Theories of Soft Budget Constraints and the Analysis of Banking Crises[*]

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[*] Some of the material in this paper is taken from "Banks' Bad Debts: Policies, Creditor Passivity, and Soft Budget Constraints," forthcoming in A. Meyendorf and A. Thakor, eds. *Financial Sector Development in Economies in Transition*, MIT Press. I would like to thank John Bonin, Mathias Dewatripont, Patrick Legros, Gerard Roland, and Mark Schaffer for helpful conversations.

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Abstract

This paper proposes a new taxonomy for classifying models of soft budget constraints which allows identification of two classes of models. Distinguishing between these classes of models is useful, as they yield SBCs in differing circumstances and have differing theoretical and policy implications. The taxonomy is used to motivate an area of economic theory in which SBC models can yield novel insights: the analysis of banking crises. A model is presented in which SBCs arising from creditor passivity have implications for the question of the appropriate policy for dealing with bad debts on troubled banks balance sheets. The paper also compares the implications of the two classes of SBC models for the analysis of banking crises.

Keywords: soft budget constraints, banking crises, financial reform

Non-Technical Summary

The term soft budget constraints (SBCs), originated by Janos Kornai, constitutes one of the most important theoretical innovations arising from the study of socialist and transition economies. The theory of soft budget constraints has improved the understanding of many areas of transition in which relationships between governments and firms, firms and banks, or governments and banks are important. Yet, whereas the theory of soft budget constraints has been useful for analyzing problems of transition, its potential range of application extends beyond transition economies.

This paper has two main goals. First, it proposes a new taxonomy for classifying soft budget constraint (SBC) models, which are now numerous. The taxonomy allows identification of two distinct classes of SBC models with differing theoretical origins and, therefore, differing policy implications. The two classes consist of SBC models based on the seminal model of Deawtripont-Maskin and SBC models based on the notion of creditor passivity.

The second goal of the paper is to illustrate how SBC models can yield novel insights in the analysis of banking crises. The taxonomy of SBC models is used to compare applications of each class of SBC models to the analysis of banking crises. The issues that can be addressed by each class are different, though complementary. By way of illustration, I present a model in the creditor passivity class that analyzes the tradeoffs faced by regulators in their choice of policies for "cleaning" the balance sheets of financially distressed banks that are allowed to continue in operation during the course of banking crises. I then identify open questions related to banking crises that are suggested by the study of the two classes of models.

1 Introduction

The concept of soft budget constraints (SBCs), originated by Kornai (1980), constitutes one of the most important conceptual innovations arising from the study of socialist economies and later the transition economies (TEs). The notion of SBCs has had a significant impact on the understanding of relationships between governments and firms, firms and banks, and even between governments and banks in TEs. Banking reform, privatization, competition policy, and macroeconomic policy represent but some of the areas of transition for which the policy implications of SBCs have been drawn.[1] It is now well recognized that the hardening of firms' budget constraints is one of the necessary conditions for success of the transition.

The importance of SBCs is not limited to the study of TEs. For example, SBCs have been used to analyze financial system structure (Dewatripont-Maskin, 1995), corporate governance (Povel, 1997), and federalism (Qian and Roland, 1998). Indeed, the ultimate range of applications of models of SBCs to other areas of economic theory remains an open question. Kornai himself notes (Kornai, 1998) that the full implications of SBCs have probably not yet been realized in theoretical models.

This paper reconsiders the theoretical foundations of models of SBCs. It proposes a new taxonomy for classifying SBC models which allows identification of at least two classes of models: those following Dewatripont-Maskin (1995), and models related to the notion of creditor passivity (Mitchell, 1993). Distinguishing between these two classes of models is useful, as they yield SBCs in differing circumstances and thus have differing theoretical and policy implications. I use the taxonomy to motivate an additional area in which SBC models can yield novel insights: the analysis of banking crises. By way of illustration, I present a model (based on Mitchell, 1998a) in which SBCs arising from creditor passivity have important implications for the question of the appropriate policy for dealing with bad debts on troubled banks' balance sheets. This question, which has proven to be an important policy question in practice[2], has not previously been analyzed in the theoretical

[1] See Dewatripont, Maskin, and Roland (1997) for a survey of models of SBCs relating to different areas of the transition. Berglof and Roland (1998) survey, in the context of a unifying framework, a number of models relating to SBCs and banking in TEs.

[2] For IMF discussions see Dziobek and Pazarasioglu (1997), Ingves and Lind (1997), and Sundararajan and Balino (1991). For discussions relating to banking reform in TEs see Abel and Bonin (1993), Begg

banking literature. Several of the policy tradeoffs relating to this question would not arise in banking models which ignore the existence of SBCs. In addition, these tradeoffs arise only in the context of the class of models of SBCs created by creditor passivity.

After presenting the model and its results, I identify a number of additional questions relating to banking regulation and banking crises where models with SBCs can enhance understanding of the issues. I then refer to the taxonomy of SBC models to compare the implications of the two classes of models for the analysis of banking crises (see Huang and Xu (1998a, 1998b) for an application of the D-M model and Mitchell (1998a, 1998b) and Aghion-Bolton-Fries (1998) for applications of the creditor passivity model). I show that the two classes yield differing, but complementary, policy implications. In brief, models based on D-M yield implications for the structure of firm finance and for markets for loans to banks suffering liquidity problems. Models relating to creditor passivity yield implications for prudential regulations (e.g., accounting rules, definitions of bad loans, and bank solvency definitions) and for the design of bank closure or bank rescue policies.

Although Kornai's original description of SBCs involved government bailouts of loss-making firms, most formal models of SBCs have focused on the creation of SBCs by banks. Both classes of models discussed in this paper start from the observation that banks can create SBCs. D-M show that banks that are "too large" may create SBCs (since the amount of available funds makes them unable to commit not to refinance "bad" projects for which it is actually efficient to refinance after default). These authors demonstrate that dynamic commitment problems are at the heart of SBCs. The source of the commitment problem in this model, and in models building on this model, is sunk costs. That is, at the point at which the creditor decides whether or not to refinance a debtor that is in default, the initial investment is sunk. This prevents the creditor from refusing to refinance a debtor for which it is efficient to refinance. Yet, whereas the *ex post* decision (i.e, once default has occurred) to refinance a debtor is efficient in this model, the bank's inability to commit not to refinance creates an *ex ante* inefficiency (i.e., before any default occurs) in the original financing of projects.

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and Portes (1993), Bonin (1993), Bonin and Schaffer (1995), Brainard (1991a, 1991b), Calvo and Frenkel (1991), Caprio and Levine (1992), Coricelli and Thorne (1993), Dornbusch (1991), Estrin, Hare, and Suranyi (1992), Levine and Scott (1992), Marrese (1994), Saunders and Sommariva (1993), and Thorne (1993).

In contrast to the D-M model, SBCs arising in models of creditor passivity[3] do not originate from sunk costs. Consequently, SBCs created by passive creditors (who, for example, may rollover and refinance debt in default in order to hide their own financial difficulties) can result in refinancing and firm continuation decisions that are inefficient. Hence, inefficiency occurs at the *ex post* stage. As a result, models of creditor passivity can generate SBCs in situations in which they would not arise in the model of D-M. The taxonomy proposed in Section 2 further clarifies the distinctions between these two types of models and the conditions under which SBCs arise in each.

A recent IMF study (Lindgren, Garcia *et al.*, 1996, cited in Corbett (1998)) identifies 130 countries as having experienced banking sector difficulties during the 1980s and 1990s. Thirty-six of these countries were judged to have suffered banking crises. Despite the relative frequency of occurrence of banking crises, research on this topic is still at an early stage. Several recent papers, motivated by the Asian crisis, explore potential causes of financial crises. Yet, very little formal analysis of the consequences of crises or of optimal regulatory or institutional response has been undertaken. The model presented in this paper is intended to illustrate how allowing for SBCs may yield new insights into the optimal regulatory response to banking crises.

Two questions faced by regulators when banking sector problems develop are when to close down versus recapitalize banks and what policies to use to clean the balance sheets of troubled banks that are allowed to remain in operation. The model of this paper addresses the latter question. The model departs from existing banking literature in a number of ways. Existing literature has focused on the regulator's bank closure decision.[4] The models of bank closure assume no asymmetric information between banks and regulators regarding the financial health of the bank at the point where the regulator must make the closure decision.[5] The decision is based upon the expected future profit of the bank, which is known

[3]Mitchell (1993) defines creditor passivity as creditors' passively rolling over their loans in default rather than actively pursuing their claims.

[4]See, for example, Boot and Thakor (1993), Mailath and Mester (1993), Dreyfus, Saunders, and Allen (1994), and Rochet and Tirole (1996).

[5]A notable exception to the assumption of symmetric information between regulators and banks is the work of Dewatripont and Tirole (1994), who assume that banks may make unobserved choices between continuing or stopping projects that default. However, these authors do not endogenize the bank's choice, nor do they analyze the regulator's bank closure or rescue decisions.

to the regulator and the bank. Finally, the closure decision is made before the bank's assets are actually in default; therefore, there is little scope for consideration of policies to deal with bad assets on banks' balance sheets.

Allowing for asymmetric information and for banks' decisions regarding their treatment of defaulters alters the policy tradeoffs in the regulator's bank closure decision.[6] It also brings into direct focus the question of what to do with the bad assets of troubled banks. The model of this paper formalizes the bank's treatment of its debt in default (and, therefore, allows for SBCs) and assumes asymmetric information between the regulator and the bank concerning the level of default on the bank's balance sheet. The asymmetric information gives the bank the opportunity to (inefficiently) roll over bad debt in order to hide its financial condition.

Indeed, it appears that banks commonly conceal their financial states through loan rollovers. References to banks' ability to disguise their default are frequent in policy discussions of banking sector difficulties. Corbett (1998) provides a revealing quote from Lindgren *et al.*: "*In addition, owners and managers of unsound banks have incentives to...show loans as performing in order not to lose their bank.*" In an IMF discussion of "risky assumptions" that analysts often make when working with economies where there is no strong tradition of private ownership, Roulier (1997) describes one such risky assumption, that "*[i]ncentives exist to allocate resources efficiently, enforce debt recovery, and preserve bank capital.*" According to Roulier, "*bank managers* [in these economies] *still function under incentives that encourage rolling over rather than collecting bad debts.*"

The framework developed in this paper to analyze the effects of policies for cleaning banks' balance sheets is a two-tier hierarchy consisting of a regulator, banks, and firms. Hidden information and moral hazard exist at both levels of the hierarchy. The regulator must choose a policy for dealing with troubled banks' assets without full knowledge of the extent of their financial distress.[7] The regulator's policy choice influences banks' treatment

[6]Two papers in the banking literature that model banks' reporting of bad loans, albeit in contexts quite different from the model of this paper, are O'Hara (1993) and Rajan (1995).

[7]It is a well known characteristic of banking regulation and of banking crises that the true level of bad debt on banks' balance sheets is often learned only during the course of implementation of the policy chosen in response to the bad-debt problem. The level of bad debt is virtually always greater than the originally estimated levels. Also, see Dewatripont-Tirole (p. 67) for data on favorable ratings assigned by regulators to banks in periods just preceding failure.

of their debt in default and, consequently, their level of loan recovery. Banks may choose "rollover" for their defaulting loans, which has the effect of hiding the default but which lowers loan recovery, or they may choose "workout," which is an active attempt to recover repayment through restructuring or liquidation of the debtor. Workout is costlessly observable and reveals the level of default; however, it yields higher loan recovery than rollover. The bank's response to the regulator's policy is labelled the *direct effect* of the policy.

Note that since banks' rollover of loans in default (creation of SBCs) result in lower rates of loan recovery and, therefore, in lower bank values, the occurrence of SBCs can actually create (or exacerbate) a banking crisis. The inefficiency created by the bank's choice of rollover (for firms for which it would have been efficient to restructure or liquidate) is reinforced by debtor firm managers' reactions to the SBCs. When banks choose rollover, firm managers have increased incentives to divert the firm's assets for their own personal benefit at the expense of the firm's profit. Asset dissipation by a firm manager lowers the firm's future value and lowers even further the ultimate repayment of the bank loan. The manager's choice of asset dissipation as a function of the occurrence of default and of the bank's choice of workout or rollover is referred to as the *indirect effect* of the policy.

The effect of SBCs on firm behavior in this model is similar to effects on firm behavior that have been identified in other models of SBCs.[8] The novel feature of the firm response to SBCs in this model is that it is an indirect response to the regulator's choice of policy for the bank. Existing models of bank closure policies focus solely on direct effects of policies. The analysis here shows that indirect effects can also be important.

The framework developed for evaluating policy tradeoffs is applied to analyze three policies that have been either advocated or employed to clean banks' balance sheets in TEs. The policies considered are *self reliance*, which is a laissez-faire policy of leaving the debt on the banks' books and letting them solve their own problems; *debt transfer*, whereby the debt is transferred from commercial banks' balance sheets to a specialized, "bad-debt" bank; and *debt cancellation*, whereby the debt is cancelled from firms' and banks' balance sheets. Although the model is applied to analyze policy tradeoffs in TEs, which are particularly vulnerable to banking crises, the modeling framework and the issues

[8]D-M model the effects of SBCs as being a lowering of quality of firms applying for financing. Berglof and Roland (1998) and Qian and Roland (1998) model the effects of SBCs on firm behavior in terms of lower managerial effort.

addressed are general. It is straightforward to adapt the model to nontransition economies and to analyze additional policies, as Aghion, Bolton, and Fries (1998) illustrate.

The analysis demonstrates that when the regulator chooses the policy of self reliance, then severly distressed banks will roll over loans in order to conceal their financial states; the banks create SBCs. Debt transfer, which removes the debt from the commercial banks' balance sheets to a bad-debt bank and recapitalizes the commercial banks, avoids the problem of banks' rollover of loans, assuming that the government can properly align the incentives of the bad-debt bank's manager (so that this manager chooses workout for loans in default). Yet, whereas debt transfer can eliminate loan rollovers, it may result in lower loan recovery than would be obtained by the original bank when the latter chooses workout for its loans in default. An assumption made in the model–which is common in the banking literature and is supported by empirical evidence–is that because of a loss of inside information on debtors when loans are transferred from the original bank to the bad-debt bank, the latter's ability to recover loans is lower than the ability of the original bank.[9]

Debt cancellation is a policy that has been advocated for the TEs by a number of prominent economists, principally because much of the debt in default was inherited from the previous regime.[10] These economists have argued that cancellation of the inherited debt from state-owned firms' and banks' balance sheets early in the transition would remove a burden from the past from firms' balance sheets and would have no net effect on the value of state-owned assets, since all banks and firms are initially state-owned. Interestingly, debt cancellation has also been proposed in the reform of the Chinese banking system, despite the fact that the economic transition has been in progress for several years.

In terms of the model of this paper, the writeoff of debt from firms' balance sheets with debt cancellation implies that no default will occur (during the period under consideration) and, consequently, no restructruring or liquidation of firms will be undertaken by banks. Firm managers are then free to dissipate the firm's assets with no discipline imposed by

[9]For theoretical models where banks acquire inside information about their debtors see Rajan and Petersen (1994) and Gorton and Winton (1998). Empirical evidence supporting the claim that information is lost when loans are transferred from the original commercial bank to other institutions is provided by Slovin et al (1993) and James (1991).

[10]See Begg and Portes (1993), Blanchard et al (1991, p. 49), Calvo and Frenkel (1991), and Dornbusch (1992).

the banking sector. The underlying intuition is that default can have a beneficial effect of triggering a process of information-gathering and firm valuation by the bank (Harris and Raviv, 1990). If this information allows the bank to better monitor the firm manager and to slow asset dissipation, then the sum of the net worths of the firm and the bank will be higher when the debt is left on firms' books (and default allowed to occur) than when it is cancelled. Since no source of potential corporate governance other than creditors exists early in the transition, the problem of lack of discipline among firm managers may be severe. These observations imply that debt cancellation may actually lower bank and firm values relative to other policies for cleaning banks' balance sheets.

The policy chosen by the regulator is the policy that maximizes the expected value of bank and firm values, where the expectation is taken over the regulator's prior regarding the level of default on banks' balance sheets. Policy tradeoffs can be briefly summarized as follows. No policy will be optimal in all situations; the policy that is optimal will depend upon the expected levels of default on banks' balance sheets, the seriousness of the problem of asset dissipation among firms, the potential skill of a bad-debt bank relative to commercial banks at recovering loans, and the viability of firms that default. Debt cancellation is more likely to be optimal: the higher the expected rate of default (and, therefore, the higher the probability that the commercial bank would choose rollover); the less effective is the bad-debt bank at workout; and the less serious is the problem of firm managers' asset dissipation. Self reliance is more likely to be optimal: the lower the expected rate of default; and the greater the seriousness of firms' asset dissipation. Debt transfer is more likely to be optimal: the higher the expected rate of default and the more effective is the bad-debt bank at workout. It should be straightforward in practice to identify the importance of each of the factors determining the optimality of a given policy.

The paper proceeds as follows. Section 2 provides the taxonomy of SBC models, defines classes of models, and discusses conditions under which each class of models generates SBCs. Section 3 outlines the merits of the policy of debt cancellation and describes policies actually applied in the banking crises in Hungary, Poland, and the Czech Republic. It also reviews related theoretical literature. Sections 4 and 5 present the model and analyze policy tradeoffs. Section 6 identifies additional issues in banking regulation that are amenable to analysis with SBCs models. It also compares applications of differing models of SBCs to

banking crises and their policy implications. Section 7 concludes.

2 Soft Budget Constraints and Creditor Passivity

Although the concept of SBCs was proposed by Kornai, there is no consensus on the exact definition of the concept. For example, the interpretation by Dewatripont-Maskin of SBCs differs from Kornai's original discussion of government bailout of loss-making firms. Yet, Kornai's own interpretation of SBCs has evolved somewhat over time. For the purposes of this paper, I formulate a definintion of SBCs that is general enough to encompass both the D-M interpretation and Kornai's original description.

Definition: *A firm has a soft budget constraint if: (1) it has negative expected net present value but receives financing; or (2) if a financial decision of a creditor or the government following default allows the firm to continue in operation although its assets would yield a greater return in an alternative use.*

This definition allows for a number of differing cases of SBCs. It is possible to classify these cases according to two criteria: whether the decision to finance a firm is *ex ante* inefficient; and whether a continuation decision is *ex post* inefficient. *Ex ante* decisions are those made prior to default; *ex ante* efficiency corresponds to the financing of only positive expected net present value firms (or projects). *Ex post* decisions are those made following default; *ex post* efficiency refers to the continuation of only those firms whose returns are higher in continuation than in liquidation.

The table below presents the four possible combinations of *ex ante* and *ex post* characteristics of firms and should be considered as consisting of four large cells. The table identifies the cases that would qualify as SBCs if firms in these cases were to receive initial financing or were to be continued in operation following default. For example, the upper-right cell represents the case of a firm with positive expected NPV at the *ex ante* financing stage; however, upon default the return to claimants is higher in liquidation than in continuation. If a firm in this case is continued in operation following default, it has a SBC. The lower-left and lower-right cells both represent firms with negative expected NPV. If firms in these cases receive finance, they have SBCs. The lower-left cell represents the case where the refinancing decision is efficient; the lower-right cell represents the case where the

refinancing decision is inefficient. Note that the only case where the provision of finance combined with a continuation decision following default is consistent with hard budget constraints is the case appearing in the upper-left cell. Initial financing or continuation decisions lead to SBCs in all other cases.

	Ex post efficiency	**Ex post inefficiency**
Ex ante efficiency	*HBC*	*SBC* Kornai (1980) Shleifer-Vishny (1994) Mitchell (1998a), (1998b) Aghion et al (1998) Perotti (1998) Bai-Wang (1998)
Ex ante inefficiency	*SBC* D-M, 1995 Berglof-Roland (1995), (1997) Li (1997); Qian-Roland (1998) Povel (1998) Huang-Xu (1998a), (1998b), (1998c) Qian-Xu (1998)	*SBC*

We may now identify the cases that correspond to different models of SBCs. Papers listed in each cell represent models in which SBCs correspond to the characteristics represented by that cell. The model of D-M and models based on D-M represent the case in the lower-left cell. These models apply to a situation in which it is *ex post* efficient to refinance; however, *ex ante* it is inefficient to provide finance. Firms with negative expected NPV receive finance at the *ex ante* stage because banks are unable at this stage to distinguish between firms with positive and those with negative expected NPVs. Firms with negative expected NPVs that default and for which it is *ex post* efficient to refinance are refinanced because at the *ex post* stage the original loan is sunk. Firms for which it is *ex post* ineffi-

cient to refinance (the lower-right cell) would not be continued in operation in the model of D-M.

Cases represented by the upper-right cell correspond to SBCs created by *ex post* inefficiencies rather than *ex ante* inefficiencies. Kornai's original description of SBCs (including the model of Shleifer-Vishny, 1994) may be placed in this category. Kornai's conception of SBCs may be represented by an assumption that the government has an objective that is inconsistent with maximizing the value of the firm.

Models relating to creditor passivity also fall into the upper-right cell. Note, however, that the assignment of papers in the upper-right cell rather than the lower-right cell (or both cells) is arbitary. Although models in the upper-right cell represent situations where *ex post* inefficiencies lead to SBCs, none of the models explicitly rules out the possibility that additional, *ex ante* inefficiencies are created by the *ex post* inefficiencies. One could expect that, as in D-M, a belief that defaulting firms will be refinanced would lead more managers of bad projects to apply for initial financing, creating an *ex ante* inefficiency. Nevertheless, the primary focus of the models cited in the upper-right cell is on *ex post* phenomena.

Mitchell (1993) identifies three categories of potential explanations for creditor passivity (i.e., when creditors other than the government make the continuation decision). Any of these categories can yield SBCs corresponding to the case of the upper-right cell of the table. The categories of explanations relate to: (1) the value of the creditor; (2) the creditor's relationship with the government; and (3) the value of the debtor. Specific examples of explanations falling into each of these categories, respectively, are:

1. Creditors do not want to signal default because of their own weak financial positions
2. Creditors believe that they or the debtor will ultimately be rescued
3. The creditor's placement in the absolute priority ordering in bankruptcy liquidation lowers the amount that it would recover relative to continuation

In contrast to explanations 1 and 3 in the above list, explanation 2 may imply the existence of a commitment problem on the part of the government: the government cannot commit not to bail out (at least some) creditors or debtors that are insolvent. As discussed in Mitchell (1993), one reason for the government's commitment problem may be the existence of externalities arising from the default of a large number of banks or firms. Indeed,

Mitchell (1998b) presents a model which formalizes the discussion in Mitchell (1993) of a government's inability to commit not to rescue banks when "too many" banks are in trouble. This type of situation is labeled "too many to fail."[11] The model presented in Section 4 of this paper incorporates explanation 1 in the above list.

3 Policies to clean banks' balance sheets

As mentioned above, transition economies are particularly vulnerable to banking crises. One of the explanations for this vulnerability is that the commercial banks in all of the economies were created by breaking off divisions of the central bank in the previous regimes, and the inherited portfolios contained significant portions of bad assets. Yet, the quantities of bad debt have also increased in the years following the banks' inception. Policy makers realized that it would be necessary to "clean" banks' balance sheets before they could be privatized.

The criterion employed in this paper to evaluate tradeoffs between policies to clean banks' balance sheets is the effect of the policy on the value of firms' and banks' assets. Since state-owned banks in TEs will eventually be privatized, their net worth is important. The net worth of state-owned firms that are being privatized is also important, whether firms are privatized by sale or through voucher methods. While the former method yields much-needed government revenue, the net worth of a firm that is privatized through voucher methods is also important because it will determine the probability that the firm stays out of bankruptcy and the size of dividends that it may distribute. Both of these factors are important for maintaining political support for the transition process.

Policies applied to troubled banks have effects on both bank and firm behavior; therefore, there is a need to take into account the behavior of borrower firms' managers when choosing a policy. The assumption that firm managers may appropriate returns or the firm's assets for their personal benefit is commonly employed in the economics and finance literature.[12] This assumption is especially relevant to the TEs, where property rights are much less clearly defined than in developed market economies. Because of managers' ability

[11] Independently, Perotti (1998) has modeled externalities arising from the insolvencies of many firms.

[12] Examples include Bolton and Scharfstein (1990, 1995), Grossman and Hart (1982), Hart and Moore (1990, 1996), Jensen (1986), and Shleifer and Vishny (1992).

to divert resources from state-owned firms, the timing of privatization of firms is also an important determinant of the value of firms. The longer the required time for privatization, the greater the potential for leakage and subsequent reduction in firms' values.[13] Even fast, mass privatization programs have not necessarily led to the rapid establishment of effective corporate governance. (See Brada, 1996.)

Debt cancellation entails writing off the inherited debt at the beginning of transition.[14] Because debt cancellation lowers the (book) value of banks' assets, it will likely need to be accompanied by some measure, such as recapitalization, in order to restore bank solvency. Similarly, since the policy of debt transfer involves removing the inherited assets from the banks' balance sheets, this policy may also require recapitalization of banks. In addition, if the policy of self reliance results in banks' writing off of a large quantity of debt, recapitalization will also be necessary. Recapitalization has accompanied both debt transfer and self reliance in practice.

The obvious motivation for the recommendation of debt cancellation is that if the inherited debt no longer exists, then it cannot pose any of the problems associated with large quantities of bad debts on banks' balance sheets. In addition, removal of the debt overhang eliminates from firms' balance sheets a burden from the past. In the absence of capital market imperfections, the argument that debt cancellation will eliminate problems associated with bad debt without changing the net worth of government assets is compelling. Yet, debt cancellation has almost never occurred in practice.[15] The most frequently cited explanation for the absence of this policy has been that it creates a credibility problem: if the government is willing to cancel debt once, then agents may believe that the government will be willing to cancel debt in the future.

The feature of debt cancellation that gives rise to the credibility problem, however, is recapitalization rather than cancellation of the debt *per se*. If banks were not recapitalized

[13]Most discussions of privatization in the TEs acknowledge the problem of managerial malfeasance and dissipation of asset values. See, for example, Lipton and Sachs (1990), Blanchard et al (1991, p. 36), and Boycko, Shleifer, and Vishny (1993). None of the discussions of the problem of bad debt on banks' balance sheets has recognized the relevance of this phenomenon.

[14]It may appear to be an extreme assumption that all of the inherited debt is written off; however, the actual problem of identifying the portion of the inherited debt that was bad in the economies in transition has been extremely difficult.

[15]The exception is Bulgaria, which undertook a cancellation of bank debt in 1993.

in conjunction with debt cancellation, then they would oppose this policy, since it would require them to write down their assets. Since recapitalization has accompanied both debt transfer and self reliance policies that governments have actually implemented, these latter policies also give rise to an analogous credibility problem.[16] The credibility argument, then, cannot completely explain why policies other than debt cancellation have been chosen. This paper offers an alternative explanation relating to the effects of policy choices on banks' and firms' asset values. I show that whereas the removal of the debt overhang from the past may have some benefit, it may be overshadowed by the negative effect of unmonitored asset dissipation if the problem of asset dissipation among firms is important. Self reliance or debt transfer will, in this case, yield higher bank and firm values. The table in Appendix 1 describes the actual policies of debt transfer and self reliance implemented in the Czech Republic, Hungary, and Poland.

4 The Model

The timing of events is as follows. In period 0 each commercial bank in the economy has a continuum of debtors of measure 1 with loans equal to d for each debtor. Each bank has an amount H in deposits. Total debt repayments for a firm equal $d(1+s)$, where s represents the interest rate. Interest sd is assumed to come due in period 1, whereas principal d comes due in period 2. Prior to the beginning of period 1, and before the precise level of default on banks' balance sheets is known, the government (G) chooses a policy: debt cancellation; debt transfer; or self reliance.

At the beginning of period 1 firms realize their period-1 income and learn their continuation and liquidation values. The combination of income and continuation and liquidation values determines each firm's type (good or bad debtor). All of this information is private to firms.

After firms have realized their income and learned their types, banks receive interest repayments from good debtors, and they observe default by bad debtors if debt cancellation has not been chosen. (When debt cancellation is chosen, loans are written off the banks' and the firms' books prior to period 1, and default does not occur in period 1.) Information

[16] This point has been noted by several authors, e.g., Bonin (1993), Brainard (1991a), and Marrese (1994).

regarding default is private to the bank. If default has occurred, banks decide whether to roll over or work out the loans in default. The term workout denotes any action, such as a bankruptcy proceeding or an out-of-court workout, in which the bank attempts to recover some of its loan and possibly to reorganize or liquidate the firm. Workout of a loan enables a bank to value the firm and to slow or halt the dissipation of assets. The process of workout is assumed to be costly.

Once banks have decided whether to work out or roll over their defaulting loans, firms then choose their levels of asset dissipation to undertake during period 1. During period 1 firms operate under government ownership. Asset dissipation and managerial appropriation of profit will occur during this period (if managers have chosen positive levels of asset dissipation) unless managers' activities are constrained as a result of a loan workout.

At the beginning of period 2 all firms are privatized (or some possibly liquidated).[17] If asset dissipation has occurred during period 1, the value of a firm's assets that is realized at this point will be lower than the value that would have been realized had no asset dissipation occurred. Loans that are still outstanding are repaid in period 2.

The timing of events is summarized below.

Period 0

G chooses a policy

Period 1

Firms realize income, learn their continuation/liquidation values (hence, learn their types)

Default on loans occurs

Banks observe default

Banks choose action

Firms choose level of asset dissipation

Period 2

Privatization of firms

[17] Although the assumption of state ownership of firms in period 1, followed by privatization in period 2, allows for analysis of the effects of differing methods of privatization on policy tradeoffs in TEs, this assumption is not essential to the analysis of policy tradeoffs. It is straightforward to apply the framework developed here to economies with privately owned firms. In the latter case, firms that are not liquidated during period 1 continue in operation in period 2.

Outstanding loans repaid

The bank that observes default in period 1 and that decides whether to work out or roll over debt will be the bad debt bank if debt transfer is the policy choice and the commercial bank if self reliance has been selected.

Privatization of firms at the beginning of period 2 is assumed to occur through individual sale. There are assumed to be a sufficient number of buyers so that if a firm's continuation value minus its outstanding debt obligations exceeds its liquidation value, the firm will be sold. (Policy tradeoffs when firms are privatized via voucher methods are discussed in Mitchell, 1998a).

4.1 Firm behavior

The amount of asset dissipation that occurs during period 1 affects the firm's value in period 2. Let the proportion of the firm's assets that are dissipated be given by Δ.

Assumption 1: *The maximum feasible value of* Δ *is given by* $\overline{\Delta} \leqslant 1$.

$\overline{\Delta}$ is determined by existing institutions and regulations and will differ from economy to economy. For instance, if regulation of managerial behavior is nonexistent, then managers are free to steal the firm's assets and $\overline{\Delta} = 1$. (This is indeed what occurred in a number of countries at the beginning of the transition.) If there is some degree of regulation of managerial behavior, then $\overline{\Delta} < 1$.

Let $x_i(\Delta)$ denote the continuation value (gross of debt repayments) in period 2 for firm i and for a given period-1 level of asset dissipation Δ. $x_i(\Delta)$ is assumed to be decreasing in Δ, with $x_i(0) = \overline{x}_i$ and $x_i(1) = 0$. The value $\overline{x}_i$ represents the period-2 continuation value of the firm if no asset dissipation occurs in period 1. This is the maximum possible continuation value of the firm. Asset dissipation during period 1 lowers the firm's period-2 continuation value. When $\Delta = 1$, there are no assets left in the firm to operate in period 2.

Define the liquidation value $l_i(\Delta)$ of the firm in period-2 in a manner similar to the continuation value. $l_i(\Delta)$ is nonnegative and decreasing, with $l_i(0) = \overline{l}_i$ and $l_i(1) = 0$.

Firm i's period-2 value, gross of debt obligations, is then given by the maximum of the continuation and liquidation values: $V_i(\Delta) = \max\{x_i(\Delta), l_i(\Delta)\}$. If the firm is continued

in operation in period 2 and if the debt obligation remains on the firm's books, then its period-2 value net of debt obligations will be given by $x_i(\Delta) - d$.

Definition 1: A firm i is *viable* if $\overline{x}_i > \overline{l}_i$.

A firm will be called viable if its maximum continuation value is greater than its maximum liquidation value. That is, in the absence of any asset dissipation and in the absence of a debt overhang, its value in continuation would be greater than its liquidation value.

Asset dissipation by firm managers in period 1 determines two sources of private managerial benefits. On one hand, asset dissipation confers current (period-1) private benefits on managers. On the other hand, asset dissipation reduces the future value of the firm and thus potentially reduces the manager's future private benefits if the firm continues in operation. Denote the value of current private benefits from a level Δ of asset dissipation by $b(\Delta)$, where $b(0) = 0$ and $b(\cdot)$ increasing.

Denote the manager's future private benefits by a function $P_i(\Delta) = \zeta \cdot Max[0,$firm's continuation value$]$. For example, if the debt is left on the firm's balance sheet and if the firm is continued in operation in period 2, then $P_i(\Delta) = \xi \cdot Max[0, x_i(\Delta) - d]$. The parameter ξ takes on a value between 0 to 1 and represents the degree to which the manager's future private benefits from continued operation of the firm are tied to the firm's value. If the manager is the sole owner of the privatized firm, $\xi = 1$. On the other hand, if the manager is sure to have no relationship with the privatized firm, $\xi = 0$. ξ is determined at least partly by the method of privatization. Note that since $x_i(\cdot)$ is decreasing in Δ, $P_i(\cdot)$ is also decreasing in this variable. Clearly, if the firm is liquidated before period 2, $P_i(\Delta) = 0$.

Assumption 2: *The manager's utility is* $U_i(\Delta) = b(\Delta) + P_i(\Delta)$.[18]

The manager's salary from working in the firm is normalized to zero in the utility function specified by Assumption 2. This function reflects the tradeoff between current and future benefits that the manager faces in dissipating the firm's assets.

Assumption 3 guarantees that asset dissipation is inefficient.

Assumption 3: *One dollar's reduction in period-2 firm value yields less than a dollar's increase in current private managerial benefits.*

There are two types of firms in the model: good debtors and bad debtors. Definitions

[18] For expositional simplicity I assume no discounting in the managerial utility function or in bank profit.

of the types reflect combinations of assumptions on period-1 incomes and on the solvency of firms.

Definition 2: A *good debtor* has the following characteristics: (1) period-1 income exceeds interest payments sd;(2) $\overline{x_i} - d \geq 0$.

Definition 3: A *bad debtor* has the following characteristics: (1) period-1 income is less than sd;(2) $V_i(0) - d < 0$.

That firms are assumed to be either good debtors or bad debtors reflects some implicit assumptions on period-1 income flows. These assumptions are made for expositional convenience only and do not affect the qualitative results of the model.[19] Definition 2 implies that all firms that earn enough income in period 1 to meet interest repayments are solvent (in the absence of asset dissipation); i.e., profit from continuation in period 2 exceeds debt repayments. Definition 3 implies that all firms that default on interest payments in period 1 are insolvent and, simultaneously, that all firms that are insolvent cannot avoid default on interest repayments in period 1. An assumption on income flows that is consistent with the above definitions is that solvent firms earn period-1 income equal to sd and insolvent firms earn period-1 income equal to 0.[20]

Bad debtors have so much debt on their books relative to potential earnings that default in period 1 is inevitable. That these firms have a large debt overhang, however, does not necessarily imply that they are not viable. Some of these firms' continuation values in the absence of the debt overhang and in the absence of asset dissipation may well exceed their liquidation values.

The level of asset dissipation chosen by a firm manager is endogenous. It will be a function of the firm's type (good or bad debtor), G's choice of policy, and bank response to default. In the subsections below I analyze bank behavior and firms' asset dissipation decisions for each policy.

[19] More precisely, these assumptions rule out the need to take into account the case where defaulters are illiquid but not insolvent and the case where nondefaulters are insolvent but liquid.

[20] The assumption that firms' types are realized (exogenously) at the beginning of period 1 is made to simplify the exposition. This assumption, however, is not essential to the model. Results that would obtain with a more general model in which firms' choices of levels of asset dissipation determine their type in period 1 are discussed in Mitchell (1998b).

4.2 Self reliance

Assumption 4 describes the banker's utility function.

Assumption 4: *The banker's objective function is* $W(\Pi, \rho) = \max[\Pi, 0] + \rho$, *where* Π *represents two-period bank profit and* ρ *represents a private benefit to the banker of maintaining the bank in operation.*[21]

The private benefit ρ in Assumption 4 can actually be interpreted in a number of ways. One interpretation is that given in the assumption: ρ is the private benefit of keeping the bank in operation (under the implicit assumption that the bank will be closed or the manager replaced if the bank becomes insolvent), where in this model two-period bank profit is equivalent to bank net worth. Note that if the bank is insolvent but liquid and if the insolvency is not discovered until nonpositive profit is realized in period 2, the bank manager receives no monetary benefit but still enjoys the private benefit of keeping the bank open during period 1. In contrast, if the insolvency is discovered in period 1, the manager will lose the private benefit and will thus have a level of utility of zero. The presence of ρ in the bank manager's objective function thus creates an incentive to hide the bank's insolvency by rolling over loans in default.

A more general interpretation of ρ is that it represents a private benefit from managing a solvent bank. The implicit assumption here is that $\rho = 0$ if the bank is known to be insolvent, even if the government rescues the bank through recapitalizing it. That is, the bank manager's reputation or future career advancement is greatly diminshed if the manager is known to be in charge of an insolvent bank, even if the insolvent bank is recapitalized by the government.[22]

A bank with some proportion α of its loan portfolio in default chooses between two actions: workout or rollover.[23] Workout and rollover policies are defined as follows.

[21] This objective function is also employed in Aghion, Bolton, and Fries (1998). A similar objective function is employed in Rajan (1994).

[22] The Japanese banking crisis illustrates this case. Although the Japanese government decided to rescue banks via an offer of recapitalization, it was feared that Japanese bank managers would be reluctant to take advantage of the offer because of the negative consequences for them. ("Obuchi's Big Bail-Out," *Financial Times*, Oct., 14, 1998.) Indeed, Japanese banks were slow to apply for recapitalization, and it was widely believed that the amounts that they did request were well below what they actually needed.

[23] I assume that the bank either works out or rolls over all of its debt. Its optimal strategy in some cases may be to work out some portion of its defaulting debt and to roll over the rest. Allowing for partial

Workout:

(i) At a cost $c(\alpha)$, the bank learns $V_i(\Delta)$ for each firm in default and can halt asset dissipation. $c'(\cdot) > 0$; $c''(\cdot) \geq 0$.

(ii) The bank may write off some debt.

Rollover:

Loans are rolled over; therefore, on the bank's balance sheet the loans appear to be performing.

The function $c(\alpha)$ reflects costs associated with the process of information gathering and valuation of the firm that must accompany workout, whether it is through a bankruptcy reorganization procedure or an out-of-court workout. Even if the bank can access inside information concerning its debtors, the process of valuation and of determining the best course of action for the firm is costly.[24] The function $c(\cdot)$ may also reflect the increased costs of raising deposits when the bank is known to be financially troubled.

Assumption 5: *The bank's choice of workout is observable and its value of α becomes known when it chooses workout.*

Assumption 5 states that when the bank chooses workout, this action is observable to the regulator. An obvious example is when the bank initiates a bankruptcy procedure against a defaulter. Yet, even out-of-court workouts require banks to undertake actions that are easily observable. In addition, writing off of debt requires visible changes to a bank's balance sheet. The choice of workout, therefore, reveals the level of default on the bank's balance sheet.

Assumption 5 implies that the bank cannot simultaneously roll over its loans so as to disguise its default and surreptitiously undertake a workout to value its debtors and increase loan repayment. Whereas the benefit to rolling over loans is that the value of α remains unobserved, a cost is that the bank does not learn the continuation and liquidation values

workout and partial rollover does not change the qualitative results.

[24]For example, Ingves and Lind (1997) identify activities necessary to evaluate problem borrowers and, to decide whether to liquidate versus restructuring them as including assessments of the company's future development and probability of repayment; conducting of cash flow and earnings analyses; and evaluation of the value of collateral. These activities are clearly costly. Bankruptcy costs are also an obvious component of these costs when bankruptcy procedures are invoked against borrowers.

of its defaulters; therefore, it cannot slow asset dissipation or force defaulters to liquidate or to restructure. The bank does know, however, the general probability distribution of continuation and liquidation values of bad debtors and can thus calculate a conditional expected value of a firm given that it is a bad debtor. These expected values will influence the bank's decision regarding whether to work out or roll over loans in default given a policy of self reliance.

Obviously, the conditional expected value of a firm calculated by the bank will be a function of the firm's type (good or bad debtor) and of the level of asset dissipation that is expected to be chosen by the firm manager. Define the conditional expected continuation and liquidation values (gross of debt repayments) in period 2 of a firm, given that it is a bad debtor and given some level of period-1 asset dissipation Δ, by $x(\Delta \mid B)$ and $l(\Delta \mid B)$, respectively. The conditional expected period-2 value of the firm given that it is a bad debtor is then given by $V(\Delta \mid B) = E\{\max[x(\Delta \mid B), l(\Delta \mid B)]\}$. The conditional expected value in period 2 for a good debtor is defined analogously: $V(\Delta \mid G) = E\{\max[x(\Delta \mid G), l(\Delta \mid G)]\}$.

Recall that by Definition 3 bad debtors are insolvent; they have asset values that are lower than the face value of their debt. For each bad debtor i, $V_i(0) - d < 0$. This implies that if none of a bad debtor's debt is written off in period 1 (i.e., if the bank chooses rollover), the firm will not be sold in period 2 when it is put up for privatization, since no buyer would be willing to pay a positive price for the firm. This observation raises the question of the government's treatment of firms that it does not succeed in selling at the beginning of period 2. The answer to this question is important, as it affects policy tradeoffs.

Potential responses by the government with regard to unsold firms are either liquidation (piecemeal sale) of these firms or a giveaway of the firms, for example, to their employees. In the case of the first response, the liquidation of unsold firms would effectively eliminate firms' soft budget constraints that were created by banks' rolling over loans in default. However, as is discussed in Mitchell (1998a), this policy may also lead to some excessive liquidation of firms. In the case of the second response, the giveaway of unsold firms, self reliance with rollover by banks will lead to some excessive continuation, since it results in the continuation of all bad debtors in period 2, even nonviable ones.

In order to keep the exposition in this section as simple as possible, I assume that the government adopts the second response; firms that are not sold in period 2 are given away. This assumption also renders the environment analyzed more comparable to nontransition economies where firms are already privately owned, and thus where bad debtors whose loans have been rolled over would automatically continue in operation in period 2.

Assumption 6: *The government gives away firms that it is unable to sell through the privatization process in period 2.*

All defaulting firms whose loans are rolled over will be continued in operation in period 2 and their values will be given by their continuation values $x_i(\cdot)$. Given that for all bad debtors i, $x_i(\Delta) < d$ (since $V_i(0) < d$), the bank will recover in debt repayments in period 2 the entire contination value $x_i(\Delta)$ for each bad debtor. (This will also be the case when the government privatizes firms via mass privatization methods, such as voucher programs, rather than by sale.)

The policy of self reliance with banks choosing rollover will thus create two potential sources of inefficiency: fims may be inefficiently continued in operation in period 2 and asset dissipation of firms is unhalted, resulting in lower firm values than if asset dissipation were stopped. Note that self reliance with a choice of workout by banks will not lead to inefficient continuation of firms. During the course of a workout in period 1 the bank learns $x_i(\cdot)$ and $l_i(\cdot)$ for each bad debtor i, and it can also halt asset dissipation. If firm i is nonviable ($\overline{x}_i < \bar{l}_i$), the bank will liquidate the firm and will recover $\bar{l}_i$.

In order for the bank to evaluate its expected profit with workout and with rollover and to choose between these actions for its loans in default, it must know the level of asset dissipation that would be chosen by firms, given the bank's action. Firms' choices of asset dissipation are identified in the following subsections. These choices are then taken into account, in standard backward dynamic programming fashion, in the conditional expected values incorporated in the expression for the bank's profit given a choice of workout and its profit with rollover.

4.2.1 Asset dissipation by good debtors.

Call the manager of a good debtor a "good" manager. It is tempting to conjecture that since asset dissipation is inefficient (by Assumption 3) and since good debtors are solvent,

good managers will always choose a lower level of asset dissipation than will managers of bad debtors. This intuition, however, is not entirely correct. The fact that a manager's private benefit from continuation of the firm constitutes only a fraction of the firm's period-2 value may give even the good manager the incentive to dissipate the maximum possible amount of assets in period 1, leading ultimately to default of the good debtor on its principal repayments in period 2.

Only if the fraction ξ in the manager's private-benefit function $P_i(\Delta) = \xi \cdot (x_i(\Delta) - d)$ is "high enough" or if the firm's period-2 continuation value $x_i(0) - d$ is high enough will the good manager be encouraged to choose less than the maximum level of asset dissipation. The following technical assumption is sufficient to guarantee that good managers will not dissipate assets to the point of default on debt repayments in period 2.

Assumption 7: *$P_i(0) > b(\overline{\Delta})$ for all good debtors i.*[25]

The following claim follows directly from Assumption 7 and characterizes the asset dissipation decision of the good manager.

Claim 1: *The good debtor i will choose a level of asset dissipation Δ_i^G, such that $0 \leqslant \Delta_i^G \leqslant \overline{\Delta}$, with $\Delta_i^G < \overline{\Delta}$ if $[x_i(\overline{\Delta}) - d] \leqslant 0$.*

Proof: See Appendix 2.

Claim 1 states that the good manager will never choose asset dissipation equal to $\overline{\Delta}$ if so doing would cause the firm to become insolvent in period 2. Note that Δ_i^G is independent of the bank's choice of action in response to default of bad debtors.

4.2.2 Asset dissipation by bad debtors.

Since bad debtors are insolvent, $V_i(0) < d$ for every bad debtor i. As a consequence $P_i(\Delta) = 0$ for all Δ and for every bad debtor i, whether the bank chooses rollover or workout in response to default. Suppose that the bank chooses rollover. Then the debt overhang is

[25] This assumption implicitly imposes some restrictions on parameter values, such as a minimum value on ξ. For example, if $\xi = 0$, then the assumption would not hold, since $P_i(0) = 0 < b(\overline{\Delta})$. This assumption is made only to simplify the exposition. If good debtors had the incentive to dissipate assets to the point of default in period 2, the bank would have to make a decision in period 1 about the level of monitoring of good debtors during this period. Including a monitoring decision would complicate the model without adding insights.

not removed, and the firm remains insolvent in period 2; $x_i(\Delta) - d < 0$ for all Δ. Thus, $P_i(\Delta) = \xi \cdot Max[0, x_i(\Delta) - d] = 0$. Now suppose that the bank chooses workout and writes off enough debt to allow viable firms to be sold in period 2. The bank will write off an amount of debt that leaves the new level of debt repayment exactly equal to $\overline{x}_i$. (Recall that the bank is able to halt asset dissipation with workout.) Thus, for firm i, $\overline{x}_i - \widetilde{d} = 0$ where $\widetilde{d}$ is the new amount of debt remaining on firm i's balance sheet. Again, $P_i(\Delta) = 0$.

That $P_i(\Delta) = 0$ for all bad debtors implies that there no longer exists a tradeoff for the firm manager between current and future private benefits of asset dissipation: increasing the current dissipation of assets does not result in a reduction of future private benefits. We can now identify bad debtors' choices of asset dissipation.

Workout. The bank halts asset dissipation. Thus, firm manager i's utility will be equivalent to the payoff that she would have received in the absence of any asset dissipation: that is, for all Δ, $U_i(\Delta) = b(0) + P_i(0) = 0$. Since $U_i(\Delta) = 0$ for all Δ, the manager has no incentive to choose a positive level of Δ.

Rollover. When the bank rolls over the loan of a firm in default, asset dissipation is not halted. The manager's utility is thus $U_i(\Delta) = b(\Delta) + P_i(\Delta) = b(\Delta)$. The manager maximizes utility by choosing $\Delta = \overline{\Delta}$. Claim 2 follows immediately.

Claim 2: *The bad debtor will choose* $\Delta = 0$ *if the commercial bank chooses workout and* $\Delta = \overline{\Delta}$ *if the bank chooses rollover.*

Claim 2 illustrates that asset dissipation is higher with rollover than with workout.

4.2.3 Banks' actions.

Bank two-period expected profit incorporates firms' responses to the bank's action. Expected bank profit given a proportion α of the portfolio in default and given workout is[26]

$$\Pi^w(\alpha) = (1 - \alpha)(1 + s)d + \alpha \cdot V(0 \mid B) - c(a) - H. \tag{1}$$

Note that workout allows the bank to recover repayments equal to the maximum expected firm value, $V(0 \mid B)$, of bad debtors; this conditional expected value reflects the expected continuation value for viable firms and the expected liquidation value for nonviable firms.

[26] I assume that deposits are not withdrawn until period 2.

Bank two-period expected profit given α and rollover, taking into account bad debtors' choices of asset dissipation, is

$$\Pi^r(\alpha) = (1-\alpha)(1+s)d + \alpha \cdot x(\overline{\Delta} \mid B) - H. \tag{2}$$

In contrast to workout, rollover results in the bank recovering repayments equal only to the continuation values of all bad debtors subject to their maximum levels of asset dissipation.

Assumption 8 guarantees that workout by the commercial bank will always be socially desirable; i.e., $\Pi^w(\alpha) > \Pi^r(\alpha)$ for all α.

Assumption 8: $\alpha \cdot [V(0 \mid B) - x(\overline{\Delta} \mid B)] > c(a)$ *for all* α.

Assumption 8 states that the expected gain in repayment to the bank (equal to the gain in firm value) from workout relative to rollover exceeds the workout costs $c(\alpha)$ for all α. Yet, although workout is actually more profitable than rollover for all α, the presence of the private benefit ρ in the banker's objective function will motivate the banker to roll over loans whenever $\Pi^w(\alpha) \leqslant 0$.

Claim 3: *Define* α^* *by the value of* α *such that* $\Pi^w(\alpha^*) = 0$. *The bank manager will choose rollover for all* $\alpha \geq \alpha^*$.

Claim 3 implies that managers of insolvent banks will choose rollover.[27]

4.3 Debt Cancellation

With debt cancellation the inherited debt is cancelled from the commercial banks' and the firms' balance sheets in period 0, and the banks are recapitalized. Because the debt has been cancelled, no default occurs in period 1 and the bank has no choice to make between workout and rollover. Yet, because there is no default in period 1, there is no mechanism to halt asset dissipation by firms. It is straightforward to show that the level of asset dissipation chosen by a "good debtor" i (i.e., a firm that would have been a good debtor if the debt had not been cancelled) remains Δ_i^G, the level chosen with self reliance. Although

[27] In this simple version of the model only managers of insolvent banks ever choose roll over. In a more general model solvent but financially distressed banks may also choose to roll over loans. For example, Mitchell (199b) shows that if rollover is a riskier action than workout, then solvent but financially troubled banks will choose rollover. Rajan (1994) shows that solvent banks may also choose to roll over loans for reputational reasons.

the future private benefits for a good manager are now given by $P(\Delta) = \xi \cdot x_i(\Delta)$ rather than $\xi \cdot [x_i(\Delta) - d]$, the value of Δ that maximizes the manager's objective function does not change.

Now consider "bad debtors," or firms that would have been bad debtors if the debt were not cancelled. Assuming, as in Assumption 6, that the government gives away at the beginning of period 2 firms that it was unable to sell as a whole, the future private benefits for bad manager i become $P_i(\Delta) = \xi \cdot x_i(\Delta)$ rather than $P_i(\Delta) = 0$. Given the higher level of future private benefits and the dependence of these benefits on Δ, managers of bad debtors may well have an incentive to choose $\Delta < \overline{\Delta}$. Define $\Delta^B_{i,dc}$ to be the value of Δ that maximizes the utility of a bad manager i when debt cancellation is the policy; $\Delta^B_{i,dc} \leqslant \overline{\Delta}$.

Factors affecting the level of $\Delta^B_{i,dc}$ relative to $\overline{\Delta}$ will include the degree of viability of bad debtors and the degree to which managers derive private benefits from firms once they are privatized (i.e., the value of ζ). The greater the viability of firms (i.e., the higher is $\overline{x}_i$ relative to $\overline{l}_i$) the greater the incentive to reduce asset dissipation. The nature of the privatization process will also affect firm managers' willingness to abstain from dissipating assets in response to debt cancellation. The higher the probability that the manager will be kept on after privatization, the greater the incentive to reduce asset dissipation in period 1. For example, if the probability of continuation of the manager upon privatization is positively linked to the continuation value of the firm at the point of privatization, then the manager will have less incentive to dissipate the firm's assets.

The policy of debt cancellation generates two potential tradeoffs relative to the policy of self reliance. On one hand, the asset dissipation of bad debtors is not halted, whereas with self reliance and workout it is. Firms' values are thus lower with debt cancellation than they would have been with self reliance and workout by banks. On the other hand, removal of the debt overhang raises the continuation values of bad debtors and thus may result in lower levels of asset dissipation relative to levels that would have occurred with self reliance and rollover by banks.

4.4 Debt Transfer

With debt transfer the commercial banks' inherited debt is transferred to a bad debt bank in period 0 and the commercial bank is recapitalized. I assume initially that the bad

debt bank is created for the purpose of working out the debt and will be closed upon termination of its duties. Because the bad debt bank is not a commercial bank and does not accept deposits, its "solvency" is not an issue. I assume that G is able to structure the compensation scheme of the bad debt bank's managers so that they have an incentive to maximize debt collection and to choose workout.

Obviously, these assumptions do not represent the only possible scenario regarding the operation of a bad debt bank. Indeed, a number of open questions regarding the appropriate design and operation of bad debt banks (or asset management corporations as they are sometimes called) have received attention in policy discussions of banking crises. Questions relating to the design of bad debt banks include whether the bad debt bank should be closed after it has finished handling the debt that has been transferred to it, whether the bad debt bank receives good as well as bad assets, whether the bank should be privately or publicly funded, and whether there should be one bad debt bank as opposed to several, each being associated with a particular commerical bank. Countries such as the U.S., Japan, Sweden, Thailand, and the Czech Republic have established bad debt banks but have in fact differed in the ways in which they have answered these questions.

The questions surrounding the design of bad debt banks reflect concerns both with the level of loan recovery by the bad debt bank and with the creation of proper incentives for bad debt bank managers to maximize loan recovery. As an example relevant to this paper, if G is not able to appropriately align the bad debt bank manager's incentives with social interests, then this bank manager may roll over some of its loans in default. It is worth noting that no formal analysis has been undertaken to date of issues concerning the design and operation of bad debt banks.

The above discussion suggests that there are a number of reasonable but competing assumptions that one could make regarding the design and operation of a bad debt bank. Rather than arguing for a particular design of a bad debt bank, I adopt the approach of evaluating policy tradeoffs under differing assumptions. With respect to the question of the bad debt bank manager's incentives, I first identify policy tradeoffs under the assumption that the government has succeeded in motivating the bad debt bank manager to choose workout for all levels of debt. I then indicate how these tradeoffs would change if the bad debt bank manager were to choose rollover for some levels of bad debt. With respect to

the skill at loan recovery by the bad debt bank, I indicate how differing degrees of skill by this bank affect the policy tradeoffs.

I show below that under the assumption that the bad debt bank always chooses workout, if the costs of workout for the bad debt bank are the same as workout costs for commercial banks and if the bad debt bank is as skilled as the commercial bank at recovering loans, then debt transfer will always be preferred to self reliance. There is, however, reason to believe that the bad debt bank may not be as effective as the commercial bank in undertaking workout. In particular, if the commercial bank has access to inside information about borrowers' values, then workout by the bad debt bank will not be as effective as workout by the commercial bank.

Assumption 9: *Due to informational asymmetries between commercial banks and bad debt banks, commercial banks are better able to determine their borrowers' values and to recover loan repayments with workout.*

Assumption 9 can be translated into an assumption that the bad debt bank is able to slow, but not to halt, asset dissipation when this bank undertakes workout. Let $\widehat{\Delta}_{DT}$, where $0 < \widehat{\Delta}_{DT} \leqslant \overline{\Delta}$, be the expected level of asset dissipation that remains unrecovered when the bad debt bank undertakes workout. If bad debtors choose a level of asset dissipation at least as great as $\widehat{\Delta}_{DT}$, the conditional expected value of a bad debtor given workout by the bad debt bank will be $V(\widehat{\Delta}_{DT} \mid B)$, where $V(\overline{\Delta} \mid B) \leqslant V(\widehat{\Delta}_{DT} \mid B) < V(0 \mid B)$. Furthermore, because $\widehat{\Delta}_{DT}$ of asset dissipation remains unrecovered, the manager of a bad debtor receives utility of $b(\widehat{\Delta}_{DT})$ when the bad debt bank undertakes workout,[28] as opposed to a utility of zero when the commercial bank undertakes workout.

Claim 4: *The bad debtor will choose $\Delta = \widehat{\Delta}_{DT}$ when debt transfer is the policy.*

The level of asset dissipation chosen by bad debtors with debt transfer is greater than that chosen with self reliance and workout but less than the level chosen with self reliance and rollover.

[28] For the same reasons cited in Section 4.2.2, $P_i(\Delta) = 0$ for all bad debtors i and for all Δ.

5 G's policy choice

G must choose a policy before α is known.[29] G's objective is to select the policy which yields the highest expected net worth of banks and firms, where the expectation is taken over α and where G takes into account banks' and firms' behavior at each value of α. The optimal policy will thus depend upon G's prior over α and upon other parameter values. Pairwise comparison of policy choices provides the intuition for characterization of the optimal policy. G's balance sheets with workout, rollover, debt cancellation, and debt transfer are given in Appendix 1.

5.1 The choice between debt cancellation and self reliance.

Consider a value of $\alpha < \alpha^*$; i.e., a value of α for which the bank would choose workout with self reliance. Define $x(\Delta_{dc}^B \mid B)$ to be the conditional expected continuation value of a firm given that it is a "bad debtor" and given a policy of debt cancellation. Comparison of G's balance sheets with workout and debt cancellation indicates that G will prefer workout to debt cancellation for this value of α if $\alpha \cdot [V(0 \mid B) - x(\Delta_{dc}^B \mid B)] > c(\alpha)$. This inequality states that the gain in the value of firms with workout by the commercial bank relative to expected firm value with debt cancellation exceeds the cost of workout.

Assumption 8 guarantees that $\alpha \cdot [V(0 \mid B) - x(\overline{\Delta} \mid B))] > c(\alpha)$ for all α;however, it does not guarantee that the above inequality holds. That is, if Δ_{dc}^B is low enough, the policy of debt cancellation may be preferred to workout for some values of α. This can only be the case if the problem of asset dissipation among firms is not serious; i.e., if removal of the debt overhang alone motivates bad managers to choose low levels of asset dissipation.

Now consider a value of $\alpha > \alpha^*$, or such that the commercial bank chooses rollover. Examination of G's balance sheets reveals that debt cancellation will be preferred to rollover if $x(\Delta_{dc}^B \mid B) \geq x(\overline{\Delta} \mid B)$. This inequality always holds; therefore, debt cancellation is preferred (possibly only weakly) to self reliance for all $\alpha \geq \alpha^*$.

[29]This assumption is not as extreme as it might appear at first glance. G's prior over α may have been established on the basis of earlier monitoring of banks and even the discovery of some level of default in previous periods.

5.2 The choice between debt transfer and self reliance.

Consider a value of α such that the commercial bank chooses workout. G's balance sheets reveal that debt transfer will be preferred to workout if and only if $V(\widehat{\Delta}_{DT} \mid B) \geq V(0 \mid B)$. This equality never holds (Assumption 9); therefore, workout is preferred to debt transfer for all $\alpha < \alpha^*$. Now consider a value of α such that the commercial bank chooses rollover. Debt transfer will be preferred to rollover if and only if $\alpha[V(\widehat{\Delta}_{DT} \mid B) - x(\overline{\Delta} \mid B)] - c(\alpha) > 0$; i.e., only if the expected increase in firm value with workout by the bad debt bank relative to expected firm value when the commercial bank rolls over the debt justifies the cost of workout.

5.3 The choice between debt transfer and debt cancellation.

Debt transfer will be preferred to debt cancellation for all values of α such that $\alpha\{V(\widehat{\Delta}_{DT} \mid B) - x(\Delta_{dc}^{B} \mid B)\} - c(\alpha) > 0$. This inequality states that the gain in the expected value of bad debtors with debt transfer relative to the value with debt cancellation exceeds the expected costs of workout by the bad debt bank. The expected gain in the value of bad debtors with debt transfer relative to debt cancellation is achieved through workout by the bad debt bank and has two potential origins: a reduction in the level of asset dissipation ($\widehat{\Delta}_{DT}$ vs. Δ_{dc}^{B}) and the liquidation of nonviable firms versus continuation of all firms with debt cancellation (leading to expected firm values given by $V(\cdot)$ with debt transfer vs. $x(\cdot)$ with debt cancellation). The gain to debt transfer is entirely reflected in loan recovery by the bad debt bank since bad debtors' are insolvent.

5.4 The optimal policy.

The optimal policy is the policy that yields the highest expected value of bank and firm assets (equivalently, G's balance sheet) where the expectation is taken over G's prior over α. While it is obvious from the above discussion that the optimal policy will depend upon parameter values and upon the distribution of α, there are nonetheless some general observations that can be made with respect to the optimal policy. First, note that the asset dissipation of good managers is invariant to G's policy choice. The policy choice influences only the behavior of bad managers.

The fact that a number of analysts have proposed the policy of debt cancellation raises the question of the conditions under which this policy would be optimal. Obviously, a necessary condition for debt cancellation to be optimal is that it is preferred to debt transfer. The following definition aids the discussion.

Definition 4: A bad debt bank is *effective* if

$$\int_0^1 \left\{\alpha[V(\widehat{\Delta}_{DT} \mid B) - x(\Delta_{dc}^B \mid B)] - c(\alpha)\right\} f(\alpha)d\alpha > 0, \tag{3}$$

where $f(\alpha)$ represents G's prior over α.

A bad debt bank will be called effective if the expected value of bank and firm assets (where the expectation is taken over α) with debt transfer is greater the expected value with debt cancellation. The inequality of Definition 4 is simply the expectation taken over α of the inequality given in Section 4.3.

It is clear from the Definition 4 that the greater the ability of the bad debt bank to slow asset dissipation, the more likely it is that the bad debt bank will qualify as effective. It is also clear, however, that the problem of unmonitored asset dissipation with debt cancellation is important: the higher is Δ_{dc}^B, the more likely it is that the bad debt bank will qualify as effective.

The following proposition provides necessary and sufficient conditions for debt cancellation to be optimal.

Proposition 1 *Debt cancellation is optimal if and only if: (i) the bad debt bank is not effective; (ii) the expected gains to self reliance and workout relative to debt cancellation are less than the expected losses of self reliance and rollover relative to debt cancellation; i.e.,* $\int_0^{\alpha^*} \left\{\alpha[V(0 \mid B) - x(\Delta_{dc}^B \mid B)] - c(\alpha)\right\} \cdot f(\alpha) < \int_{\alpha^*}^1 \alpha \left\{x(\Delta_{dc}^B \mid B) - x(\overline{\Delta} \mid B)\right\} \cdot f(\alpha)$.

Condition (i) follows directly from Definition 4. Condition (ii) follows from taking the expectation over α of the inequalities presented in Section 4.1 and accounting for the endogeneity of the commercial bank's workout/rollover decision as a function of α. It is clear from condition (ii) that the greater is the probability that $\alpha > \alpha^*$ and the lower is Δ_{dc}^B, the more likely is debt cancellation to be preferred to self reliance.

As mentioned above, some economists who have advocated debt cancellation for TEs have cited the benefit of this policy as deriving from the removal from firms of a burden

from the past. Indeed, the elimination of the debt burden translates into higher cash flow for firms in period 2, which is just matched by a lower cash flow to banks. Yet, because of firm managers' ability to dissipate their firms' assets, the higher cash flow of firms will not necessarily translate into higher values relative to values with other policies. The following corollaries formalize this point.

Corollary 1 *A necessary condition for debt cancellation to dominate self reliance is that there exist some bad debtors i for which* $\Delta^B_{i,dc} < \overline{\Delta}$.

In order for the government's return on its assets to increase as a result of cancelling debts from the past, some managers of bad debtors must reduce their dissipation of the firm's assets in response to the cancellation of the debt. If the expected level of asset dissipation with debt cancellation does not fall below that with self reliance and rollover, then self reliance will always be preferred to debt cancellation at least weakly, with strict preference if there is some value of $\alpha < \alpha^*$ which occurs with positive probability.

Corollary 2 *Sufficient conditions for debt cancellation to be optimal are: (1)* $\Delta^B_{i,dc} = 0$ *for all i and (2) all bad debtors are viable.*

If removal of firms' debt burdens from the past stimulates all firm managers to cease asset dissipation and if, in addition, all bad debtors are viable (so that there is no potential benefit in having either the commercial bank or the bad debt bank liquidate nonviable debtors through workouts), then debt cancellation will be optimal.

These observations demonstrate that when problems of asset dissipation among firms are serious, debt cancellation cannot be optimal. Whether debt transfer or self reliance will be optimal in this case depends upon both the skill of the bad debt bank at workout and the incentives for the bad debt bank manager to work out rather than roll over loans. In order to isolate these issues, I continue to describe policy tradeoffs under the assumption that the incentive problem has been resolved; i.e., the bad debt bank always chooses workout. I then reinterpret policy tradeoffs under the assumption that the bad debt bank chooses rollover for some values of α.

The following proposition provides conditions for the optimality of debt transfer.

Proposition 2 *Necessary and sufficient conditions for debt transfer to be optimal are: (i) the bad debt bank is effective;*

(ii) the expected gains to debt transfer relative to self reliance and rollover are greater than the expected losses to debt transfer relative to self reliance and workout; i.e.,

$$\int_0^{\alpha^*} \left\{\alpha[V(0 \mid B) - V(\widehat{\Delta}_{DT} \mid B)]\right\} \cdot f(\alpha) < \int_{\alpha^*}^1 \alpha \left\{V(\widehat{\Delta}_{DT} \mid B) - x(\overline{\Delta} \mid B) - c(\alpha)\right\} f(\alpha).$$

Condition (i) follows from Def. 4. Condition (ii) follows from Section 4.2, taking into account the endogeneity of the commercial bank's workout/rollover decision. The left-hand side of the inequality represents the expected loss in firm values with debt transfer relative to self reliance and workout; the right-hand side represents the expected gain to debt transfer relative to self reliance and rollover. The lower is the value of α^* and the greater is the probablity that $\alpha > \alpha^*$, the more likely is debt transfer to dominate self reliance.

It is now possible to formalize a result stated earlier regarding the skill of the bad debt bank.

Corollary 3 *Suppose that the bad debt bank is as skilled as the commercial bank at workout. Then debt transfer will be preferred to self reliance.*

Proof: That the bad debt bank is as skilled as the commercial bank at workout implies that $\widehat{\Delta}_{DT} = 0$. The corollary then follows directly from Assumption 8 and from condition (ii) of Proposition 2 with $\widehat{\Delta}_{DT} = 0$.‖

Proposition 2 also gives rise to a simple necessary condition for debt transfer to dominate self reliance.

Corollary 4 *A necessary condition for debt transfer to dominate self reliance is that*

$$\alpha^* \cdot [V(\widehat{\Delta}_{DT} \mid B) - x(\overline{\Delta} \mid B)] - c(\alpha^*) > 0.$$

Recall from Section 4.2 that self reliance dominates debt transfer for all $\alpha < \alpha^*$. In order for debt transfer to dominate self reliance, it must be preferred for at least some values of $\alpha \geq \alpha^*$. This implies the condition stated in Corollary 4. More generally, define $\widehat{\alpha}$ as the minimum value of α such that $\widehat{\alpha} \cdot [V(\widehat{\Delta}_{DT} \mid B) - x(\overline{\Delta} \mid B)] - c(\widehat{\alpha}) = 0$. The value $\widehat{\alpha}$ is the critical value of α at which the costs of workout by the bad debt bank begin to

exceed the gains to this policy relative to self reliance and rollover. If $\widehat{\alpha} < 1$, then there exist some values of α for which the gains to workout by the bad debt bank relative to rollover of loans do not justify the costs of workout. Obviously, if $\overline{\alpha} < \alpha^*$, debt transfer cannot dominate self reliance. One may restate the condition in Corollary 4 as $\widehat{\alpha} > \alpha^*$.

On the basis of the above results, it is now straightforward to deduce necessary and sufficient conditions for self reliance to be optimal.

Corollary 5 *A sufficient condition for self reliance to be optimal is that (i)* $\widehat{\alpha} < \alpha^*$ *and (ii)* $\Delta^B_{dc} = \overline{\Delta}$.

Condition (i) is sufficient for self reliance to dominate debt transfer. Condition (ii) implies that debt cancellation cannot dominate self reliance.

Corollary 6 *Necessary conditions for optimality of self reliance are: (i)* $\widehat{\Delta}_{DT} > 0$; *(ii) if* $\Delta^B_{i,dc} = 0$ *for all bad debtors* i, *then there exist some nonviable bad debtors.*

Condition (i) follows from Corollary 3. Condition (ii) follows from Corollary 2.

The results of this section bring together factors relating to information asymmetries and to bank and firm behavior to characterize the optimal policy. These results also point to another observation. The severity of the banking crisis will influence the optimal choice of policy. Specifically, if at the point at which regulators acknowledge the crisis and select a policy commercial banks are suspected to be insolvent, then self reliance cannot be optimal. The most extreme example of this case would be where $f(\alpha) = 0$ for $\alpha \in [0, \alpha^*)$. Note that the severity of the banking crisis may be a consequence either of the cause of the crisis (e.g., a macroeconomic shock) or of the point in the crisis at which regulators decide to intervene. In many countries prudential regulations and bank supervisory capacity are weak, so that regulators do not recognize a banking crisis until banks have become insolvent. At this point a policy of self reliance cannot be optimal.

5.5 Incentives of the bad debt bank manager.

It is now possible to identify how policy tradeoffs change when the regulator does not succeed in properly aligning the incentives of the bad debt bank manager; i.e., if the bad debt bank manager decides to roll over loans for some values of α. This manager might roll

over loans in order to prolong the existence of the bank or to give the impression that the bank is more profitable that it actually is. Define $\widetilde{\alpha}$ to be the lowest value of α for which the bad debt bank begins rolling over debt, and suppose (for simplicity of exposition) that this bank chooses rollover for all $\alpha \geq \widetilde{\alpha}$. Note that, as is the case with self reliance and rollover by the commercial bank, when the bad debt bank rolls over loans, managers of bad debtors will choose levels of asset dissipation equal to $\overline{\Delta}$, and firms will continue in operation in period 2. Expected firm values then become $x(\overline{\Delta} \mid B)$ rather than $V(\widehat{\Delta}_{DT} \mid B)$.

The definition of an effective bad debt bank must now be modified.

Definition 4′: A bad debt bank is *effective* if

$$\int_0^{\widetilde{\alpha}} \left\{\alpha[V(\widehat{\Delta}_{DT} \mid B) - x(\Delta_{dc}^B \mid B)] - c(\alpha)\right\} f(\alpha) + \int_{\widetilde{\alpha}}^1 \alpha \left\{x(\overline{\Delta} \mid B) - x(\Delta_{dc}^B \mid B)\right\} f(\alpha) d\alpha > 0, \tag{4}$$

where $f(\alpha)$ represents G's prior over α.

The first integral in Def. 4′ represents the range of α over which the bad debt bank works out its debt; the second integral is the range over which the bad debt bank rolls over debt. It is clear from Def. 4′ that the bad debt bank is now less likely to qualify as effective when it rolls over debt for some values of α.

Policy tradeoffs change as follows. Although the wording of Proposition 1 and its two corollaries remain unchanged, the definition of an effective bad debt bank is altered. Necessary and sufficient conditions for debt transfer to dominate self reliance must also be modified. Note that self reliance and rollover will now be weakly preferred to debt transfer for all $\alpha \in [\widetilde{\alpha}, 1]$, since both policies yield $x(\overline{\Delta} \mid B)$.

Corollary 3′: *A sufficient condition for debt transfer to dominate self reliance is that* $\widehat{\Delta}_{DT} = 0$ *and* $\widetilde{\alpha} > \alpha^*$.

It is no longer sufficient that the bad debt bank be as skilled at workout as the commercial bank in order for debt transfer to be preferred to self reliance. The bad debt bank must also have stronger incentives to workout debt than does the commercial bank manager. If the incentives of the bad debt bank for workout are weaker than those of the commercial bank (i.e., if $\widetilde{\alpha} < \alpha^*$), then self reliance will be preferred to debt transfer even if $\widehat{\Delta}_{DT} = 0$. Corollary 4 is also similarly modified by adding the condition on $\widetilde{\alpha}$.

Corollary 4′: *Necessary conditions for debt transfer to dominate self reliance are that*

(i) $\alpha^* \cdot [V(\widehat{\Delta}_{DT} \mid B) - x(\overline{\Delta} \mid B)] - c(\alpha^*) > 0$ *and (i)* $\widetilde{\alpha} > \alpha^*$.

As in Corollary 4, condition (i) of Corollary 4′ requires that workout by the bad debt bank be cost effective when α^* of the portfolio is in default. Condition (ii) states that the bad debt bank manager's incentives for workout must be stronger than the commercial bank's. These results demonstrate that potential answers to questions concerning the appropriate design of bad debt banks must be evaluated in terms of their implications for both the level of debt recovery by the bad debt bank and the incentives for bad debt bank managers to act in regulators' interests.

6 Banking issues and SBCs

Policy discussions relating to the appropriate handling of banking crises have accorded a considerable degree of importance to the question of bad-debt banks, referred to in the literature as asset management corporations (AMCs). A number of countries, among them the U.S., Japan, Sweden, Thailand, and the Czech Republic, have established AMCs in response to banking sector difficulties. The analysis above suggests that the creation of AMCs is not unambiguously optimal and that the design of these institutions and their links to the original banks should be given careful consideration. No theoretical research to date has focused on the appropriate design and operation of AMCs. This topic represents a clear area in which SBC models can be fruitfully extended. Important questions relating to AMCs include the following. Should AMCs be created during banking crises? If so, should there be one or many? What type of assets should be transferred to AMCs? What relationship should the AMC have with the original bank? These topics are a subject of ongoing research (See discussion in Corbett-Mitchell, 1999).

The question of bank closure versus recapitalization is another important topic in which there is considerable scope for analysis with SBC models. Indeed, one might conjecture that in the model of Section 4 the regulator could prevent distressed commercial banks' rollover of loans in default–and simultaneously obtain the benefit from having these banks conduct the workouts–by offering to recapitalize them (assuming that the bank managers who accept the recapitalization are not dismissed). With a sufficient infusion of funds insolvent banks would no longer be insolvent and their incentive to hide bad loans would

have been eliminated. As intimated above, however, whether such an offer of recapitalization will succeed will depend upon the impact on bankers' reputations of accepting the recapitalization. Moreover, as suggested by the model of Rajan (1994), the reputational impact for an individual banker of accepting recapitalization may in turn depend upon the total number of banks needing and accepting the recapitalization offer. Banks prefer to report bad debt when other banks are also reporting bad debt, since in this case the harmful reputational effect is minimized. Experience in the Japanese banking crisis appears consistent with this idea. In brief, the issue of troubled banks' willingness to accept a government's offer of recapitalization appears to present yet another important, though less well recognized, question that models allowing for SBCs could be used to address.

Aghion, Bolton, and Fries (1998) extend the model of Sections 4 and 5 to analyze the case where banks would accept an offer of recapitalization (ignoring the issue of bankers' reputational concerns). They address the following questions: when and whether to rescue a failing bank; and how to rescue banks at least cost. These authors first rederive the result presented above that insolvent banks that will be closed (or the manager dismissed) once their insolvency is discovered have an incentive to hide their defaulting loans. They then show that if these banks are recapitalized and bank managers not dismissed, a new tradeoff arises: the bankers now have an incentive to liquidate (workout in the above terminology) too many loans in order to receive a higher amount of recapitalization. So, whereas a "tough" recapitalization policy leads to SBCs, a "soft" recapitalization policy leads the bank manager "to take an overly tough approach to firm liquidations, while exaggerating her own recapitalization requirements."[30] Aghion *et al.* then design a recapitalization scheme which preserves bankers' incentives to reveal truthfully their default by liquidating the correct number of defaulters. The recapitalization policy is based on the observed number of liquidations by banks and exhibits a two-part pricing formula: the first tranche of liquidations are paid a lower price than the next tranche. This analysis illustrates the importance of questions relating to the appropriate amounts and form of recapitalization for troubled banks and the conditions attached to the recapitalization.

A factor in practice that appears to distinguish a banking crisis from a situation where one or a few banks suffer financial difficulty is the perception of systemic risk. Banking crises

[30] Berglof and Roland (1995) analyze a model whereby banks, whose liquidity positions are observed by the regulator, may create SBCs (refinance firms) in order to qualify for subsidies.

tend to be defined in terms of the fragility or insolvency of the entire banking system.[31] Curiously, few papers in the banking literature have taken account of systemic factors when analyzing banking sector difficulties. Mitchell (1998b) models the effect of systemic risk on a regulator's choice between bank closure and recapitalization. Like the model of Sections 4 and 5 above, this paper allows for SBCs. The systemic effect of banking crises is captured via a situation whereby regulators find it less costly to rescue and recapitalize banks than to close them if "too many" banks are troubled. The intuition behind this situation of "too many to fail" (TMTF) is that the costs of applying tough policies to banks (such as closure or merger with a more profitable bank) are increasing and convex in the number of banks that have to be closed or merged. There are a number of reasons that costs may exhibit these properties. For example, when a bank is closed, the cost of finance for its existing borrowers rises due to the loss of inside information on the borrower. If a large number of banks is closed, the resulting reduction in total finance to firms may lead to a slowdown of the economy. The total costs generated by the closure of many banks, then, become greater than the costs associated with recapitalization of these banks and allowing them to continue in operation.

The potential for a situation of TMTF to be triggered creates a coordination problem among banks, which in turn creates a new motivation for SBCs. Troubled but solvent banks may decide to roll over loans of defaulters, in the belief that other banks are pursuing the same strategy and that TMTF will be triggered. When TMTF is triggered, troubled banks are recapitalized.

A key result of the analysis is that when the regulator believes that banks will create SBCs in the hope of triggering TMTF, it is optimal to react to this threat by regulatory "softening." One form of softening involves lowering the *ex ante* monitoring capacity (e.g., weakening the definition of bank solvency) so that fewer banks will qualify as insolvent and so that the regulator will credibly be able to be tough with (close or merge) banks *ex post*. As a consequence, troubled banks that would have rolled over loans in the belief of triggering TMTF will no longer have an incentive to do so, and firms' budget constraints will harden. A form of regulatory softening consistent with this description occurred in the U.S. savings and loans crisis and in the Japanese banking crisis. Motivations for the

[31] See Corbett (1998) for a discussion of the various definitions of banking crises that have been employed in the empirical and policy literature.

softening appear to be similar to that suggested by the model.

One of the implications of the model of Mitchell (1998b) is that in economies where TMTF is a threat, it may be impossible to establish tough prudential regulations without risking a bailout of the entire banking system. This result reflects not only the importance of taking account of systemic risk in the analysis of banking crises but also the significance of the link between *ex ante* regulations and *ex post* policy responses to the crisis. Both of these issues represent open areas for future research.

As suggested in the introduction, SBC models following the approach of D-M can yield insights into the causes of banking crises and the importance of financial market institutions. Huang and Xu (1998a, 1998b) use a variant of the D-M model to model causes of banking crises. They show that initial financing of firms by a single investor (a bank) as opposed to multiple investors (several banks) can lead to SBCs (in a manner similar to D-M). That "bad" projects will be (efficiently) refinanced leads to the *ex ante* financing of bad projects. This implies that if a bank suffers a liquidity shock prior to the realization of the return on its project, outsiders will not know if the project is good or bad. As a consequence, repayment on any loan extended to the bank to ease its liquidity problem will be uncertain.

If, in addition, the bank knows more about the likelihood that its project is good or bad than do outsiders, this asymmetric information can lead to a 'lemons' problem in the market for interbank loans. Banks with high probabilities of having good projects will find it too costly to pay the cost of borrowing to cover their liquidity needs; therefore, these banks will not borrow and will be particularly vulnerable to bank runs. A similar problem arises if the government wishes to lend to the better-quality troubled banks. Only lower-quality troubled banks will accept recapitalization in the form of government bonds. This implies that the optimal policy is for the government to recapitalize all illiquid banks. If the government faces a budget constraint and cannot recapitalize all illiquid banks, it will recapitalize banks randomly.

The papers by Huang and Xu offer a formalization of systemic risk created by the contagion effect of financial difficulties among banks. Policy implications of the model emphasized by the authors include the following. Banking crises can be prevented or their effects minimized if firm financing is provided by multiple rather than single investors. In economies where SBCs occur, "without information on the solvency of banks, the govern-

ment has no other choice but to provide loans to all illiquid banks or to provide loans to a proportion of them randomly." In economies where HBCs occur, "with sufficient information on the solvency of banks, the government should consider the tradeoff between closing down illiquid banks and letting solvent banks take over illiquid banks."

We are now in a position to compare the policy implications of the two classes of models applied to the analysis of banking crises. As the papers of Huang and Xu illustrate, the class of models following D-M yield implications about the structure of firm finance that minimizes the effects of banking crises. SBC models arising from creditor passivity are largely silent on this issue. In contrast, creditor passivity models yield implications for policies for treating bad debt on distressed banks' balance sheets, an issue on which the former class of models is silent. Although creditor passivity models have not yielded specific predictions regarding the *ex ante* structure of firm finance, they can yield predictions concerning *ex ante* prudential regulations and their influence on the *ex post* handling of banking crises.

Both classes of models have been used to draw policy implications regarding the regulator's bank recapitalization decision. In the model of Huang-Xu (1998b) good banks refuse government offers of recapitalization in the form of loans because the lemons problem makes required repayment too high for these banks. Only low-quality banks will accept recapitalization in the form of loans. In the model of Aghion-Bolton-Fries good banks may request too much recapitalization. In this model recapitalization is in the form of a subsidy. In Mitchell (1998b) solvent but troubled banks may create SBCs in the expectation of receiving recapitalization, which is also in the form of a subsidy.

What explains the differing results regarding recapitalization in these models? First, it should be noted that all of these models assume asymmetric information between the bank and outsiders. In creditor passivity models creditors may hide default. Asymmetric information in Huang-Xu concerns the probability that a project will default. Huang-Xu have introduced asymmetric information as an extension of the D-M model. Although it is impossible to distinguish good from bad projects at the *ex ante* financing stage, each bank receives a private signal regarding the probability that the project is good after the project has been financed but before the return is realized. This private information leads to problems in the interbank loan market and with recapitalization via loans from the

government.

Although both classes of models involve asymmetric information, recapitalization in the two classes of models serves different purposes. In Huang-Xu recapitalization occurs in the form of a liquidity loan, where banks' liquidity problems appear before returns are realized on the projects that they have financed. That is, banks become illiquid before they become insolvent (where insolvency implies that the *realized* value of assets is less than the value of liabilities). In other words, banks become illiquid although some of them may ultimately remain solvent. If returns on projects were realized before banks suffered liquidity shocks, the lemons problem would disappear. Alternatively, if conditions attached to the recapitalization that is offered at the point of the liquidity shock could be made contingent on the realized outcome of the bank's project, the problem of higher quality banks refusing to accept offers of government bonds would also likely disappear.

In models with creditor passivity, the recapitalization is extended after returns on projects have been realized and default has already occurred. In this situation banks are liquid although they may be insolvent.[32] In contrast to the D-M class of models, the form and amount of recapitalization has an influence on the severity of the problem of SBCs. Recapitalization is used by the regulator in the creditor passivity models as a means of rescuing banks and returning insolvent banks to solvency. In this case, it is desirable that the insolvent banks accept the recapitalization. Furthermore, as Aghion *et al.* illustrate, appropriate specification of recapitalization may actually eliminate the existence of SBCs.

In summary, the Huang-Xu model sees recapitalization in terms of the role of the central bank as a lender of last resort; creditor passivity models analyze recapitalization as a component of bank rescue packages. Future research would be useful for further clarification of the implications of these two types of models for questions regarding the point at which governments may intervene when banking sector difficulties appear, the effects of differing forms of recapitalization, and the conditions that should accompany recapitalization.

[32]It is very common that banks become insolvent although they are still liquid. For example, most S&Ls in the U.S. were liquid up to the day that they were closed by regulators.

7 Conclusion

This paper proposes a new taxonomy for classifying models of SBCs. It shows that the classes of models identified through this taxonomy have different theoretical origins and policy implications. The distinctions between the two classes of models become particularly significant when considering applications of SBC models to the analysis of banking crises. The paper illustrates how SBC models may shed light on several questions relating to banking crises and how the two classes of SBC models illuminate different issues. One question on which both classes overlap is the recapitalization of troubled banks. Yet, the modeling of recapitalization, including its purpose and the point at which it is offered to banks, has differed in each class of models. Both types of recapitalization are actually important in practice. The ultimate complementarity or overlap of the two classes of models with respect to the question of bank recapitalization constitutes an interesting topic for further research.

The model of the paper illustrates one of numerous potential applications of SBC models to banking crises. It presents a new framework for analyzing policy tradeoffs for dealing with bad debt on the balance sheets of troubled banks. The analysis indicates how policies to clean banks' balance sheets have differing real effects on banks' and firms' asset values. Policy tradeoffs derive both from the direct effects of policies on banks' treatment of defaulters and indirect effects on firm managers' activities relating to dissipation of the firm's assets.

The analysis shows that the creation of a bad-debt bank (asset management corporation) may be optimal; however, it will not necessarily constitute the optimal policy. More precisely, policy tradeoffs relating to bad debt banks are sensitive to the ability of the bad debt bank to recover repayments on debt transferred to it and to the incentives of the bad debt bank manager to work out the bad debt. The conditions under which the bad debt bank is established, its likely life span, and the remuneration of its managers will all determine the incentives of these managers to be active or passive with respect to the bad debt and, consequently, the desirability of this policy relative to other policy choices.

Discussion of the model of this paper, together with comparison of existing applications of the two classes of SBC models to banking crises, suggests that there remain a number of open questions in the areas of banking regulation and banking crises for which understand-

ing could be improved through SBC models. The extent of applications of SBC models to this area has not yet been fully realized.

7.1 Appendix 1

Policies adopted to clean banks' balance sheets in three East European economies

CZECH REPUBLIC - **Debt transfer and self reliance**

-Three commercial banks created Jan. 1, 1990

-40% of loans to two largest banks were revolving inventory credits extended at negative interest rates

-2/3 of revolving inventory credits transferred in 1991 to Consolidation Bank

-Commercial banks recapitalized with government securities

HUNGARY - **Self reliance; switch to debt transfer**

-Five commercial banks created Jan. 1, 1987

-Bank provisioning and bankruptcy used until 1993

-Loan consolidation program begun in 1993

-Banks recapitalized in 1991, 1992, 1993, and 1994 (Total recapitalization estimated at $3.5 billion)

POLAND - **Self reliance**

-Nine commercial banks created in Feb., 1989

-Banks instructed to create bad loan divisions in 1992

-Law on financial restructuring in 1993 required banks to undertake U.S. Chap. 11-type restructuring agreements

G's balance sheets for differing policy choices

Assume that y_G is the expected period-1 income earned by a good debtor and that the expected period-1 income of a bad debtor is zero. Denote by R the value of government securities used to recapitalize banks when debt cancellation or debt transfer is chosen.

G's balance sheet with self reliance and workout:

Assets	
Expected income from good debtors:	$(1-\alpha)\cdot(y_G + V(\Delta^G \mid G))- (1-\alpha)\cdot(1+s)d$
Expected bank net worth	$(1-\alpha)\cdot(1+s)d + \alpha \cdot V(0 \mid B) - c(\alpha) - H$
Liabilities	
None	

G's balance sheet with self reliance and rollover:

Assets	
Expected income from good debtors:	$(1-\alpha)\cdot(y_G + V(\Delta^G \mid G) - (1-\alpha)\cdot(1+s)d$
Expected bank net worth	$(1-\alpha)\cdot(1+s)d + \alpha \cdot x(\overline{\Delta} \mid B) - H$
Liabilities	
None	

G's balance sheet with debt cancellation:

Assets	
Expected income from good debtors	$(1-\alpha)\cdot(y_G + V(\Delta^G \mid G))$
Expected income from bad debtors	$\alpha \cdot V(\Delta^B_{dc} \mid B)$
Expected bank net worth	$R - H$
Liabilities	
Securities	R

G's balance sheet with debt transfer:

Assets	
Expected income from good debtors	$(1-\alpha)\cdot(y_G + V(\Delta^G \mid G))- (1-\alpha)\cdot(1+s)d$
Expected commercial bank net worth	$R - H$
Expected bad debt bank net worth	$(1-\alpha)\cdot(1+s)d + \alpha \cdot V(\widehat{\Delta}_{DT}) - c(\alpha)$
Liabilities	
Securities	R

8 Appendix 2

Proof of Claim 1: Suppose that $\Delta_i^G = \overline{\Delta}$ and $[x_i(\overline{\Delta}) - d] \leqslant 0$. The manager's utility is given by $b(\overline{\Delta}) + P_i(\overline{\Delta})$, which equals $b(\overline{\Delta}) + 0$, or $b(\overline{\Delta})$. Assumption 7 implies that the manager's utility would be higher with a choice of $\Delta_i^G = 0$; therefore, a choice of $\Delta_i^G = \overline{\Delta}$ cannot be utility-maximizing.‖

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