International Lending and Political Economy Frictions

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Abstract

This paper analyzes the effect of political instability on net capital outflow, debt accumulation, and the welfare of a sovereign borrower. Political instability is proxied by the sovereign's impatience. The loan contract is constrained by two frictions characteristic to international lending: 1) moral hazard where the lender cannot observe whether the borrower efficiently uses the loan and 2) risk of repudiation. I show that a politically unstable country achieves higher utility, borrows more and experiences less capital outflow than a patient borrower. The difference in the borrower and the lender discount factors allows for an intertemporal trade in payoffs that benefits the borrower.

JEL Classification: E44, F34, G22, G30

Keywords: sovereign debt, moral hazard, political instability, risk of repudiation.

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1 Introduction

Emerging economies have experienced numerous economic crises characterized by debt defaults followed by capital flights and drop in consumption.[1] Consumption in developing countries is as volatile as output suggesting that borrowing through the international credit market may not provide full insurance.[2] Various explanations have been put forth to explain why developing countries are not able to smooth their consumption using international loans and suffer from capital outflows. In international lending, there is no third party a country can appeal to against another country in case of a default, thus a lender may impose harsher punishments to deter the borrower from defaulting. Moral hazard due to corruption and lack of transparency prevalent in developing countries may impede lenders from fully observing whether the loan is put to productive use and is invested efficiently or if it gets wasted.[3] These observations motivate studying sovereign debt and capital flows within a framework that accounts for moral hazard and risk of repudiation to capture difficulties faced by lenders.

An additional friction commonly experienced in developing countries is political instability. When politicians are not certain that they will still be in office in the future, there are more incentives to behave shortsightedly. Thus the more politically unstable the country is, the more impatient it will likely be.[4] Although political instability has been widely studied to assess its effect on growth and development, an investigation of its effect on debt and related matters such as debt accumulation and capital outflow, whether empirical or theoretical, is limited.[5] Thus, whether political instability in a framework with moral hazard and risk of repudiation can generate observed capital flights is still an open question.

I explore in this paper how a borrower's impatience affects his utility level, debt accumulation

[1]Observed crises are: Mexico in 1994; Hong Kong, Indonesia, Malaysia, and Thailand in 1997, Russia and Brazil in 1998, Chile, Colombia and Ecuador in 1999, Turkey and Argentina in 2001.

[2]Kose et al. (2003), for example, find consumption has been more volatile than output in emerging countries between 1960-1999. This contrasts with developed countries like the U.S. where consumption, although correlated with output, has been only half as volatile as output in the post war period as documented by Andolfatto (1996).

[3]Mauro (1995) find that corruption reduces investment and Tanzi and Davoodi (1997) show that corruption reduces quality of public investment, and Ciocchini et al. (2003) find that corrupt countries face high borrowing costs.

[4]Using similar reasons, Aguiar et al. (2009b) and Aguiar et al. (2009a) proxy political instability by an impatience of the government so that the government's discount factor is smaller than the market rate to study economic volatility issues.

[5]Empirical studies I include Lensink et al. (2000) and Le and Zak (2006) who find an evidence of a relationship between political risk and capital flight.

and net capital outflow when there are two impediments to a loan contract: risk of repudiation and moral hazard. There is an infinitely lived borrower and a lender who is born in each period and lives for two periods. They choose a loan contract that depends on history of actions of both players. If the borrower defaults, the lender can permanently exclude him from the credit market. The technical approach of this paper is based on Atkeson (1991) model where he studies international lending where the loan contract is constrained by risk of repudiation and moral hazard. Using net endowment as a state variable that summarizes history dependence of actions, Atkeson shows that a two player dynamic game between the lender and the borrower can be formulated as a recursive problem using the set-valued dynamic programming technique developed to solve repeated games by Abreu, Pearce, and Stacchetti (1986, 1990).

By extending Atkeson's model for an impatient borrower, I find that for low levels of net endowment, the borrower achieves higher utility value when he is more patient. However, for higher levels of net endowment, the result is reversed: the impatient is able to attain higher utility payoff. The impatient borrower also borrows more. The result is due the difference in the borrower and lender discount factors which allows for an intertemporal trade in payoffs that benefit the borrower. Since the impatient borrower values today's utility more and discounts tomorrow's utility more heavily, he borrows more to increase his consumption today which enables him to achieve higher utility compared to a patient borrower. Moreover, for high levels of net endowment, since the impatient borrower borrows more, he does not experience as much capital outflow as the patient one.[6]

Since emerging economies that had defaulted on their external debt have been able to borrow again, I also consider a temporary exclusion from the credit market when the borrower deviates from the loan contract. This contrasts with Atkeson (1991) where he assumes the exclusion is permanent. When the exclusion from the credit market is temporary, the borrower whether impatient or patient attains slightly higher utility and experiences less capital outflow but this difference in utility and capital flow between temporary and permanent exclusions is small.

There is an extensive literature on international lending but few papers have considered the effect of political instability. Cuadra and Sapriza (2008) analyze the effect of political instability, modeled as parties alternating in power, on defaults and interest rates and Amador (2003) on repayments. However both of these papers assume full information and neither analyze the effects of political instability on capital flows. Alesina and Tabellini (1989) use a two period model to analyze the

[6] Capital flow is normalized by output.

effect of political uncertainty (where two governments alternate in power) on debt accumulation and private gross capital flight but assume full information and that the government pays back the debt (i.e. there is no risk of repudiation). This paper is similar to Tsyrennikov (2007) who adopts Atkeson's model to analyze the relative importance of moral hazard vs. risk of repudiation to loan contracting in generating the capital outflows. Although Tsyrennikov (2007) assumes throughout his simulations that the borrower and the lender have different discount factors, he considers only one parameter value and does not give a comparison between patient and impatient borrowers.

In what follows, Section 2 provides the environment and Section 3 describes the model. Section 4 provides quantitative results and Section 5 relaxes the default punishment term.

2 The Environment

The environment is an extension of Atkeson (1991). There is an infinitely lived borrower with endowment $Y_0 - d_0$ of consumption good at time $t = 0$. A risk neutral lender is born in each period with endowment of M and lives for two periods. In each period the borrower consumes c_t, invests I_t that determines the distribution of stochastic output Y_{t+1} for the next period, borrows b_t and chooses repayment amount for the next period d_{t+1}. Thus in each period the borrower allocates the output Y_t between consumption, investment, repayment, and chooses a loan amount all of which may depend on past realizations of output, loans, and repayments. Borrower's endowment in each period is $Q_t = Y_t - d_t$ and is used to summarize the history dependence of allocations. Thus allocation $\sigma = \{c_t(Q^t), I_t(Q^t), b_t(Q^t), d_{t+1}(Y_{t+1}; Q^t)\}_{t=0}^{\infty}$ is a mapping from histories of borrower endowments $Q^t = (Q_0, Q_1, ..., Q_t)$ to consumption, investment, loan, and repayment schedules.

Definition: An allocation is *feasible* if for all $t \geq 0,\ Q^t,\ Y_t \in \mathbf{Y}$

$$c_t(Q^t) - b_t(Q^t) + I_t(Q^t) \leq Y_t - d_t(Y_t) \tag{1}$$

where $c_t(Q^t), I_t(Q^t) \geq 0, \qquad b_t, d_{t+1} \leq M$

Assumption: Support of output realizations is the finite set $\mathbf{Y}$. Distribution of output in any period depends only on the previous period's investment choice. Probability of output Y' tomorrow given today's I is $g(Y'; I)$ such that $g(Y'; I) > 0 \quad \forall\ Y' \in \mathbf{Y}$

Borrower's preferences over allocations are given by:

$$U^B(\sigma) = (1 - \delta_B) E_0^{\sigma} \sum_{t=0}^{\infty} \delta_B^t u(c_t(Q^t))$$

where u(c) is the utility such that $u' > 0$, $u'(0) = +\inf$, and $u'' < 0$. Lender's preferences are:

$$U^{L_t}(\sigma \mid Q^t) = -b_t(Q^t) + \delta_L \sum_{Y_{t+1} \in Y} d_{t+1}(Y_{t+1}; Q^t) g(Y_{t+1}; I_t(Q^t))$$

where δ_B and δ_L are borrower and lender discount factors respectively.[7]

In order for a contract allocation to be supported in equilibrium, the contract has to be offer both players at least as good of a payoff as not contracting at all. If the borrower decides to not follow through with the contract and default, the lender has a right to seize any future deposits the borrower makes with another lender and thereby force the borrower into autarky. Thus a loan contract has to offer the borrower at least his autarky utility. Lender's reservation utility is simply zero since staying out of a contract neither costs him nor earns him payoff. This incentive consideration constrains both players choices' and is defined as the following:

Definition: An allocation is *individually rational* if for all $t \geq 0, Q^t$

$$U^B(\sigma \mid Q^t) \geq U^B_{aut}(Q_t) \text{ and } U^{L_t}(\sigma \mid Q^t) \geq 0 \tag{2}$$

where U^B_{aut} is the borrower's reservation utility obtained in autarky from refusing all future loan contracts and consuming and investing on his own forever. U^B_{aut} is a solution to the programming problem:

$$U^B_{aut}(Z) = \max_I (1 - \delta_B) u(Z - I) + \delta_B \sum_Y U^B_{aut}(Y') g(Y'; I)$$

Thus in each period the borrower chooses consumption, loan amount, investment, and repayment so that the lender is incentivized to provide him with a loan while the lender chooses to accept the contract or force the borrower into autarky.

3 The Pareto Problem

The next two definitions give constraints on the set of allocations imposed by moral hazard and risk of repudiation.

Definition: An allocation σ is *immune from threat of repudiation* if for all $t \geq 0, Q^t, Y_t \in Y$, the continuation allocation $\sigma \mid Q^t; Y_{t+1}$, after the realization of output Y_{t+1}, satifies:

$$U^B(\sigma \mid Q^t; Y_{t+1}) \geq U^B_{aut}(Y_{t+1}) \tag{3}$$

[7] When $\delta_B = \delta_L$, we have Atkeson model.

Definition: An allocation σ is *incentive compatible* if for all feasible allocations $\sigma' = (\sigma^{c'}, \sigma^{I'}, \sigma^b, \sigma^d)$ (with the components σ^b and σ^d unchanged):

$$U^B(\sigma) \geq U^B(\sigma') \tag{4}$$

An allocation σ is defined as *constrained Pareto optimal* if it maximizes the borrower's payoff $U^B(\sigma)$ subject to the constraints of (1) feasibility, (2) individual rationality, (3) immunity from the threat repudiation, and (4) incentive compatibility.

Let V be the borrower utility correspondence with domain $\mathbf{Q}$ such that for each $Q \in \mathbf{Q}$, V(Q) is set of borrower payoffs from allocations that satisfy constraints of the constrained Pareto optimal allocation:

$$V(Q) = \{U^B(\sigma) \mid \text{satisfies } (1) - (4) \text{ and } Q_0 = Q\}$$

3.1 Solving Equilibrium Value Correspondence

Atkeson shows that the problem of finding the payoff sets of equilibrium strategies can be defined recursively using the notions of admissibility, self-generation, and factorization developed by Abreu, Pearce, and Stacchetti (1986, 1990). Any payoff $v \in V(Q)$ can be decomposed between utility from the first period consumption and expected utility from continuing the contract which is a discounted sum of the second period utility and onward. Utility from continuing the contract is itself value of an equilibrium allocation since continuation of a contract that satisfies constraints (1)-(4) has to also satisfy them. Value from continuing the contract can be denoted by a continuation value function that takes all possible realizations of Q_1. A pair of current action and continuation value from borrower's value correspondence is called admissible if they satisfy one period version of constraints (1)-(4). More specifically, let $A = (c, I, b, d')$ be the choice of current actions and $U : \mathbf{Q} \to \mathbf{R}$ be the continuation value function such that $U(Q') \in W(Q')$ for all Q', then:

Definition: The pair (A, U) of current actions and continuation value function, is *admissible with respect to W at Q* if it satisfies the following four conditions:

$$c + I - b \leq Q, \qquad b, -d'(Y') \leq M, \qquad c, I \geq 0 \tag{1'}$$

$$(1 - \delta_B)u(c) + \delta_B \sum_{Y' \in Y} U(Q')g(Y'; I) \geq U^B_{aut}(Q) \tag{2i'}$$

$$b \leq \delta_L \sum_{Y' \in Y} d'(Y')g(Y'; I) \tag{2ii'}$$

for all $Y' \in \mathbf{Y}$,

$$U(Y' - d'(Y')) \geq U^B_{aut}(Y') \tag{3'}$$

$$I \in arg \max_I (1-\delta_B)u(Q+b-I) + \delta_B \sum_{Y' \in Y} U(Y' - d'(Y'))g(Y'; I) \tag{4'}$$

Then the value of (A, U) is given by:

$$E(A,U)(Q) = (1-\delta_B)u(c) + \delta_B \sum_{Y' \in Y} U(Y' - d'(Y'))g(Y'; I)$$

And let operator $B(W)(Q)$ be defined as:

$$B(W)(Q) = \{E(A,U)(Q) \text{ s.t. } (A,U) \text{ admissible with respect to W at Q}\}$$

The notion of admissibility together with operator B, which is monotone and preserves compactness, allows formulation of the sequence problem as a recursive problem. A correspondence W is self-generating if $W(Q) \subset B(W)(Q)$. Following Abreu, Pearce, and Stacchetti (1986, 1990), Atkeson shows that a graph of self-generating set is a subset of the equilibrium correspondence which itself is a self-generating set. Thus operator B is analogous to the Bellman operator in dynamic programming defined over arbitrary non-empty valued and uniformly bounded payoff set and $V(Q)$ can be found as B's largest bounded fixed point.

3.2 The Optimal Contract as a Functional Equation

Following Atkeson (1991), it is straightforward to show that the value of optimal contract, $\bar{V}(Q) = \sup_{\nu \in V(Q)} \nu$, can be solved as a solution to the following functional equation:

$$\bar{V}(Q) = \max_A (1-\delta_B)u(c) + \delta_B \sum_{Y' \in \mathbf{Y}} \bar{V}(Y' - d'(Y'))g(Y'; I) \tag{Program P}$$

subject to:

$$c + I - b \leq Q, \qquad b, -d'(Y') \leq M, \qquad c, I \geq 0 \tag{1'}$$

$$b \leq \delta_L \sum_{Y' \in Y} d'(Y')g(Y'; I) \tag{2'}$$

$$\bar{V}(Y' - d'(Y')) \geq U^B_{aut}(Y') \quad \forall Y' \tag{3'}$$

$$I \in arg \max_{I \in [0, Q+b]} (1-\delta_B)u(Q+b-I) + \delta_B \sum_{Y' \in Y} \bar{V}(Y' - d'(Y'))g(Y'; I) \tag{4'}$$

Unlike in a standard dynamic programming problem, in program P the value function itself appears in the constraints and hence it is not a simple contraction mapping like the Bellman operator. Program P is instead based on the framework of Abreu, Pearce, and Stacchetti (1986, 1990).

4 Quantitative Analysis

4.1 Calibration and Functional Forms

For the quantitative analysis, I adopt the following functional forms and parameter values.[8] The utility function is: $u(c) = \frac{c^{(1-\gamma)}-1}{1-\gamma}$ with risk aversion parameter $\gamma = 0.5$. Output has a finite support with three possible realizations: $\mathbf{Y} = \{9.35, 10, 10.7\}$. By assumption (5) in Atkeson (1991), the distribution of output $g(Y'; I)$ is a convex combination of two underlying distributions $g_0(Y')$ and $g_1(Y')$:

$$g(Y'; I) = \lambda(I) g_0(Y') + (1 - \lambda(I)) g_1(Y') \tag{1}$$

with $g_0(Y_i')/g_1(Y_i')$ monotone in i, $0 \leq \lambda(I) \leq 1, \lambda'(I) > 0$, and $\lambda''(I) < 0$ for all I, where g_0, g_1, and $\lambda(I)$ are set to:

$$g_0 = \begin{bmatrix} 0.05 \\ 0.35 \\ 0.60 \end{bmatrix}, \qquad g_1 = \begin{bmatrix} 0.60 \\ 0.35 \\ 0.05 \end{bmatrix}, \qquad \lambda(I) = min((I/\bar{I})^{\eta}, 1) \tag{2}$$

Investment technology parameters are $\bar{I} = 0.755$ and $\eta = 0.55$ and lender's endowment is M=4.45. To compare between patient and impatient borrowers, lender's discount factor is fixed at $\delta_L = 0.95$ while borrower's discount factor takes values from the set 0.95, 0.9, and 0.8.

For the value of the optimal contract, first, a grid search is employed over discretized actions and states as an initial approximation. State space is discretized on a grid with a range [1, 16] uniformly spaced with 16 values. Since I use the same state space to compute the reservation utility values at the three output realizations, I also include the three realizations of output in the state space. There are 5 action variables: investment, loan, and three repayment variables for each of the three output realizations. For the action grid, I first start with a coarse grid with wide ranges and narrow it down to an interval where the optimal actions fall. Thus, the grid range for the loan variable is [-6, 0] uniformly space with 61 values, for debt repayment is [-M, 0] uniformly spaced with 21 values, and for investment is [0, 0.4] with 4 uniformly spaced values. Thus there are 2,259,684 (=61*21*21*21*4) possible combination of actions. Optimization results with grid search is then used as initial values for a final computation of value functions and policy functions

[8] To make my result comparable to Tsyrennikov's I adopt similar parameter values and functional assumptions. Tsyrennikov chooses parameters to replicate 1993-2005 empirical statistics in Argentina which defaulted on its debt in 2001.

using continuous actions.[9]

Since the preferences of the lender (i.e. $U^L \geq 0$) enter the model as a constraint for the borrower's maximization problem, I focus on the borrower's payoff from the optimal contract. Thus for each initial value of state variable Q, the value correspondence set of equilibrium allocations is an interval instead of a two dimensional set. To compute this interval of equilibrium payoffs at each iteration, I use a grid search to find the minimum and maximum of $B(W)(Q)$ among discretized actions and continuation values that meet the constraints. Grids are slightly coarser than grids described in the previous paragraph for the optimal contract since iterating on sets takes computationally longer.

4.2 Numerical Results

Figure 1 shows the equilibrium value correspondence for a sample of output net of repayment levels, Q, when the borrower and the lender have the same discount factors and when the borrower is more impatient than the lender. For each Q, the two sets are bounded below by their respective reservation utility values. In both cases, as Q increases, utility from being in autarky increases and the equilibrium value set shifts up.

At lower values of Q, the borrower achieves higher utility when he is more patient. However, for higher levels of Q, the result is reversed: the more impatient the borrower, the higher the payoff. This is due to the difference in discount factors where the borrower benefits from trading payoffs across time. Since the impatient borrower values consumption today more and discounts tomorrow's utility more heavily, he borrows more for today's consumption which enables him to achieve higher utility compared to a patient borrower. Lehrer and Pauzner (1999) show this intertemporal tradeoff is indeed what happens when players have differing discount factors. In repeated games with two players with different patience levels, they find that the feasible and individually rational set is bigger than the feasible set of the stage game and, unlike in repeated games with players with same discount factors, the equilibrium set can contain points outside the feasible set of the stage game.

The value of the optimal contract from Program P correspond to maximum (top) values of the equilibrium sets in figure 1 for the respective borrower discount factors and the same movement in utility occurs as the borrower becomes more impatient. Figure 2 shows the value of the optimal contract computed as a solution to a functional equation (program P) instead of a fixed point of the

[9] See the appendix for more detail on optimization method with continuous actions.

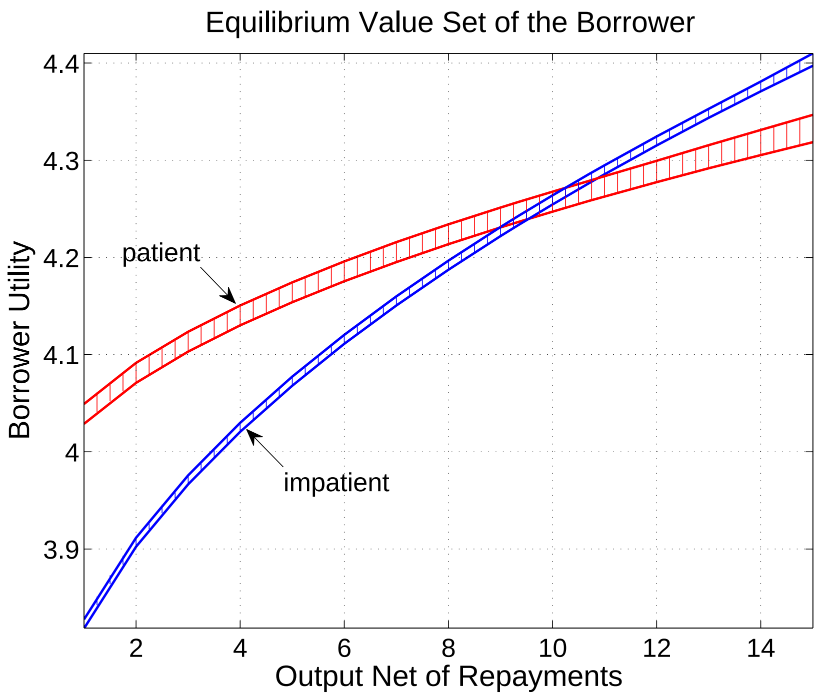

Figure 1: red: $\delta_L = \delta_B = 0.95$ and blue: $0.95 = \delta_L > \delta_B = 0.9$

B operator as in figure 1. Lender's discount factor is fixed at $\delta_L = 0.95$ while borrower's changes from $\delta_B = 0.95$ (in red) to $\delta_B = 0.9$ (in blue) to $\delta_B = 0.8$ (in green).

Tsyrennikov (2007) shows that a positive amount of borrowing is not supported in the Atkeson framework, i.e. the borrower either saves or avoids accumulating debt. Figure 3 shows the optimal loan contract $(b(Q), d'(Q))$ when the lender and the borrower have same patience level (solid lines) and when the borrower is impatient (in dashed lines). In both cases, at lower net endowment levels (around $Q \leq 10$ when patient and $Q \leq 11$ when impatient) the borrower does not borrow or save ($b(Q) \approx 0$), and at higher Q levels the borrower saves ($b(Q) < 0$) and withdraws in the next period ($d'(Q) < 0$). The borrower (whether patient or impatient) withdraws more at low output realizations and less at high output realizations ($abs(d(Y_1)) \geq abs(d(Y_2)) \geq abs(d(Y_3))$). The patient borrower, who values tomorrow's utility more, saves more at each Q which allows him to withdraw more in the next period. Since the impatient borrower discounts tomorrow's utility more heavily, he values consumption today more and is willing to have less to withdraw from in the next period. Hence, the impatient borrower does not save as much and has less net endowment in the following period but is able to consume more today and achieve higher utility compared to a patient borrower.

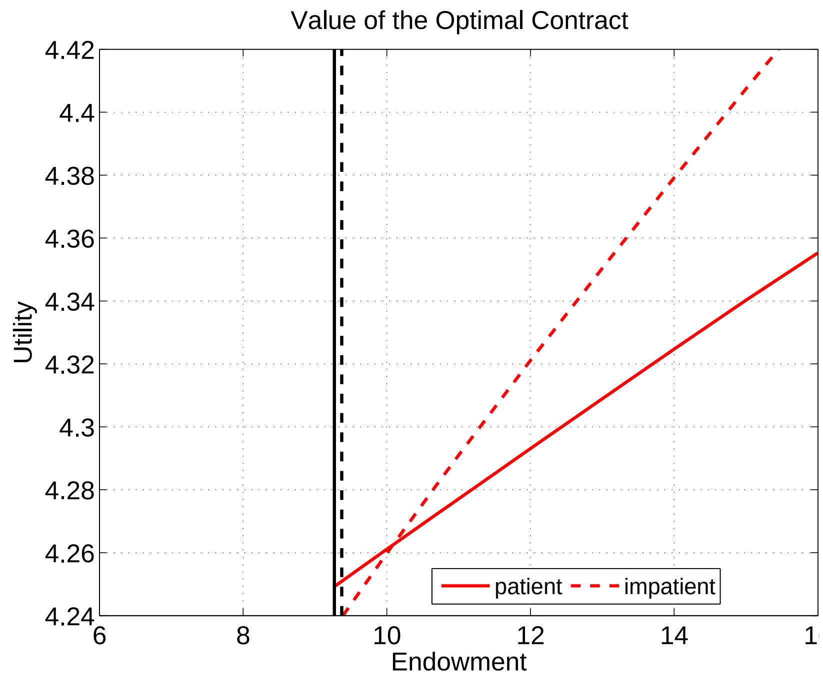

Figure 2: Three Different Borrower Discount Factors: $\delta_B = 0.95, 0.9, 0.8$

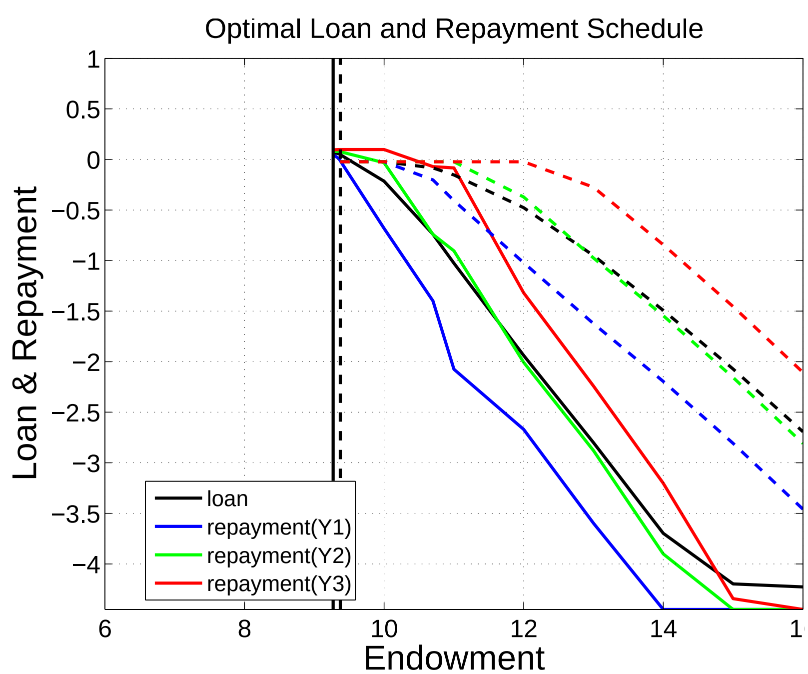

Figure 3: in solid: $0.95 = \delta_L = \delta_B = 0.95$, in dashed: $0.95 = \delta_L > \delta_B = 0.9$

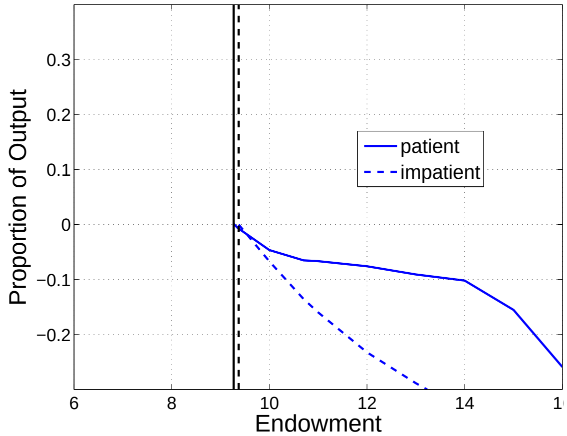

Figure 4: Solid lines: $\delta_L = \delta_B = 0.95$, dashed lines: $0.95 = \delta_L > \delta_B = 0.9$

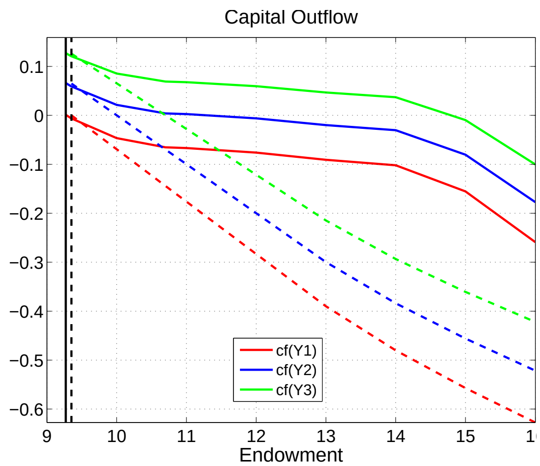

Figure 5: Solid lines: $\delta_L = \delta_B = 0.95$, dashed lines: $0.95 = \delta_L > \delta_B = 0.8$

For the purpose of computing capital outflow, for a given Q', debt repayment is computed as $d(Q) = Q' - Y'$ and capital flow is the difference between $d(Q)$ and $b(Q')$ where the latter comes from the policy function. Figure 4 compares capital outflow to output ratios in a case where the lender and the borrower have the same discount factors ($0.95 = \delta_L = \delta_B = 0.95$, solid lines) with a case where the borrower is more impatient than the lender ($0.95 = \delta_L > \delta_B = 0.9$, dashed lines). The patient and impatient borrowers experience similar levels of capital flow for low Q (about $Q \leq 9.5$) but for higher Q (around $Q > 9.5$): capital outflow is less for the impatient borrower if $d(Q) - b(Q') \geq 0$, or if $d(Q) - b(Q') < 0$, the impatient borrower has more capital inflow.

When the enforcement constraint (3') binds, $V(Q^*) = U^B_{aut}(Y_1)$ at some Q^*, Atkeson shows that the new loan, $b(Q' = Q^*)$, the borrower gets after realization of $Q' = Y' - d(Q)$ cannot be greater than what the borrower paid back in the previous period $d(Q)$. In other words capital outflow, $d(Q) - b(Q')$, is nonnegative or, equivalently, there will never be a capital inflow. Vertical lines in figure 4 mark the lowest observed net endowment, Q^*, where this enforcement constraint binds. In line with Atkeson's result that the borrower experiences nonnegative capital outflow in the lowest realization of output, capital outflow is 0% for both patient and impatient borrowers. This result is consistent with Tsyrennikov who shows that capital outflow has to be exactly zero at Q where the constraint binds. Figure 5 further demonstrates the difference between patient and impatient borrower where the borrower is even more impatient ($0.95 = \delta_L > \delta_B = 0.8$). Same results hold here as in figure 4.

5 Impatient Lender

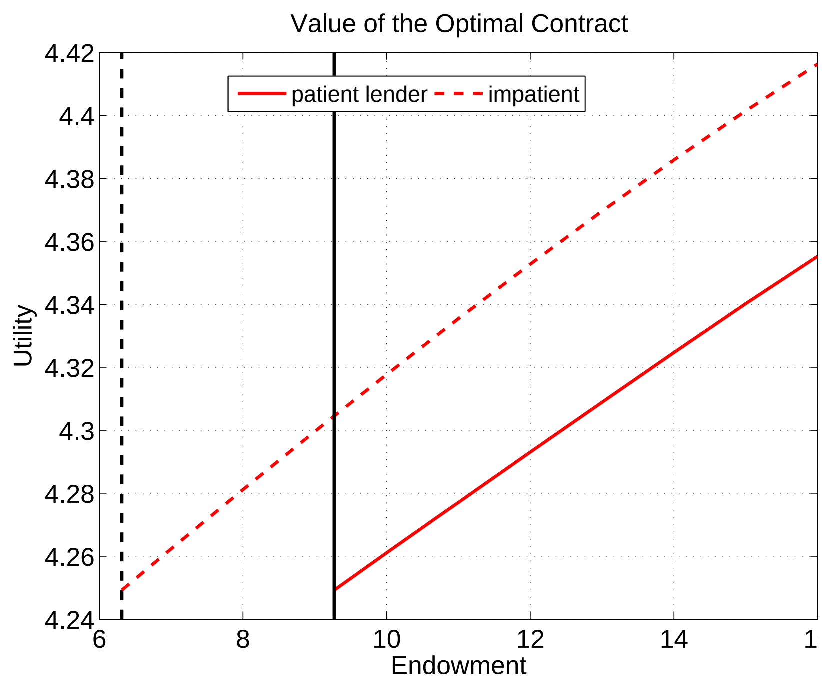

Figure 6: Solid: benchmark, dashed: impatient lender

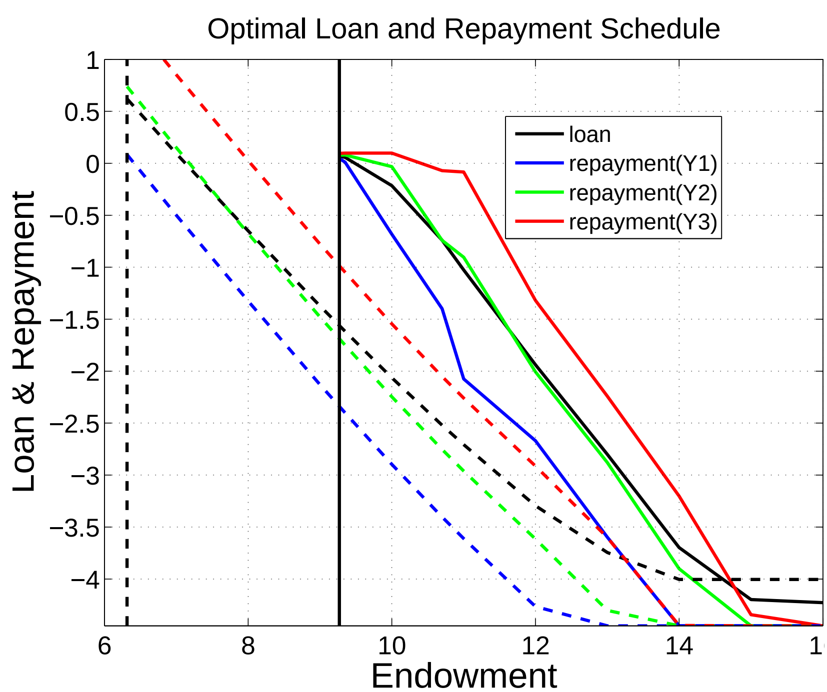

Figure 7: Solid: benchmark, dashed: impatient lender

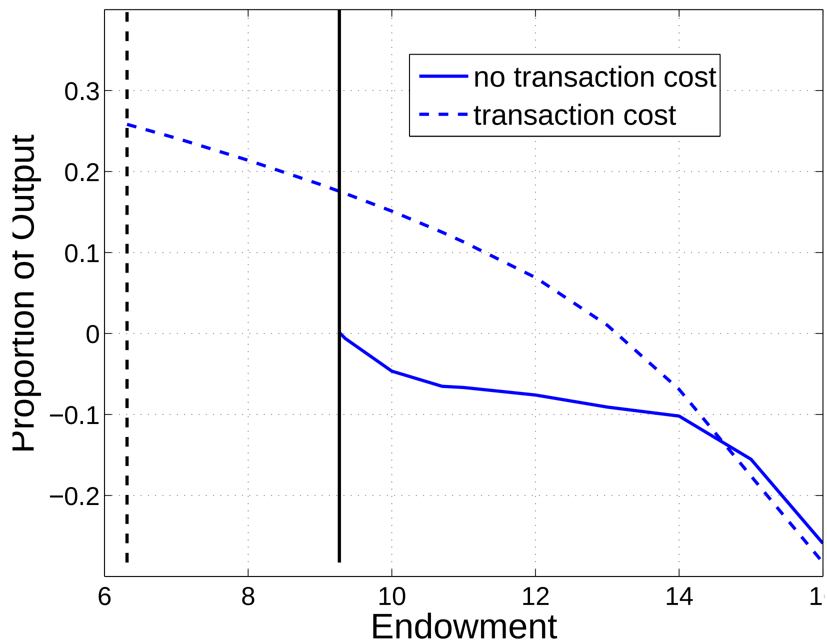

Figure 8: Solid: benchmark, dashed: impatient lender

6 Temporary Exclusion from the Credit Market

Emerging economies that had defaulted on their external debt have been able to borrow again. To investigate the effects of exclusion from the credit market on the nature of the loan contract, I also consider a temporary exclusion from the credit market instead of permanent one when the borrower deviates from the loan contract. This contrasts with Atkeson (1991) where the exclusion is permanent. When autarky is temporary, the reservation utility is modified as:

$$U^B_{aut}(Z) = \max_I (1-\delta_B)u(Z-I) + \delta_B \sum_{Y'\in\mathbf{Y}} [\theta\bar{V}(Y') + (1-\theta)U^B_{aut}(Y')]g(Y';I)$$

where θ is the probability that the borrower will re-enter the credit market and is set to $\theta = 0.282$ for the numerical simulation as in Arellano (2007). The code is modified accordingly so that at each iteration of the value function the reservation utility is computed as well.

The difference in utility achieved with temporary autarky versus permanent is very small. Though negligible, the autarky value shifts up (by 0.0012 everywhere which is equivalent to 0.04% increase in consumption) when the punishment of being in autarky is temporary, hence value of the optimal contract in temporary exclusion is slightly above (by 0.003% more in consumption) the permanent. This is true whether the borrower and the lender have same patience (figure 9) or if the borrower is more impatient (figure 10). Correspondingly, capital outflow is slightly less when it is a temporary reversion to autarky whether the borrower is patient or impatient. Thus, the borrower benefits from having an access to the credit market again but the benefit is small.

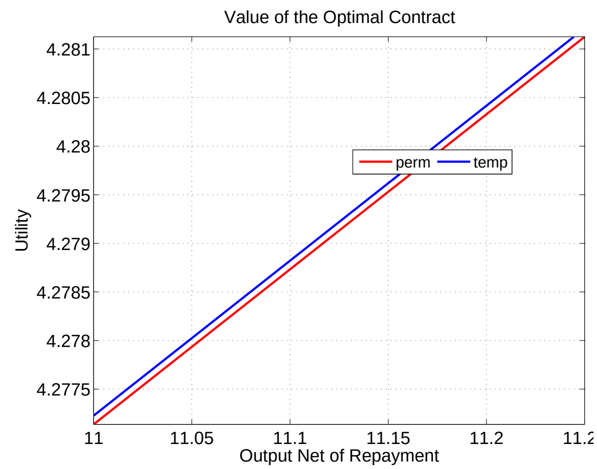

Figure 9: $0.95 = \delta_L = \delta_B = 0.95$

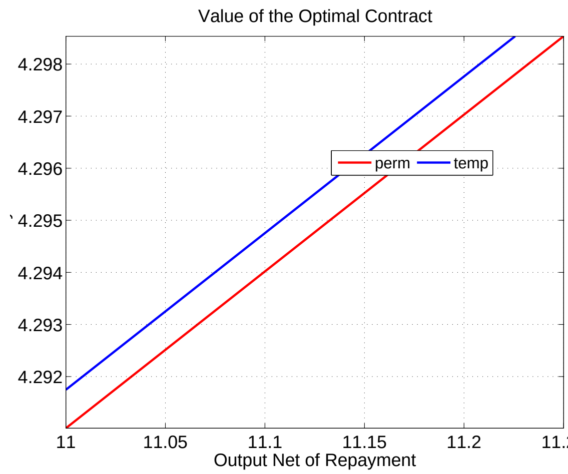

Figure 10: $0.95 = \delta_L > \delta_B = 0.9$

7 Conclusion

This paper analyzes the effect of political instability, proxied by impatience of a borrower country, on debt accumulation, capital outflow and utility level the borrower can achieve from a loan contract with a lender. The loan contract is constrained by two impediments characteristic to international lending: 1) moral hazard where the lender cannot observe whether the borrower uses the loan efficiently and 2) risk of repudiation from an absence of a third party to enforce sovereign debt obligations. I find that for high levels of net endowment an impatient borrower achieves higher utility, borrows more, and does not experience as much capital outflow as a patient borrower. This arises from the difference in borrower and lender discount factors where the borrower can benefit from trading payoffs across time. Since there is a link between political instability and the severity of moral hazard (e.g. corruption, lack of transparency) and how risky the country is to repudiation, the results suggest that, perhaps, the two constraints already capture the capital outflows. Further avenues of research could be: studying the effect of an impatient lender or modeling the probability of re-entering the credit market endogenous in the model, possibly, dependent on the discount factor.

8 Appendix

8.1 Optimization with Continuous Actions

This section describes the Sequential Quadratic Programming (SQP), the optimization routine used to solve the optimal contract and value functions with continuous actions. Given a constrained optimization problem,

$$\min_x f(x), \quad \text{subject to:}$$

$$g_i(x) = 0 \quad i = 1, ..., m_e$$

$$g_I(x) \leq 0 \quad i = m_e + 1, ..., m$$

and its Lagrangian

$$L(x, \lambda) = f(x) + \sum_{i=1}^{m} \lambda_i \cdot g_i(x)$$

at each iteration of SQP, the following quadratic problem (QP) is solved for a search direction $d \in R^n$:

$$\min_{d \in R^n} \frac{1}{2} d^T H_k d + \nabla f(x_k)^T d \quad \text{s.t.}$$

$$\nabla g_i(x_k)^T + g_i(x_k) = 0, \quad i = 1, ..., m_e$$

$$\nabla g_i(x_k)^T + g_i(x_k) \leq 0, \quad i = m_e + 1, ..., m$$

The solution d is then used to form the next iterate: $x_{k+1} = x_k + \alpha_k d_k$ where α_k is the step length. Thus the QP is a combination of a quadratic approximation of the Lagrangian and a linear approximation of the constraints. H_k is a positive definite approximation of the Hessian matrix of the Lagrangian function.

SQP is a popular method for continuous constraint optimization problems and most computational softwares have a routine that is based on it. I used Matlab's implementation of SQP under the *fmincon Active Set* routine where the Hessian is updated with the BFGS method.[10]

[10] See Matlab documentation on Constrained Nonlinear Optimization for more detail.

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