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# Reviving Reputation Models of International Debt

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Unlike lenders in domestic credit markets, lenders in the international credit market have little recourse if borrowers do not repay debt. There are few direct legal sanctions that can be used against such borrowers, especially when they are sovereign countries. In the 19th century, military invasions were used to enforce international debt repayment, but that sort of thing is no longer done. (See English 1996.) Given this situation, researchers have wondered, why do sovereign countries ever repay debt?

An early answer to this question was offered by Eaton and Gersovitz (1981). They argue that sovereign countries may repay their debt because they fear that defaulting on it will tarnish their reputations and thus hinder their ability to borrow in the future. Much work has followed that explanation; see, for example, Kletzer 1984; Manuelli 1986; Grossman and Van Huyck 1988; Atkeson 1991; and Cole, Dow, and English 1995.

Recently, however, Bulow and Rogoff (1989b) have challenged this explanation. In a provocative article, they claim to show that "under fairly general conditions, lending to small countries must be supported by the direct sanctions available to creditors, and cannot be supported by a country's 'reputation for repayment'" (1989b, p. 43, abstract). A key reason for the difference between this result and the results in the rest of the literature is that Bulow and Rogoff assume that, regardless of a country's past behavior, it can earn the market rate of return by saving abroad with risk-neutral bankers who can commit to honoring any contracts they sign. The rest of the literature assumes, either explicitly or implicitly, that if a country defaults, it cannot save.†

In this article, we reexamine the argument of Bulow and Rogoff (1989b). For clarity's sake, we state their argument in two parts. First, they claim that a good reputation for repaying loans cannot by itself support lending to a sovereign country. Second, they claim that such lending must be supported by direct sanctions. We find that the first claim holds and provide a simple proof for our model. (They provide a proof in a more general setup.) We find that the second claim does not hold. To disprove it, we construct a model in which there are no direct sanctions on a sovereign country, but in which reputation can support large amounts of lending to that country.

We argue that since countries are involved in many different types of relationships, reputation may be able to support debt even with Bulow and Rogoff's assumption (about

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†In Cole and Kehoe 1995a, we explain how different assumptions about the ability to save after a default lead to different results.

Pesendorfer (1992) and Mohr (1991) have looked at conditions for the existence of a reputation equilibrium. Pesendorfer (1992) considers a scenario in which a government must assemble an optimal portfolio from existing financial assets in the world market. In that scenario, even if the set of world assets is complete, adding the restriction that each asset in the portfolio must be held in a positive position may force the government to bear risk. The fear of bearing such risk may be sufficient to give the government an incentive to repay its debt. Mohr (1991) shows that a reputation equilibrium might exist in an overlapping generations model if a government can run a type of rational Ponzi scheme.

the ability to save abroad) if the analysis is expanded from *partial reputation* models, in which debt is viewed in isolation, to a *general reputation* model which includes all the country's relationships. We develop such a general reputation model in which, for simplicity, there is just one other relationship besides the debt relationship.

We find that the ability of reputation to support debt in our general reputation model depends critically on the nature of that other relationship. For debt to be supported, the payoffs in the other relationship must provide the country with net benefits from maintaining a good reputation—or *reputation spillovers*—which, along an equilibrium path, in some sense, both are large enough and last forever. In general, for these net benefits to be calculated, the whole equilibrium must be calculated, and simple conditions cannot be put on the primitives of the environment to ensure that reputation spills over enough to support large levels of debt. In the special, but common, setup in which the other relationship is a simple repeated one, these net benefits are constant, and simple conditions on the primitives of the model can be obtained which ensure that large levels of debt can be supported by spillovers. For brevity's sake, we will refer to relationships with such large and long-lasting benefits of maintaining a good relationship as relationships with *enduring benefits.* We will refer to relationships in which, along any equilibrium path, the net benefits from maintaining a good relationship eventually become small as relationships with *transient benefits.*

We begin by reviewing Bulow and Rogoff's (1989b) first claim, that in a model of a single debt relationship, there can be no positive debt in equilibrium. We then examine their second claim by adding other relationships to the model. We briefly consider relationships which have *transient benefits*. We find that even though reputation can spill over from the debt relationship to some other transient benefit relationships, with this type of added relationship there is a unique equilibrium with no debt.

Next, we consider adding other relationships which have *enduring benefits*. The simplest examples of such relationships are repeated relationships in which the per period benefits from maintaining the relationships are constant. For such relationships, the present value of maintaining a good relationship is necessarily large for high discount factors. Of course, there are more elaborate dynamic relationships with physical state variables which also have enduring benefits. We illustrate how differently spillover works when the other relationship is enduring by considering a model with debt and a simple repeated labor relationship. In the model, reputation spillovers support debt in the sense that certain *spillover strategies,* which connect behavior in one relationship to behavior in the other, are equilibria. These equilibria have positive debt. Thus, these are examples of models in which there are no direct sanctions, yet debt can be supported in equilibrium—precisely what Bulow and Rogoff (1989b) claim is not possible.

Bulow and Rogoff (1989b) do seem to recognize, however, that there could be exceptions to their claim. At the end of their article, they discuss a trigger strategy model in which a country is playing a tariff game in which either raising tariffs or defaulting on foreign debt triggers a costly trade war. Bulow and Rogoff conjecture that such trigger strategies can potentially support debt, thus invalidating their second claim. One interpretation of our article is that we work out conditions for this conjecture to be true. We find that for it to be true, reputation in the debt relationship must spill over to another relationship with enduring benefits.

The main contribution of this article is to give a counterexample to the claim that in a world in which countries can always earn the market rate of return on their savings, lending to small countries must be supported by direct sanctions. A secondary contribution of our article is to exposit a model of a country's general reputation which is potentially interesting in its own right. Indeed, if one agrees with Bulow and Rogoff's (1989b) assessment of the data that one way or another the citizens and government of a country in default can always find ways to earn the market rate of return on their investments, then the Bulow and Rogoff (1989b) article essentially kills the standard partial reputation models (and lays the groundwork for the direct sanctions approach adopted by Bulow and Rogoff 1989a and Fernandez and Rosenthal 1990). In that light, one view of our article is that it revives the reputation approach. Moreover, if one agrees with English's (1996) assessment that the historical evidence for direct sanctions is weak, then currently at least, our general reputation model is the only model in which reputation can support debt.

## An Economy With One Debt Relationship

We begin with an economy that consists of two countries. One country has a number of risk-neutral bankers, who we call *Swiss bankers.* These bankers can commit to honoring any contracts they sign. The other country is represented by the government, which has access to a country-specific investment project and needs to borrow resources to fund it. We will show that the relationship between the government and the Swiss bankers necessarily has transient benefits for the government. Because of this, there is no equilibrium with positive debt.

We prove this result by setting up a contradiction. We suppose to the contrary that there is an equilibrium with positive debt. In such an equilibrium, the government must prefer repaying the debt to defaulting on it. We construct a deviation for the government, from its original strategy, in which it defaults on its debt and improves its welfare, thus contradicting our original supposition. In this deviation, the government will take the money it was supposed to pay back to the bankers and safely save it and earn the market rate of return.

To keep the notation simple, we will let the bankers the government originally borrowed from be the same bankers the government saves with after it defaults on its loans. Clearly, the model can be interpreted as having one set of bankers who lend to the government and another set who let the government safely save with them. We will refer to the one set of bankers in the model as *Swiss bankers* when we want to emphasize that they will allow the government to safely save with them, regardless of the government's past behavior, and we will refer to them simply as *bankers* otherwise.

Specifically, in each period $t$, $t = 0, ..., \infty$, the economy has a consumption-capital good, which is perishable and cannot be stored during a period. Swiss bankers are risk neutral, live for two periods, have a discount factor $\beta$, and are endowed with a large amount of the consumption-capital good in each period. We suppose that each period has two Swiss bankers, who are denoted $i = 1, 2$. (Assuming two bankers yields the same results as assuming any number $N > 1$, and the assumption saves on notation.) The government is infinitely lived, is risk neutral, discounts the future at rate $\beta$, and is endowed with zero units of the consumption-capital good at the beginning of period 0.

In each period $t$, an investment of $x_{t+1}$ units in period $t$ produces output of $A_{t+1}x_{t+1}$ units in period $t + 1$. Here $A_t$ is a deterministically fluctuating productivity parameter that specifies the investment project's gross return. For simplicity, we assume that

$$(1) \qquad A_t = \begin{Bmatrix} A, \text{ if } t \text{ is odd} \\ 0, \text{ if } t \text{ is even} \end{Bmatrix}.$$

(Letting productivity fluctuate is an easy way of giving the government an incentive to borrow. This simple pattern of fluctuations makes the resulting borrowing pattern simple, but is otherwise inessential.)

The project has a maximal size of one. Throughout the article, we will assume that the discount factor satisfies

$$(2) \qquad \beta A > 1$$

as well as $\beta < 1$.

To build intuition, let us begin by examining an economy in which institutions are such that agents in both countries can and do commit to repaying their loans. We refer to the resulting allocations as the *full-commitment allocations.* Competition among bankers ensures that the equilibrium gross rate of interest on one-period loans that mature at $t$ is $R_t = \rho$, where $\rho \equiv 1/\beta$. From inequality (2), then, we know that the return on the project $A$ is greater than $\rho$; hence, with such an interest rate in each odd-numbered period, the government optimally borrows to fully fund the project. Thus, in each odd-numbered period, starting with period 0, the government borrows one unit, invests it, and consumes zero. In the next period, an even-numbered period, the project yields $A$ units of output, from which the government repays the banker $\rho$; consumes the rest, $A - \rho$; and borrows zero. The discounted value of utility under commitment is, thus,

$$(3) \qquad (A-\rho) + \beta^2(A-\rho) + \beta^4(A-\rho) + \ldots = (A-\rho)/(1-\beta^2).$$

Of course, since the government has linear preferences and its discount factor $\beta$ satisfies $\beta = 1/\rho$, the timing of consumption by the government can be structured in a variety of ways to yield the same discounted value of utility.

Now consider an institutional setup in which the government cannot commit to repaying its loans. A precise description of the timing of events in the model is as follows. In each period $t$, the government starts with new output $A_tx_t$ and the value of debt either owed or saved $R_tb_t$, where $b_t$ is the loan at $t - 1$ and $R_t$ is the gross interest rate on this loan. If $b_t > 0$, then the government decides whether to repay old loans subject to the constraint

$$(4) \qquad z_tR_tb_t \leq A_tx_t$$

where $z_t = 1$ corresponds to repayment by the government and $z_t = 0$, to default. Each Swiss banker, having seen the default decision as well as the past actions of all agents, offers the government a new loan contract. Each such contract $s_{t+1}$ is a pair $(R_{t+1},b_{t+1})$ that specifies a gross interest rate and a loan amount. Let $S_{t+1}$ denote the set of loan contracts offered. The government then chooses some specific contract $s_{t+1}$ and decides how much to consume $c_t$ and invest $x_{t+1}$ subject to a constraint on the maximal size of the project

$$(5) \qquad x_{t+1} \leq 1$$

and the budget constraint

$$(6) \qquad c_t + x_{t+1} - b_{t+1} = A_t x_t - z_t R_t b_t.$$

We are assuming, remember, that Swiss bankers have a commitment device that commits them to honoring all contracts they sign. Thus, in any equilibrium, regardless of the government's past actions, if the government wants to save any amount (any $b_{t+1} < 0$), the Swiss bankers will oblige it; moreover, competition among the bankers will drive the interest rate on such savings up to $R_{t+1} = \rho$.

We set up and define equilibrium as follows. The history

$$(7) \qquad h_t = \{[z_0,S_1,s_1,x_1,c_0],\ldots,[z_{t-1},S_t,s_t,x_t,c_{t-1}]\}$$

records past actions for the government and the bankers up to period $t$. A *strategy for the government* at $t$ is a default decision $z_t(h_t)$ made at the beginning of the period together with loan contract, investment, and consumption decisions, denoted $s_{t+1}(h_t,z_t,S_{t+1})$, $x_{t+1}(h_t,z_t,S_{t+1})$, and $c_t(h_t,z_t,S_{t+1})$, made after both the default decision $z_t$ and the offer of the new set of loan contracts $S_{t+1}$. A strategy for each Swiss banker $i = 1, 2$ at $t$ is a new loan contract $s^i_{t+1}(h_t,z_t)$. We let $S_{t+1}(h_t,z_t)$ denote the set of such loan contracts.

In this economy, a *perfect equilibrium* is a set of strategies for the government and the bankers for each period $t$ that satisfy these two conditions:

1. For each history $h_t$ and $(h_t,z_t,S_{t+1})$, given the bankers' strategies from $t$ onward and the government's strategies from $t + 1$ onward, the government's strategy at $t$ maximizes its payoff over the set of strategies that satisfy (4)–(6) and $s_{t+1}(h_t,z_t,S_{t+1}) \in S_{t+1}(h_t,z_t)$.

2. For each Swiss banker $i$, for each history $(h_t,z_t)$, given the other banker's strategy and the government's strategies, the contract offered $s^i_{t+1}(h_t,z_t)$ maximizes the Swiss banker's payoffs.

When interpreting this definition, note that we impose perfection by requiring both conditions to hold for all histories, including those that do not occur in equilibrium. Note that in condition 1 we require that strategies be optimal only for a one-shot deviation from the original strategies. It is well known that this is equivalent to requiring that these strategies be optimal for all possible deviations from the original strategies.

We now show that the full-commitment allocations cannot be supported as equilibrium allocations, regardless of the discount factor. To see this, consider the full-commitment allocations, and consider the decision to repay in some even-numbered period $t$. If the government repays at $t$, it gets $A - \rho$ at $t$, $A - \rho$ at $t + 2$, and so on. Consider the following deviation. Suppose instead that the government defaults at $t$. After defaulting, it has $A$ units of output, from which it consumes $A - (1/\rho)$ units and saves $1/\rho$ units with a Swiss banker. In period $t + 1$, an odd-numbered period, the Swiss banker safely returns one unit to the government, and the government fully funds the project. In period $t + 2$, the project yields $A$, the government consumes $A - (1/\rho)$ and saves $1/\rho$ with the Swiss banker, and so on. This deviation yields $A - (1/\rho)$ in all even-numbered periods, while if the government continues with the full-commitment allocations, it receives only $A - \rho$ in even periods. Since $\rho = 1/\beta > 1$, the deviation is strictly preferred for all discount factors $\beta \in (0,1)$. Thus, in the economy with Swiss bankers, the full-commitment allocations cannot be supported as equilibrium allocations.

The intuition is simply that once the government has one unit on hand, it has no need to borrow any more; thus, the value of maintaining a good relationship with the bankers is zero. Moreover, if the government breaks this relationship by defaulting, it saves the funds it owed; thus, defaulting dominates maintaining the good relationship. More generally, in the spirit of Bulow and Rogoff's (1989b) Theorem 1, we can prove the following:

PROPOSITION 1. *In the economy with Swiss bankers, the unique equilibrium allocations have zero debt.*

The proof is in the Appendix. The intuition for this proposition is similar to the intuition for why the full-commitment allocations are not supportable as equilibrium allocations. Consider any equilibrium, and consider the period in which the present value of the debt owed by the government is maximal. Since this value of the debt is the largest it will ever be, in each subsequent period the government is, on net, paying back the bankers. If the government instead defaults and invests the funds it would have paid back, it can finance its original investment pattern and increase consumption.

Notice that in the period in which the present value of the debt owed by the government is maximal, the discounted value of the net benefits of the debt relationship is less than or equal to zero. Since this period of maximal debt occurs in finite time, the benefits from the debt relationship are necessarily transient.

## Adding Other Relationships

Now we add to the model other relationships that involve trust. We will say that an agent's reputation in one trust relationship *spills over* to another trust relationship if actions taken with regard to the first relationship affect the equilibrium actions of the parties to the other relationship. For example, if a government's decision to default on foreign bankers causes a foreign oil company negotiating an oil drilling lease with that government to withdraw from the negotiations, then the government's loss of reputation within the international credit market induced by its default is said to have *spilled over* to its relationship with the foreign oil company.

We first show that even with reputation spillover, if the other relationship is another transient benefit relationship, our earlier results are unchanged: a sovereign country will not repay its debt; hence, no positive debt can be supported in equilibrium. We then show that if we add an enduring benefit relationship, a sovereign country will repay its debt, and large amounts of debt can be supported.

### *With Transient Benefits*

Consider adding to the model with one transient benefit debt relationship another relationship with transient benefits. Clearly, the most trivial way to do that is to add another debt relationship with another group of Swiss bankers in another country which simply replicates the first debt relationship.

Consider strategies in which a government's misbehavior in one debt relationship spills over to affect its treatment in another debt relationship. Specifically, consider strategies for the bankers which specify that if the government breaks a contract with either group of bankers in either lending country, then no banker will lend it any funds again. Faced with such strategies, the government will either simultaneously honor both types of debt contracts or break both since breaking either one causes both groups of bankers to stop lending. A moment's reflection should make it clear that in such a situation, even though reputation spills over across the debt relationships, positive debt cannot be supported. Since both the benefits and the losses from defaulting in the model with two debt relationships are simply twice what they are in the model with one debt relationship, the default decisions are unchanged. Hence, even with spillovers from one debt relationship to another, no positive debt can be supported in equilibrium.

While this example is useful, it is somewhat special in that the added relationship is totally symmetric to the existing one. It is important to realize that even if misbehavior in the debt relationship spills over to a very different type of relationship, this spillover cannot support debt if the other relationship has transient benefits. In Cole and Kehoe 1995b, we consider a model in which the other relationship emerges from countries drawing from a common pool of exhaustible resources, like a common oil field. We find that whether or not the other relationship is transient depends on specific details of the technology. We can easily construct other examples, like protecting a given stock of intellectual property rights or building a single space station, that work in a similar way. A common characteristic of such examples is that the benefits from behaving well in the relationship are transient: the value of maintaining a good relationship goes to zero in finite time.

### *With Enduring Benefits*

Now consider adding to the original model a relationship with enduring benefits. In such a relationship, the discounted value of benefits from behaving well from any point in time onward never goes to zero. The simplest example of such a relationship is a repeated relationship in which the per period benefits are constant. More elaborate examples would include relationships with physical state variables. We illustrate how differently spillovers to enduring benefit relationships work by considering a simple repeated relationship.

Consider adding a labor relationship to the debt model. This labor relationship emanates from a project which is available in each period. If the number of workers hired for the project is $N_t$, the project's output is $AN_t$. The project has a maximal size of $N$. (The assumption that the labor project has the same productivity as the investment project is for notational simplicity only.) The economy has a large number of domestic agents who have the specialized skills the government needs to run the project. Each of these workers is risk neutral and has an alternative employment opportunity that earns a worker $\omega$ units with certainty in each period. We assume that

$$(8)\quad \beta A \geq \omega.$$

We will model the government as maximizing its utility subject to its resource constraints. With a little more notation, we could instead model the government as maximizing the welfare of its citizens, providing public goods by using specialized resources, and taxing in a distorting way.

When there is full commitment, the equilibrium is as follows: In each period, the government hires $N$ workers at wage $\omega$ and pays them a total of $\omega N$. In period 0, the government takes a loan of one unit from the bankers and invests it. In each even-numbered period after period 0, the government borrows one unit, invests one, and consumes $(A-\omega)N$. In each odd-numbered period after period 0, it repays the bankers $\rho$ out of the investment project's return of $A$, borrows and invests zero, and consumes $(A-\omega)N + A - \rho$.

Consider the model in which the government cannot commit to honoring contracts. The timing of the model is the same as before, with these additions. In the beginning of each period, each of the large number of workers offers an employment schedule. Each worker $j$ offers to supply $n_t(j,w_t)$ units of labor to the government for a promise of $w_t$ units of pay, where $n_t$ is either zero or one. Confronted with a continuum of such wage schedules, all of which are identical, the government announces some particular wage $w_t$ together with an employment cap $N_t$. The output of the labor project is realized immediately. After that the government decides whether or not to honor its contracts with the bankers and the workers. We let $z_t^b = 1$ and $z_t^n = 1$ correspond to honoring the debt and labor contracts. The constraints faced by the government are

$$(9)\quad z_t^b R_t b_t + z_t^n w_t N_t \leq A x_t + A N_t$$

together with

$$(10)\quad c_t + x_{t+1} - b_{t+1} = A_t x_t + A N_t - z_t^b R_t b_t - z_t^n w_t N_t$$

$$(11)\quad x_{t+1} \leq 1$$

$$(12)\quad N_t \leq N.$$

In (10) we have assumed that the number of workers is $N_t$.

Consider strategies in which misbehavior by the government in the debt relationship spills over to the labor relationship and vice versa. Specifically, suppose that the bankers' and workers' strategies specify that if the government ever breaks either the debt contract or the labor contract, it will never be trusted again: bankers will never lend to it, and workers will never work for it. We will show that even with such a spillover, positive borrowing can be supported in equilibrium. Indeed, if the government is sufficiently patient, the full-commitment allocations can be supported.

More formally, let the bankers' strategies in period $t$ specify that for any history with no previous default, namely, $z_s^b = z_s^n = 1$ for all $s < t$,

$$(13)\quad S_t = \{(R_t,b_t) \mid R_t = \rho,\ b_t \leq 1\}.$$

That is, the bankers will lend at rate $\rho$ any amount up to one. For any history in which there has been a default,

$$(14)\quad S_t = \{(R_t,b_t) \mid R_t = \rho,\ b_t \leq 0\}.$$

Thus, bankers do not lend. Let the workers' strategies specify that for any history with no previous default, $n_t(j,w_t) = 1$ if $w_t \geq \omega$ and zero otherwise. For any history with a default, $n_t(j,w_t) = 0$. The government's strategy specifies its full-commitment allocations if it has never defaulted in the past. If it has defaulted, then the government's strategies specify that it self-finance the investment project, borrow nothing, and pay the workers nothing. Call these strategies the *spillover strategies*. We then have

PROPOSITION 2. *In an economy with debt and labor relationships, there exists a* $\underline{\beta} \in (0,1)$ *such that for all* $\beta \in [\underline{\beta},1]$ *the full-commitment allocations are supportable as equilibrium outcomes.*

*Proof.* Consider the spillover strategies defined above. Consider, first, histories with no defaults before period $t$. It is optimal for the workers to work if $w_t \geq \omega$; and if the period is even-numbered, it is optimal for the lenders to lend one unit at rate $R_t \geq \rho$, if the government's strategy is to not default. It is also optimal for the government to hire $N$ workers at wage $\omega$ and borrow one unit at rate $\rho$ in even periods. The only interesting question is with regard to the government's default decision. If the government defaults on both contracts, it saves the current payments to bankers and workers, $\rho + \omega N$. However, it loses the surplus from the labor project, $(A-\omega)N$, from $t+1$ onward. Thus, sticking with full commitment is at least as good as the deviation if

$$(15)\quad \rho + \omega N \leq \beta(A-\omega)N/(1-\beta).$$

As $\beta$ increases to one, the left side of (15) monotonically decreases to $1 + \omega N$ (since $\rho = 1/\beta$) while the right side monotonically increases to infinity. Thus, there is some $\underline{\beta} \in (0,1)$ such that (15) holds for all $\beta \in (\underline{\beta},1)$.

For histories after deviations, the strategies are clearly optimal. Thus, the above strategies constitute a perfect equilibrium if $\beta \in [\underline{\beta},1]$. Q.E.D.

So far we have investigated conditions under which the full-commitment allocations are supportable as equilibrium outcomes. Even if these conditions are not met, it may be possible to support some positive borrowing. From the proof of Proposition 2, it is clear that in any period $t$, as long as

$$\text{(16)}\quad \rho b_t \leq [\beta(A-\omega)N/(1-\beta)] - \omega N$$

the government will prefer to honor its commitments rather than to default. The right side of (16) can be interpreted as the surplus utility the government obtains from maintaining its reputation in the enduring benefit relationship. Hence, the smaller is $N$ and the larger is $\omega$, the smaller is the surplus in the enduring benefit relationship and, thus, the smaller is the amount of debt that can be supported in equilibrium.

So far we have investigated one particular type of strategies for this model in which reputation spills over across the two types of relationships. Of course, since this model has an infinite horizon, there are a large number of other equilibria in which such a spillover does not occur and no debt is supported in equilibrium. In particular, consider strategies in which misbehavior in one relationship affects only the actions of agents in that relationship and doesn't spill over to the other relationships. Specifically, suppose that workers will continue to work as long as the government doesn't default on the labor contract and that bankers will continue to lend as long as the government doesn't default on its debt contract. These nonspillover strategies can clearly support an equilibrium with workers working positive amounts, but the strategies can't support any positive borrowing—for the same reasons as before.

We might want to go further and ask, can we construct a version of the model in which this spillover must occur? We think of this exercise as examining what type of model we need for the spillover equilibria to be, in some sense, the natural equilibria of the model. In Cole and Kehoe, forthcoming, we consider a finite-horizon version of this model with incomplete information. In it there is a government with the same preferences as the one considered here. In addition, there is a (vanishingly) small probability that the government is pathologically honest, in that it suffers a direct utility cost from not honoring contracts. We interpret the existence of this honest government as capturing a shred of doubt in the minds of bankers that the government they are facing may pay back their loans for some reason other than the narrowly defined pecuniary costs and benefits of so doing. (This interpretation follows that given in the chain store literature by Kreps and Wilson 1982 and Milgrom and Roberts 1982.)

In this setup, the honest government honors all debt and labor contracts. Thus, if a private agent, either a banker or a worker, sees the government break either type of contract, the agent knows that the government is not honest. A simple backward induction argument implies that workers will never work for, or bankers lend to, a government that they know is not honest. Hence, the normal government will either honor both types of contract or break both, since breaking either one causes the government to lose its reputation. Thus, the reputation of not being trustworthy in the debt relationship necessarily spills over to the labor relationship and vice versa.

In Cole and Kehoe, forthcoming, we show that for any fixed time horizon there is (essentially) a unique equilibrium. Moreover, both the finite-horizon strategies and the equilibria of the incomplete information model converge naturally to the infinite-horizon strategies and the equilibria of the complete information model. These results imply that there is both a close and a natural connection between the finite-horizon incomplete information results and the infinite-horizon complete information results. Indeed, we think of these results as providing one possible motivation for focusing on the equilibrium with spillover effects in the infinite-horizon model.

## Conclusion

We have developed a general reputation model in which countries repay their debt even when they do not face direct sanctions. The basic idea of our model is that if countries misbehave in one relationship, they will suffer negative consequences in other relationships. A necessary condition for countries to repay their debt is that misbehavior in the debt relationship spills over to a relationship which has enduring benefits for the countries.

The idea that an agent's reputation in one relationship may spill over into other relationships is certainly not new. In most of the literature, however, the spillover is such that actions of agents in one arena of behavior affect reputation in that arena only. In the debt literature, for example, if a country defaults, it ruins its reputation in the debt arena; in the industrial organization literature on entry deterrence, if an incumbent doesn't fight entry, it ruins the incumbent's reputation in the entry deterrence arena. Here we have shown that when spillovers stay within the debt arena, reputation cannot support lending. For that, a country's actions in the debt arena must spill over to a different arena, one with enduring benefits. Viewed this way, the benefits of maintaining a good relationship in one arena cannot be calculated simply by looking at that arena alone. Instead, account must be taken of the ramifications in a variety of other arenas, which, at least on the surface, may not seem to be directly connected to the arena in which the misbehavior occurs.

This basic idea can be applied in many contexts. It might explain why countries honor some commitments, like treaties, when a narrow cost/benefit analysis would recommend breaking them. Consider, for example, a fishing treaty between the United States and Canada. Suppose that at the time the treaty was signed, it seemed like a good idea, but later developments reveal that the treaty is costing the United States a lot. Nonetheless, the United States might honor the treaty because breaking it would damage its reputation with Canada in other relationships that involve trust. Moreover, breaking the treaty might cause a negative reputation spillover with, say, the Japanese in a different arena that involves a trust relationship, such as a mutual defense pact.

# Appendix
# Proof of Proposition 1

Here we provide the proof for the first proposition that we discuss in the preceding paper.

PROPOSITION 1. *In the economy with Swiss bankers, the unique equilibrium allocations have zero debt.*

*Proof.* The proof is by contradiction. Competition among bankers guarantees that they break even on any loan, so

(A1) $(R_t z_t - \rho) b_t = 0.$

This means that the government earns the market rate on both loans and savings. Therefore, if any loans are made, the gross interest rate is $\rho$; that is, if $z_t = 1$ and $b_t \neq 0$, then $R_t = \rho$. If $z_t = 0$, then no loans are made, so $b_t = 0$. Clearly, $b_t$ cannot be greater than or equal to $1/\rho$ in any equilibrium. If it were, then the government would certainly prefer to deviate by defaulting on the amount owed $\rho b_t$ and then consuming $\rho b_t - (1/\rho)$ in extra consumption in period $t$ and saving $1/\rho$. In all future odd-numbered periods, it would use the payoff from its savings to fully fund the project. In all future even-numbered periods, it would consume $A - (1/\rho)$ and save $1/\rho$. Since $b_t$ is bounded in equilibrium,

(A2) $\lim_{t\to\infty} \beta^t b_t = 0.$

Next, we show that $b_t$ cannot be any strictly positive number between 0 and 1. By way of contradiction, suppose that in some period—say, period $v$—$b_v > 0$. Let

(A3) $\beta^r b_r = \max_t \beta^t b_t.$

Thus, $r$ is the period in which the present value of borrowing is the largest. Clearly, $r$ is finite since $b_t \leq 1$ for all $t$. If multiple periods satisfy (A3), then let $r$ be the earliest such period. Consider, for now, the government deviating in period $r$ by defaulting in $r$ and then saving at rate $\rho$ the funds it would have been repaying the bankers and instead using those funds to self-finance the original consumption levels and investment. Specifically, new debt, consumption, and investment levels $\hat{b}_t$, $\hat{c}_t$, and $\hat{x}_t$ satisfy, for $t > r$,

(A4) $\beta^t \hat{b}_t = \beta^t b_t - \beta^r b_r$

(A5) $\hat{c}_t = c_t$

(A6) $\hat{x}_t = x_t.$

Notice that (A4) simply states that the present value of the new debt sequence equals the present value of the original debt sequence minus the present value of the defaulted-on debt. Of course, we can also write this in period $t$ units as

(A7) $\hat{b}_t = b_t - \rho^{t-r} b_r$

for $t \geq r$, so that the new debt sequence equals the original one minus the rolled-forward value of the defaulted-on debt.

To show that this deviation is feasible, we must show that the new debt sequence $\hat{b}_t$ is nonpositive and that at the original consumption and investment allocations the following hold:

(A8) $c_t + x_{t+1} - \hat{b}_{t+1} - A_t x_t + \rho \hat{b}_t = 0$

(A9) $\rho \hat{b}_t \leq A_t x_t.$

Clearly, $\hat{b}_t$ is nonpositive from the definition of period $r$. And $\hat{b}_t < b_t$, so (A9) holds. To see that (A8) holds, note that from (A7)

(A10) $$-\hat{b}_{t+1} + \rho \hat{b}_t = -(b_{t+1} - \rho^{t+1-r} b_r) + \rho(b_t - \rho^{t-r} b_r)$$
$$= -b_{t+1} + \rho b_t.$$

So (A8) holds, since the budget constraint held at the old allocations. Thus, this deviation, which makes the government as well off as the original allocation, is feasible.

To show that the agent can be made strictly better off, note that under our deviation

(A11) $$\lim_{t\to\infty} \beta^t \hat{b}_t = (\lim_{t\to\infty} \beta^t b_t) - \beta^r b_r$$
$$= -\beta^r b_r.$$

Clearly, in some sufficiently late period, consumption can be increased while the rest of the allocation is unaffected. Q.E.D.

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