$ form. If $U'(\cdot)$ is concave, then there is no precautionary demand for saving. Since $c_I^1(p) = c_c^1(p)$, then, for all p, the function $z_c(p)$ lies everywhere above $z_I(p)$ if agents do not have precautionary demand for saving. In this case, adding insurance must speed transition. On the other hand, if agents have precautionary demand for saving, then, for all p, the function $z_I(p)$ lies everywhere above $z_c(p)$. Then adding insurance slows transition if the precautionary demand for saving is strong and if agents are not too risk averse so that the change in the bond price induced by insurance is small. To see which case is the relevant case when agents have $CRRA$ preferences of the form c^γ/γ, we present a plot of the equilibrium values of z_c and z_I with $A_1 = 6$, $A_2 = 1$, $\beta = 1$, $\pi = .9$, as we vary γ between -1 and 1 in figure 3. We summarize our results on the impact of optimal social insurance on the cost and speed of transition as follows.

Result 1: Adding perfect social insurance into an economy with uncontingent loans raises welfare and increases the equilibrium interest rate. Social insurance speeds transition if agents have little or no precautionary demand for saving. Social insurance slows transition if agents have a large precautionary demand for saving and are not very risk averse.

We can see that this result depends on the general equilibrium considerations that arise in the closed economy by comparing this result with the impact of social insurance on the speed of transition in the model when residents of the country can freely borrow or lend abroad at a fixed world interest rate. In the open economy, we modify the definition of equilibrium with and without insurance by replacing the resource constraints by the requirement that the domestic bond price be equal to the world bond price given by p^*.

We can use figure 1 again to illustrate the open economy equilibrium without social insurance. If p^* is below the price $\bar{p}_I$ at which $V_I^z(p)$ and $V^1(p)$ intersect, then there is no search in equilibrium all agents prefer to remain in the old sector. If $p^* = \bar{p}_I$, then all agents are indifferent between staying in the old sector or searching for a match in the new sector. In this case, any value of $z \in [0, 1]$ is consistent with equilibrium. If $p^* > \bar{p}_I$, then all agents strictly prefer to search for a match in sector A and leave sector 1 to do so immediately. The determination of equilibrium with social insurance is similar to the case without social insurance. In this case, there all agents search if $p^* > \bar{p}_c = [\pi A_1 + (1 - \pi)A_2 - 1]^{-1}$. If $p^* < \bar{p}_c$, there is no search. Since $\hat{p} < \bar{p}_c$, there is a range of world bond prices p^* between $\bar{p}_c$ and $\bar{p}_I$ for which search occurs with social insurance and does not occur without social insurance. Thus, social insurance cannot decrease search in equilibrium. This result makes it clear that our earlier result that adding social insurance may slow transition depends on the requirement in general equilibrium that aggregate consumption be equal to aggregate output in each period.

Notice that in the open economy, in the transition, output and employment fall but consumption does not. Indeed, if there is social insurance and $p^* = \beta$, then consumption jumps immediately to its new long run level and output and employment fall more than they do when there is no international borrowing or lending. Since agents in this economy can borrow abroad at first to finance their consumption during the transition, the transition is less costly when international borrowing is possible.

3. Extension to the Infinite Horizon

In this section, we extend our result to a version of our model in which there is an infinite time horizon by demonstrating in a parametric example that adding social insurance may slow transition. We also show in this version of the model that adding social insurance changes not just the transition, but also raises the steady state level of output. This is because, when there is no social insurance and agents' risk aversion varies with their level of wealth, some agents will be too risk averse to search for a match in sector A, whereas all agents would search if social insurance were added.

To extend the result that the addition of social insurance can slow transition to the infinite horizon framework, we modify the environment in the following respects. Time is denoted $t = 0, 1, 2, \ldots$. All agents in the model have identical preferences of the form $U = E\sum_{t=0}^{\infty} \beta^t u(c_t)$. We assume that $A_1 = A > 1$ and

$A_2 = 1$. Let λ_t^A be the number of agents who have good matches in sector A at date t. These agents produce output $A\lambda_t^A$ at date t. Let z_t be the number of searchers and let $(1 - \lambda_t^A - z_t)$ be the number of agents who work but are not well-matched in sector A at date t. These agents who work when not well matched in sector A produce $(1 - \lambda_t^A - z_t)$. At date 0 there is some initial stock of agents λ_0^A who are well-matched in sector A. At every date t, any agent who is not well matched in sector A can search for a match in sector A. An agent who searches must forgo employment for that period and has a probability π of finding a good match in sector A. Current production and next period's number of workers well matched in sector A are given by the equations

$$Y_t = A\lambda_t^A + 1 - \lambda_t^A - z_t \tag{19}$$

$$\lambda_{t+1}^A = \lambda_t^A + \pi z_t \tag{20}$$

In the appendix, we present a solution method for equilibrium with and without social insurance in this model when agents have constant absolute risk aversion with preferences given by $u(c) = -\exp(-\gamma c)$. In the equilibrium without social insurance, we assume that the only asset that agents trade are one-period uncontingent bonds. In figure 4, we present transition paths for output and λ_t^A when $A = 10$, $\beta = .6$, $\pi = 2/5$, with the coefficient of absolute risk aversion $\gamma = 2$. In this figure, we see that adding social insurance slows transition.

In the parametric example presented above, we assumed that agents have constant absolute risk aversion. This assumption implies that, in the equilibrium without social insurance, agents' decisions to take on the risk of searching for a good match are not affected by their level of wealth. As a result, as long as search is worthwhile for some agent at bond price $p = \beta$, the unique steady state of the model has all agents well matched in sector A. On the other hand, this is not true if agents do not have constant absolute risk aversion.

We characterize which agents will choose never to search for a match in sector A in the context of the economy with no social insurance and international borrowing and lending as follows. Let the international uncontingent bond price be given by $p^* = \beta$. An agent who stays in sector 1 forever and begins life with initial bond holdings b_0 earns wages 1 every period and has constant consumption $c^1 = (1 - p^*)b_0 + 1$ every period. An agent who is well matched in sector A and has initial bond holdings b_0 earns A every period and has constant consumption $c^1 = (1 - p^*)b_0 + A$. Thus, all agents who are in sector 1 and have bond holdings b_0 such that

$$1/(1-\beta)u((1-p^*)b_0 + 1) > \tag{21}$$

$$\max_{b'} u(b_0 - p^* b') +$$

$$\beta/(1-\beta)[\pi u((1-p^*)b' + A) + (1-\pi)u((1-p^*)b' + 1)]$$

will not want to deviate at date 0 from the strategy of never searching for a match in sector A. Since agents' preferences are continuous and their utility is bounded under any feasible strategy, the result that they never want to deviate for one period from the strategy of never searching for a match in sector A implies that this strategy is the optimal strategy for these agents. Observe that when agents have constant absolute risk aversion, if (21) holds for any initial level of bond holdings b_0, it holds for all initial level of bond holdings.

4. The Impact of Social Insurance with Incentive Problems:

In this section, we examine the nature of optimal social insurance in a modified version of this environment in which agents who search must exert some unobserved effort to have any chance of finding a good match. We find that even the optimal incentive compatible insurance scheme may slow transition. Moreover, the optimal scheme involves both a fanning out of the distribution of consumption and may require a type of forced layoffs and involuntary unemployment.

In this version of the model, agents who exert effort in search have a probability π of finding a good match in sector A, while agents who do not exert effort in search have no chance of finding a good match in sector A. Agents who neither work nor exert effort in search gain utility $\tilde{\nu}$ from their leisure. Thus, if agents who search are to be induced to put effort into their search, it must be the case that

$$U(c_0^z) + \beta[\pi U(c_1^{A_1}) + (1-\pi)U(c_1^{A_2})] \geq U(c_0^z) + \beta U(c_1^{A_2}) + \tilde{\nu}$$

or that

$$U(c_1^{A_1}) \geq U(c_1^{A_2}) + \nu \tag{22}$$

where $\nu = \beta\pi\tilde{\nu}$. If $\tilde{\nu}$ is sufficiently small, then the equilibrium allocations without social insurance discussed in the previous section is incentive compatible. We assume that $\tilde{\nu}$ is sufficiently small that this is the case. Of course, with any positive $\tilde{\nu}$, the equilibrium allocation with complete social insurance is not incentive compatible.

To find the optimal incentive compatible allocation, it is convenient to let the choice variables in the planning problem be utility levels and number of searchers rather than consumption levels and number of searchers. To that end, let $C = U^{-1}$ denote the inverse utility function. The planning problem which defines the ex-ante optimal allocation with moral hazard in search is as follows. Choose z and utilities $u_0^1, u_0^z, u_1^1, u_1^{A_1}, u_1^{A_2}$ to maximize the objective

$$z(u_0^z + \beta[\pi u_1^{A_1} + (1-\pi)u_1^{A_2}]) + (1-z)(u_0^1 + \beta u_1^1) \tag{23}$$

subject to

$$u_1^{A_1} \geq u_1^{A_2} + \nu \tag{24}$$

$$zC(u_0^z) + (1-z)C(u_0^1) \leq (1-z) \tag{25}$$

$$(1-z)C(u_1^1) + z\pi C(u_1^{A_1}) + z(1-\pi)C(u_1^{A_2}) \leq$$

$$(1-z) + z\pi A_1 + z(1-\pi)A_2 \tag{26}$$

We begin by comparing the speed of transition without social insurance to that under optimal incentive compatible social insurance scheme given as the solution to above problem. Note first that when $\nu = 0$, there is no incentive problem, and the allocation with complete social insurance is the solution to this problem. The solution to this problem is a continuous function of the parameter ν, and thus for small ν, the solution is close to the complete insurance allocation. Thus, in a manner similar to that in section 2, we construct an example in which adding optimal incentive compatible social insurance slows transition. For example, with $\nu = 1$ and the rest of the parameters as in Figure 2, the optimal choice of z is .50. The number of searchers in the equilibrium without social insurance is $z = .61$. Similar results hold for a range of values of ν. It should be possible to use the methods like those in Atkeson and Lucas (1993) to show that optimal insurance also slows transition in an infinite horizon version of the model.

More interesting is the possibility that the optimal insurance scheme may involve forced layoffs and involuntary unemployment. In that vein, consider the first order conditions to the planning problem. These include

$$C'(u_0^1) = C'(u_0^z) \tag{27}$$

and

$$C'(u_1^1) = \pi C'(u_1^{A_1}) + (1-\pi)C'(u_1^{A_1} - \nu) \tag{28}$$

These first order conditions yield the following proposition.

Result 2: When agents must exert unobserved effort in search, under the optimal social insurance scheme, agents who work in sector 1 both periods receive higher expected utility than agents who search if and only if $C'(\cdot)$ is strictly convex.

To see this, not that since $C(\cdot)$ is strictly convex, (25) implies that the per period utility assigned to each type of agent in the first period is the same. The expected utility assigned in the second period to agents who stay in the old sector is u_1^1. The expected utility assigned in the second period to agents who search is $\pi u_1^{A_1} + (1-\pi)(u_1^{A_1} - \nu)$. The result follows directly from equation (26). Note that when utility takes the CARA form $u(c) = -\exp(-\gamma c)$, then $C'(u)$ is convex. When utility takes the CRRA form $u(c) = \frac{1}{\gamma}c^{\gamma}$, $\gamma \leq 1$, then the function $C'(u)$ is convex when $\gamma < \frac{1}{2}$, linear when $\gamma = \frac{1}{2}$, and concave otherwise.

Clearly, to implement such a scheme, not all agents can be allowed to choose to stay in their matches in the old sector. It is because of this element of coercion that we interpret the lay-offs as "forced" and the unemployment as "involuntary". We think of this social insurance problem as capturing elements of the problem faced by a reforming government that employs a large number of workers in the state sector and also pays unemployment insurance during transition. The government decides a fraction of the workers in the state sector to layoff, the amount of unemployment insurance to pay those that are laid off, and the unemployment insurance premiums to charge those who work in the state sector and those that find new matches in the private sector so as to maximize the expected welfare of all citizens.

We also can use these first order condition to examine the evolution of the distribution of consumption during transition. As part of the optimal social insurance scheme in the presence of moral hazard, the distribution of consumption is concentrated at a point in the first period and then fans out in the second as agents are rewarded for finding high productivity activities or punished for not finding such activities. Attempts to undo this spreading in the distribution of consumption induced by the transition process would remove the incentives for agents to put effort into search and would thus result in a less than optimal outcome.

Conclusion:

In this paper we have studied the impact of social insurance on the transition process. We have shown that social insurance can slow transition, entail involuntary unemployment, and have an impact on the steady state level of output. In this analysis we have abstracted from several important issues, including political considerations surrounding transition. For models of the role of politics in transition, see Dewatripont and Roland (1992) and Fernandez and Rodrik (1991).

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Appendix

In this appendix we prove, in the two period model that there is a unique equilibrium without social insurance and a unique equilibrium with social insurance. Then we discuss the solution method for the infinite horizon version of the model when agents have CARA utility.

Results in the two-period model: First we show that here is a unique equilibrium without social insurance. Comparing the budget constraints for agents who work in sector 1 and agents who search, it is clear that when $p = \hat{p}$ where $\hat{p} = \frac{1}{\pi A_1 + (1-\pi)A_2 - 1}$, agents who stay in sector 1 and agents who search have the same expected present value of income. Since agents are risk averse, $V_I^1(\hat{p}) \geq V_I^z(\hat{p})$. Since consumption in the first period is a normal good, $c_I^1(p)$ is increasing in p, and since $c_I^1(\beta) = 1$, from the feasibility constraint (1), it is clear that there cannot be an equilibrium with $p > \beta$. Since agents who work in sector 1 are lenders when $p \leq \beta$, $V_I^1(p)$ is decreasing in p and since those who search are borrowers, $V_I^z(p)$ is increasing in p, so there is at most one p at which these functions intersect. If $\hat{p} < \beta$ and these functions intersect at some $p \in (\hat{p}, \beta)$, then the equilibrium has search, that is, $z > 0$. If either $\hat{p} \geq \beta$ or $\hat{p} < \beta$ and these functions do not intersect at some $p \in (\hat{p}, \beta)$, then the equilibrium $p = \beta$ and there is no search, that is, $z = 0$.

Now we show that there is a unique equilibrium with social insurance. Note that when there is complete insurance, agents who search and agents who remain in sector 1 have the same wealth only if $p = \hat{p}$. Thus, if $\hat{p} < \beta$, then $\hat{p}$ is the equilibrium bond price and there is search in equilibrium. If $\hat{p} \geq \beta$, then β is the equilibrium bond price and there is no search in equilibrium.

Results in the infinite horizon model: In this subsection we present a method for solving the closed economy infinite horizon model when agents have CARA utility. In this economy we assume that agents get paid their marginal product and that the only asset that agents trade is a one-period risk free bond. An allocation in this economy is a set of sequences

$$\{\lambda_{t+1}, c_t^A(b), z_t^1(b), c_t^1(b)\}_{t=0}^{\infty},$$

and value functions $\{V_t^1(b), V_t^A(b)\}_{t=0}^{\infty}$, where λ_t is the number of agents well-matched in sector A, $c_t^A(b)$ is the consumption of agents who are well-matched in sector A and have bond holdings b at date t, $c_t^1(b)$ is the consumption of agents who are not well-matched in sector A and have bond holdings b at date t, $z_t^1(b) \in \{0,1\}$ is the decision of agents who are not well-matched and have bond holdings b to search ($z=1$) or work in sector 1 ($z=0$) at date t, and $V_t^1(b)$ and $V_t^A(b)$ are the discounted expected utilities from date t on of agents in sectors 1 and A respectively. Let ψ_0^A be the distribution of initial bond holdings for those who are well-matched in sector A, ψ_0^1 be the distribution of initial bond holdings for those who are not well-matched in sector A, and λ_0 be the number of agents initially well-matched in sector A. Let $\{p_t\}_{t=0}^{\infty}$ be a sequence of bond prices, where p_t is the price paid at date t to receive a bond which pays off one unit for sure at date $t+1$. The resource constraints in this economy are

$$\int_b c_t^A(b) p\psi_t^A + \int_b c_t^A(b) p\psi_t^A = (1-\lambda_t) + A\lambda_t,$$

where ψ_t^A and ψ_t^1 are the distribution of bond holdings for both types of agents as determined by those agents decision rules and the evolution of the number of agents well-matched in sector A is given by $\lambda_{t+1} = \pi \int_b z_t(b) d\psi_t^1 + \lambda_t$.

In equilibrium without social insurance, we require that agents' decision rules solve the following utility maximization problems stated as Bellman equations when bond prices $\{p_t\}_{t=0}^{\infty}$ are taken as given: $c_t^A(b)$ solves

$$V_t^A(b_t) = \max_{c_t, b_{t+1}} u(c_t) + \beta V_{t+1}^A(b_{t+1})$$

subject to the budget constraint

$$p_t b_{t+1} + c_t = b_t + A,$$

and $c_t^1(b)$, $z_t^1(b)$ solves

$$V_t^1(b_t) = \max_{c_t, b_{t+1}, z_t} u(c_t) + (1-z_t)\beta V_{t+1}^1(b_{t+1}) +$$

$$z_t\beta[\pi V^A_{t+1}(b_{t+1}) + (1-\pi)V^1_{t+1}(b_{t+1})]$$

subject to the budget constraint

$$p_t b_{t+1} + c_t = b_t + (1 - z_t)$$

and the constraint that $z_t \in \{0, 1\}$.

We solve for the equilibrium without social insurance as follows. Given one-period bond prices $\{p_t\}_{t=0}^{\infty}$, define time zero prices $\{q_t\}_{t=0}^{\infty}$ as $q_0 = 1$, and $q_t = \sum_{s=0}^{t-1} p_s$ for $t \geq 1$. Agents who are well matched in sector A have consumption

$$c_t^A = A + Q_t b_t + H_t$$

and value function

$$V_t^A(b_t) = -\exp(-\gamma A)\exp(-\gamma Q_t b_t)\exp(-\gamma H_t)/Q_t,$$

where

$$Q_t = (1/\sum_{s=t}^{\infty} q_s/q_t),$$

and

$$H_t = \frac{1}{\gamma}\sum_{s=t}^{\infty} q_s/q_t \log((q_s/q_t)/\beta^{(s-t)})Q_t.$$

Observe that

$$Q_t = Q_{t+1}/(p_t + Q_{t+1}),$$

and

$$H_t = [H_{t+1} + \frac{1}{\gamma}(\log(p_t) - \log(\beta))]p_t/(p_t + Q_{t+1}).$$

The utility of agents who are in sector 1 at date t and choose to search for a match in sector A is given by

$$V_t^z(b) = -\exp(-\gamma F_t)\exp(-\gamma Q_t b)\exp(-\gamma H_t)/Q_t$$

where

$$F_t = -\frac{1}{\gamma}\frac{p_t}{(p_t + Q_{t+1})}\log[\pi\exp(-\gamma A) + (1-\pi)\exp(-\gamma F_{t+1})]$$

and $\lim_{t\to\infty} F_t = F_{ss}$ where F_{ss} is the fixed point of this expression when $p = \beta$. The consumption of these agents is given by

$$c_t^z(b) = Q_t b_t + H_t + F_t.$$

The utility of agents who are in sector 1 at date t and choose to work in that sector is given by

$$V_t^1(b) = -\exp(-\gamma Q_t b)\exp(-\gamma H_t)\times$$

$$\exp(-\gamma p_t/(p_t + Q_{t+1})F_{t+1})\exp(\gamma Q_{t+1}/(p_t + Q_{t+1})).$$

Their consumption is given by

$$c_t^1(b) = p_t/(p_t + Q_{t+1})F_{t+1} + Q_t(b_t + 1) + H_t.$$

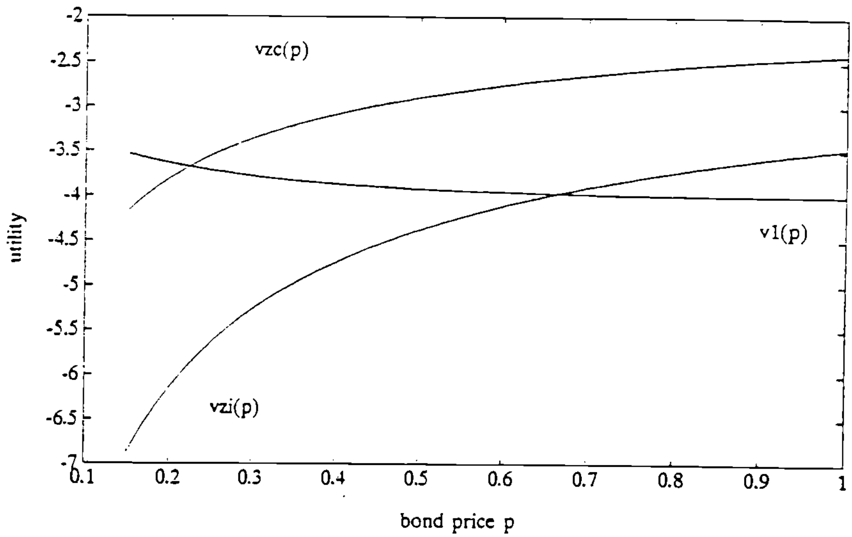
Note that agent's incentives to search are not affected by their level of bond holdings. We solve for the transition working backwards from a terminal date T and a value of λ_{T+1}^A close to one. We set $F_{T+1} = F_{ss}$, $H_{T+1} = 0$, and $Q_{T+1} = (1-\beta)$. Observe that, working backwards in time,

$$\lambda_t^A = (\lambda_{t+1}^A - \pi z_t)/(1 - z_t\pi)$$

where z_t is the fraction of agents not in sector A who search at date t. Given the solution for prices from date $t+1$ on, we first guess $z_t = 1$ and find the corresponding bond price p_t which clears the goods market at date t. If, at this bond price, the value of searching exceeds the value of working in sector 1, then this is the equilibrium bond price at date t and everyone in sector 1 searches at this time. If the value of searching does not exceed the value of working in sector 1 at this bond price, we then solve for the bond price p_t that makes individuals indifferent between searching and working in sector 1. In this case, this is the equilibrium bond price at date t, and then z_t is chosen to clear the goods market at date t. We iterate on this procedure until λ^A falls below zero. The solution of the model when there is social insurance is simplified by the assumption that agents have identical, homothetic preferences. In this case, the equilibrium with social insurance maximizes the discounted expected utility of the representative agent subject to the resource constraints given above. The solution to this problem is found as the solution to the Euler equation

$$u'(c_t) = \beta[\pi A + (1-\pi)]u'(c_{t+1}).$$

Figure 1: Social Insurance Speeds Transition



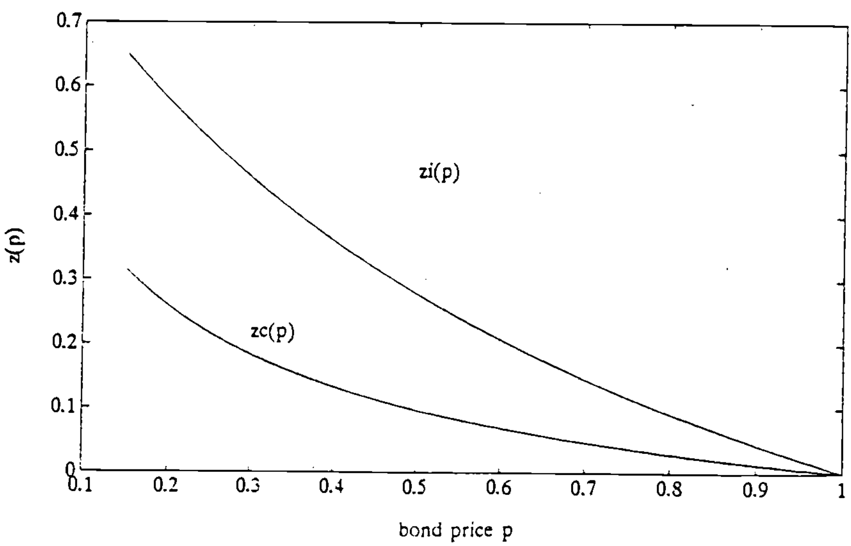


Figure 2: Social Insurance Slows Transition

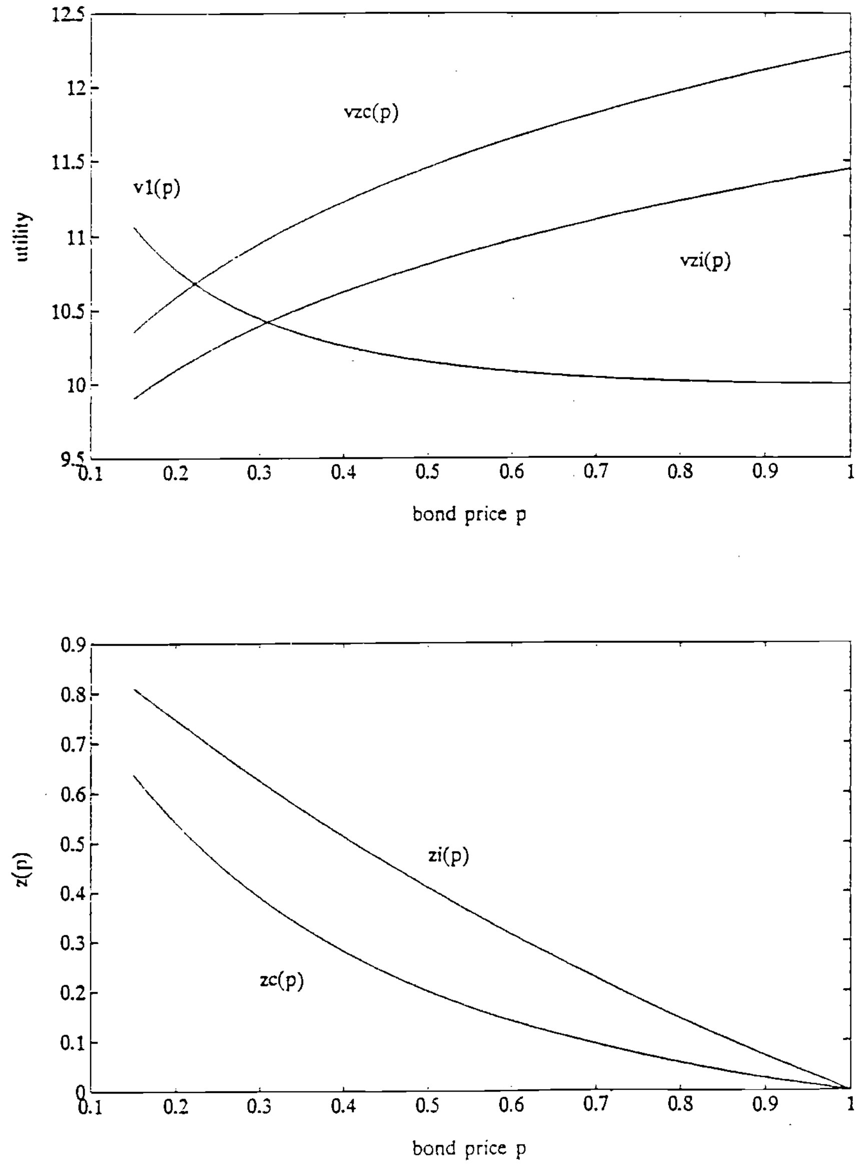


Figure 3
Speed of Transition vs. the Curvature Parameter

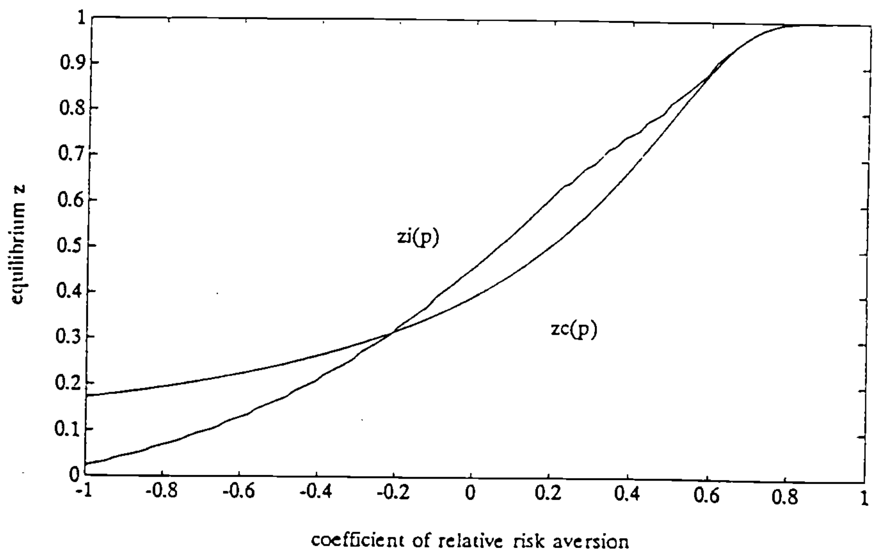


Figure 4: Transition Paths