Can HIPCs Use Hyper-incentives?[1]

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Abstract

Hyper-incentive contracts (Menzies 2004) can be used to pursue humanitarian goals (providing a safety net) while allowing creditors to offer innovative repayment-friendly contracts to debtors (eliminating a debt overhang). Both the contract of Krugman (1988) and the hyper-incentive contract are illustrated with some calculations based on current Highly Indebted Poor Countries (HIPCs). The outcomes for the two contracts are similar, but the twelve countries examined could each benefit by an average amount of US_{2002} 100 million under a hyper-incentive contract.

Key words: Debt overhang; Debt forgiveness; Hyper-incentive contract

JEL classification: F34

1 Introduction

The turbulent events of the 1970s, followed by the high-interest-rate regime of the Volker deflation, ushered in the modern third world debt crisis. For the poorest countries, most of the debt was sovereign, and owed to OECD governments and international agencies. Rescheduling occurred at the Paris Club of creditors. If the club believed, usually on the

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say-so of the IMF, that the country was making a significant adjustment effort, the debts would be rescheduled.

Initially, any rescheduling maintained the net present value of the debt, but by 1996 this was abandoned as unrealistic. The IMF and the World Bank unveiled the HIPC initiative, whereby very poor countries could apply for the writing down of sovereign debt, usually in concert with other creditors. In 1999 HIPC debt-relief was tied to success in poverty reduction, and renamed Enhanced HIPC. The overall level of assistance under Enhanced HIPC was also increased. Finally, in 2005, the debt relief effort was tied to the Millennium Development Goals via the Multilateral Debt Relief Initiative (IMF, 2007a and 2007b)

Alongside rapid developments in the world of policymaking, a literature on debt forgiveness was emerging. The key question was how countries and their creditors could or should deal with debt defaults. The answer partly depended upon the assumed motives of the creditors. One strand of the literature assumed creditors forgive in order to maximize repayments, while the other strand assumed creditors acted graciously.

As an example of the first strand, Debt Overhang models (Krugman 1988, and others[3]) proposed a setup where the excess of output over an endogenous debt repayment was kept by the debtor.[4] Partial forgiveness gets the economy going, and helps the creditors

[3] For example, Fernandez-Ruiz (1996) uses essentially the same setup as Krugman.
[4] These models implicitly assume that debtors wanted to pay their creditors, even if the debt was sovereign. This ‘gunboat technology’ sidesteps a major puzzle surrounding sovereign debt– namely, why is it repaid at all? The literature offers the threat of trade sanctions and financial autarky as potential explanations (see

recover debt. Without it, the creditors hold the original claim over a stagnant economy, but receive little by way of actual repayments. Krugman (1988) is explained in detail later.

More recently the winds of change have blown across the international community, and this is reflected in the second strand of the literature. It is not uncommon now to find writers assuming creditor graciousness. For example, Addison and Murshed (2003) write about situations where debt forgiveness could be offered to stop civil wars, and, Cordella and Dell'Ariccia (2002) consider a world where all aid (including debt relief) has the sole aim of promoting effective social programs.

Naturally, the *single* instrument of debt forgiveness cannot achieve *two* goals, namely maximal creditor returns and a target level of welfare for the indebted country. A recent proposal (Menzies 2004) involves a contract where a debtor who clears a (partly forgiven) debt *receives* an additional payment from the creditor, called a *hyper-incentive*. The hyper-incentive contract ties these two strands together, in the spirit of the following quote from Jonathan Eaton:

Eaton 1993). Also, it has been suggested that debtor governments have multiple relationships, and that appearing untrustworthy in one relationship (by defaulting) will create difficulties in other relationships (Cole and Kehoe 1998).

‘The response to the debt crisis in poor countries should be framed in terms of overall foreign aid objectives and policies. The argument for relief is *primarily* humanitarian...’

(Eaton 1990, page 45, my italics).

The hyper-incentive contract accepts this statement, while noting that *primarily* is not the same as *solely*. Creditors guarantee debtors a minimum level of anticipated well-being, along with a combination of forgiveness and cash bonuses (hyper-incentives) to maximize the creditor payoffs. The aim is to pursue humanitarian goals to an appropriate degree, while allowing creditors to offer innovative repayment-friendly contracts to debtors.[5] The level of debtor well-being offered by the creditor measures their ‘graciousness’.

This paper is organized as follows. Section 2 outlines the intuition of the hyper-incentive contract. Section 3 extends the Krugman contract and the hyper-incentive contract within a model to enable a calibration exercise in Section 4. Section 5 concludes.

2 The Intuition of the Hyper-incentive Contract

The Krugman and hyper-incentive contracts are implicitly a solution to a moral hazard problem, where the principal (the creditor) seeks to get the agent (the debtor) to act on their behalf. Therefore, both contracts make most sense when the economic reform efforts of the debtor are unobservable[6], and effort and random influences combine

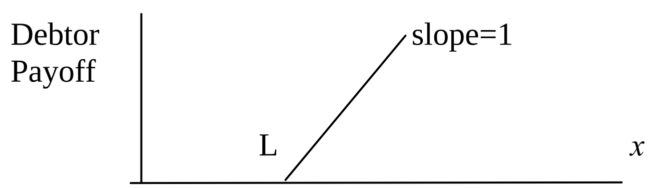
[5] What is appropriate depends on many factors, some of which are outside the scope of traditional economic analysis.

[6] Otherwise, traditional conditionality – if the debtor does A the creditor provides B – is the most appropriate form of assistance. An example of observable reform effort is floating an exchange rate.

together to produce a potential payment to the creditor. The key question is; *how much of this potential payment should the creditor request in advance?*

Krugman's answer was to *drop the requested payment to the point where the debtor has a reasonable chance of clearing it*. This gives the debtor good reason to exert effort, thereby giving the creditor a good chance of collecting the reduced amount. The nature of the incentive problem that Krugman addresses is shown in Figure 1. L is the amount of debt and *x* is the output from which to pay that debt.[7] Importantly, output x is influenced both by effort and some unforecastable shock.

Figure 1

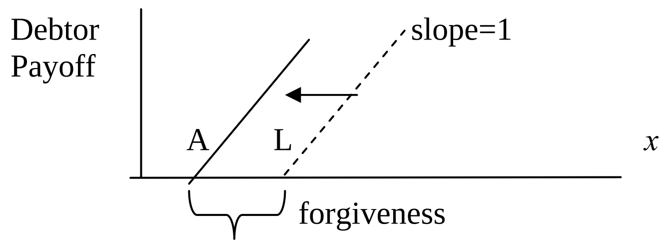


From the debtor's point of view, an x outcome up to the point L does not yield a direct benefit. That is, any extra output produced goes to the creditor, leaving a zero debtor payoff. Once the debt is cleared, every extra unit of output is kept, so the marginal payoff for every unit of extra output is unity. Since *x* is partly random, so that the debtor could end up on the flat or upward sloping portions of the payoff schedule, the *expected payoff of expending effort is decreasing in L*. This low expected payoff is the so-called

[7] Note that output here could be exports, or government revenue for paying foreign creditors. There is no requirement at this level of abstraction that it be total GDP, with the implausible implication that no GDP is consumed until it exceeds L. In the calibration exercise later in the paper effort is non-government GDP, based on personal communication with IMF staff, in a meeting to discuss this model in 2006.

debt overhang. Krugman's solution (Figure 2) is to drop the required repayment (to A), thereby increasing the expected returns to effort.

Figure 2



It is noteworthy that Krugman's analysis does not allow the well-being of the debtor nation to be independently chosen – it simply drops out of the creditor's maximization problem. There are two worthwhile objectives – repaying creditors and providing a debtor safety net – but forgiving debt, the only tool available, cannot accomplish both.

It is proved in the next section that introducing a cash bonus – a 'hyper-incentive' – to any debtor that clears a tranche of reduced debt can achieve the twin goals. With a hyper-incentive contract, the strategy is to *target the debtor's well-being by an appropriate amount of forgiveness, but include a cash bonus adjustment (a hyper-incentive) to ensure that the debtor exerts the optimal level of effort.*

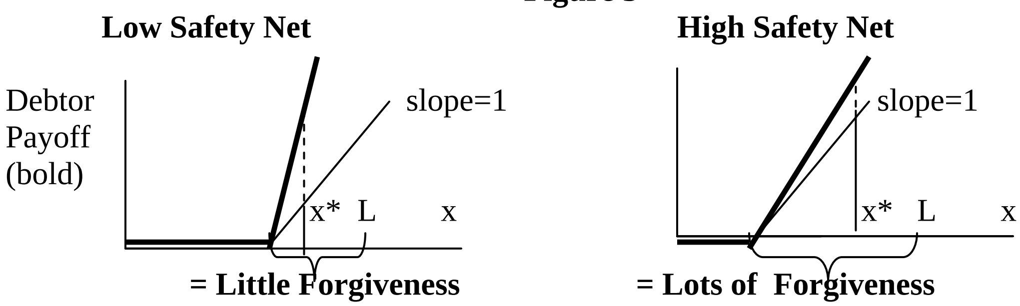
The hyper-incentive can motivate the optimal level of effort because the expected return to producing an extra unit of output under the Krugman contract is a convex combination of zero (on the flat portion) and unity (on the upward-sloping portion of the Krugman contract). No matter what level of forgiveness is chosen, the debtor benefit of a unit increment in output must be less than unity, being a convex combination of zero and unity. However, the social benefit (i.e. the combined creditor-debtor benefit) of a unit increment in output is clearly unity, which is greater than the private benefit. Effort will therefore be underprovided in the Krugman contract.

Under a hyper-incentive contract, the slope of the upward-sloping portion of the benefit schedule can be chosen to equate the (debtor's) private return to effort to the social return. If it is greater than unity, a convex combination of zero and this number can be made equal to unity – the social benefit.

The size of the bonus depends on the debtor's incentives. For countries requiring little forgiveness (i.e. those not needing a large safety net), there is the problem that effort may go unrewarded, so a large bonus is required. For countries requiring a lot of forgiveness (those needing a large safety net) the remaining incentive problem is small, so the bonus can be as well.

These observations allow us to draw two types of hyper-incentive contracts – one for a country experiencing relatively minor difficulties (requiring a low debtor safety net and little forgiveness) and one for a country experiencing severe difficulties (requiring a high safety net and lots of forgiveness). For output x*, the debtor keeps any output in excess the required repayment (shown by the light line) plus a bonus depending upon how far the output exceeds the forgiven debt (shown by the dashed vertical gap).

Figure 3



These results are now outlined more formally.

3 A Model for Comparing Contracts

The following exposition follows Krugman (1988) and Menzies (2004). However, one major extension is that output is defined such that effort is pre-multiplied by a parameter β, which facilitates the calibration exercise of Section 4.

Period 1

A Creditor lends \$L and announces the required repayment (*a*) for the second period. After observing *a* the debtor exerts effort *e*, with cost of effort $C(e)= e^2/2\lambda$.

Period 2

Nature draws a uniformly distributed error η over $(-h, h)$. This combines with effort to produce debtor output:

$$x=\beta e+\eta \qquad \text{and} \qquad E(x) =\beta e. \tag{1}$$

The parameter β allows measured effort to be mapped onto output, which is important in Section 4. If $x> a$ the debtor keeps the excess of output over the repayment, i.e. $x-a$. If not, Krugman assumes a gunboat technology transfers x to the creditor. The expected value of the debtor's 'limited liability' payoff is.

$$P \quad = \quad x \quad - \quad a \qquad \textit{If } x > a$$

$$E(P) \quad = \int_{a}^{\beta e + h} (x - a)(\tfrac{1}{2h})dx$$
$$\quad = \quad 0 \qquad \textit{If } x \leq a$$

To find the *e* that maximizes expected debtor utility, *E(Ud),* set the marginal expected private payoff (MEPP) equal to marginal cost.

$$E(Ud) \;=\; E(P) \;-\; C(e) \qquad (2)$$

$$\frac{\beta(\beta e + h - a)}{2h} \quad = \quad MEPP \quad = \quad MC \quad = \quad \frac{e}{\lambda}$$
$$\Rightarrow \quad e \quad = \frac{\lambda\beta(h-a)}{2h - \beta^2\lambda} \qquad S.O.C.\;\; \beta^2\lambda - 2h < 0 \qquad (3)$$

The equation for *e* can be interpreted as the debtor reaction function. For a given *a*, the effort choice maximizes debtor utility. Creditors face a tradeoff; more forgiveness (lower *a*) increases effort and the chance of collecting *a*, but *a* is also a cap on what can be collected. The optimal *e* (contingent on *a*) is substituted into expected creditor utility.

$$E(Uc) \;= e - E(P) - L \qquad (4)$$

The value of *a* arising from the maximization of *E(Uc)* can be less than *L*, implying debt forgiveness.

$$a = \beta\frac{\beta^3\lambda^2}{2h} + h - \beta^2\lambda \;= \quad \beta e^{Krugman} + h - \beta^2\lambda \quad = \quad x^{\max} - \beta^2\lambda \qquad (5)$$

As discussed by Krugman (1988), the creditor asks for the maximum possible output from the debtor (calculated at Krugman's optimal level of effort) less a forgiveness discount that is increasing in both β and λ. For higher marginal impacts of effort on output, the creditor's effort-increasing forgiveness discount is more beneficial to the creditor, and, for lower debtor effort costs (higher values of λ) the benefits of forgiveness are likewise more easily realized.

Optimal *a* is substituted into *(3),* giving the optimal value of *e*:

$$e_{Krug} = \beta\lambda\ (\beta^2\lambda/[2h]). \qquad (6)$$

The second order condition in *(3)* implies that optimal *e* is less than $\beta\lambda$. This is important, as we can see from adding the expected utilities of the creditor and debtor together. This is called V, for the total expected value of output net of effort:

$$V = \beta e - \frac{e^2}{2\lambda} - L \quad \Rightarrow \quad \frac{\partial V}{\partial e} = \beta - \frac{e}{\lambda} = 0$$

$$\Rightarrow \quad e = \beta\lambda \qquad (7)$$

The contract fails to maximize V, because debtor private benefit is too low, as was noted in Section 2.

The hyper-incentive contract allows the debtor payoff to have an incentive parameter. Repayment required is now *a/b,* (where *a* need not take the same value as it does in the Krugman contract).

$$
E(P) = \left\{ \begin{array}{ll} P = bx - a & \text{If } x > a/b \\ = \int_{a/b}^{\beta e+h} (bx-a)(\tfrac{1}{2h})\,dx & \\ = 0 & \text{If } x \le a/b \end{array} \right. \qquad (8)
$$

The optimal *e* is then obtained by differentiation.

$$
e = \frac{\lambda\beta(bh-a)}{2h - b\beta^2\lambda} \qquad (9)
$$

Note that the optimal *e* depends upon both *a* and *b*. It is decreasing in *a* and increasing in *b*.[8] Next, the sum of the utilities is differentiated with respect to *b*.

$$
V = \beta e[b] - \frac{1}{2\lambda} e[b]^2 - L
$$

$$
\frac{\partial V}{\partial b} = e'[b](\beta - \frac{e[b]}{\lambda}) = 0 \qquad \Rightarrow \qquad e[b] = \beta\lambda \qquad (10)
$$

The second order condition holds at the optimum (i.e., given that $\beta - e[b]/\lambda = 0$). The parameter *b* is chosen by the creditor to make it privately optimal for the debtor to set *e* equal to $\beta\lambda$, and *a* is chosen to attain a fixed reservation utility *U* for the debtor. The independent choice of the reservation utility is possible because there are now two instruments (*a/b* and *b*) available. The full solution thus involves equating *(9)* and *(10)*, meeting the participation constraint with equality

[8] The sign of the partial with respect to *b* follows from the (unstated) second order condition.

$$E(Ud) = E(P) \quad - \quad \frac{e^2}{2\lambda} = U > 0$$

and solving. The resultant expressions for *b* and the threshold a/b are the key parameters of the hyper-incentive contract.

$$\left.\begin{aligned} b \quad & = \frac{2h}{\beta^2\lambda + 2U} \\ a/b \quad & = h - 2U \end{aligned}\right\} \qquad (11)$$

The claims made above Figure 3 can now be justified. As the reservation utility *U* offered to a country rises, *a/b* and *b* both fall (‘High Safety Net’ in Figure 3) and *vice versa*.

To work out the actual amount of the hyper-incentive paid to the exporter, we note that, in reality, an exporter keeps the revenue from exports that exceed the debt repayment threshold *a/b*, so this does not need to be ‘paid to’ the debtor by the creditor. All that remains to be paid is the excess, for a realized value of *x*, say *x**:

$$HIC_{excess}=(x^*-a/b)(b-1) \qquad (12)$$

Finally, it is noted that if the reservation utility offered to the debtor is the same as is available under the Krugman contract then a switch from a Krugman contract to a hyper-incentive contract will, by construction, leave the debtor no worse off. However, since first-best effort ($\beta\lambda$) is now being exerted the size of V increases, and there is a surplus which can be divided between the debtor and creditor.[9] Quantifying the size of this surplus is the aim of the calibration exercise.

4 Calibration

Including a effort function parameter β in the models of Krugman (1988) and Menzies (2004) allows effort and output to be connected empirically. For the purposes of this exercise output and effort will be defined as: the ratio of exports to GDP, and, the ratio of non-government expenditure to GDP (both expressed in percentage terms).[10] It is natural to use exports as the output variable from which external debt obligations are paid, and the choice of non-government expenditures reflects the notion that, ceteris paribus, a reduction in the ratio of government spending to GDP will lead to an increase in exports.

A standard Mundell-Fleming framework could provide the motivation for such a claim, though reality is undoubtedly far more complex than the following simple diagram.[11]

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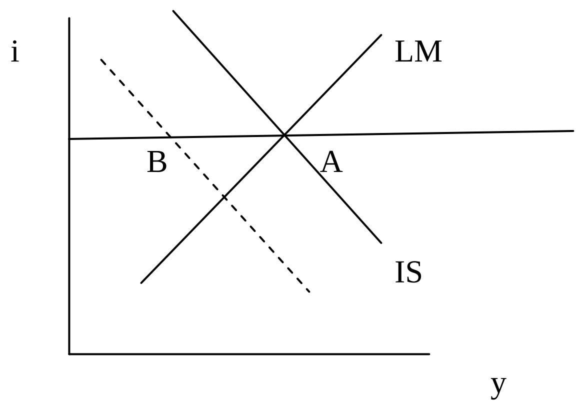
[9] As the formal model is set up, the creditor is residual claimant. However, an alternative modelling device is that the surplus be transferred to the debtor via a costless lump sum transfer at the end of period 2.

[10] All data is taken from the World Bank World Development Indicators database, and are expressed in nominal $US. Since the model variables are ratios, the currency chosen is irrelevant.

[11] The formulation for the calibration exercise must be simple enough to map to the single-variable theoretical model.

Figure 4

(i=interest rate, y=GDP)



An increase in the ratio of non-government spending to GDP is the same as a fall in government spending, shown by the dashed line. If the point A represents full-employment, then under a fixed rate regime (the norm for many poor countries) the economy will end up at A in the final equilibrium.[12] In the short run, monetary contraction takes the economy to B to maintain the exchange rate peg. Deflation follows, expanding real money and pushes the LM curve rightwards, and, depreciating the real exchange rate pushing the IS curve rightwards. These forces of change continue until the initial equilibrium A is restored. At that point, consideration of the identity GDP=C+I+G+X-M confirms that X-M must exactly offset the fall in G (assuming C and I are functions of unchanged Y and i). All that is being asserted is that part of this increase in X-M is due to an increase in X.

[12] The statement is also true under a floating rate; a depreciation increases net exports and the dashed IS curve returns to its initial position.

There is no requirement that the countries selected for this exercise be HIPCs, since the Krugman setup does not distinguish between sovereign and private debt. However, given the current interest in these countries, they are the natural choice. [13]

The required parameters for the calibration are β (the marginal impact of effort on output), h (the upper and lower bound on the error η), and λ (the cost of effort).
The first two parameters are relatively straightforward to quantify. An OLS regression of exports on non-government spending (both as a percentage of GDP):

$$x_i = \beta(100 - g_i) + u_i \qquad\qquad (g\ \ is\ \%GDP\ \ public\ spending)$$

gives β estimates for each country, and, a time series of residuals corresponding to each β estimate for each country. If the residuals are then assumed to be an i.i.d. draw from a uniform distribution, the maximum likelihood estimate for the bound h is just the maximum absolute residual.[14]

For λ it is assumed that the HIPC and Enhanced HIPC initiatives are forms of Krugman debt forgiveness contracts, and that the observed levels of non-government expenditure represent optimal effort. This is certainly an 'as if' assumption, for two reasons.

First, many of these countries suffer severe problems in governance, calling into question the basic assumption of rational action (though some might question this assumption for

[13] The list of HIPC countries is taken from Andrews et al. (1999).
[14] Again, the mapping onto the analytically tractable model requires a simple distributional assumption. The Likelihood function is $L=(1/2h)^n$ if e_i€ [h, -h], and =0 otherwise, where e_i is the estimated residual.

developed country governments as well). More fundamentally, HIPC debt forgiveness ties the level of forgiveness to the level of debt, aiming for 'sustainable' debt-to-export ratios. Krugman's model addresses a slightly different question: Given that the debt is far beyond what is going to be offered as repayment, what is the best transfer of output to ask for in the current period? Nevertheless, we assume that the HIPC initiative implicitly chooses the level of government expenditure consistent with a principle-agent solution to this period-by-period problem, in some manner. There is no other obvious way of backing out an estimate of λ, since it is difficult to estimate it independently. Table 1 gives the calibration values for β, h and λ, together with the implied first-best optimal effort levels ($\beta\lambda$).

Table 1: Key Calibration Parameters

	β	h	G	e_{Krug}	λ	SOC	e_{HIC}
Benin	0.2	8	10	90	513	-0.4	92
Bolivia	0.3	12	14	86	334	-0.3	87
Ethiopia	0.1	6	19	81	668	-0.5	85
Guyana	1.0	52	19	81	92	-11.6	92
Nicaragua	0.3	15	19	81	264	-1.9	86
Niger	0.2	10	15	85	413	-0.6	88
Sierra Leone	0.2	12	11	89	438	-2.1	97
Togo	0.5	25	11	89	204	-4.4	97
Central African Rep.	0.2	10	12	89	398	-0.4	90
Congo, Dem. Rep.	0.2	11	6	94	451	-0.5	96
Sao Tome and Principe	0.3	19	30	70	284	-9.0	92
Somalia	0.3	12	17	83	356	-1.7	89

The first column is the slope coefficient from the equation *(1)* regression.[15] The second column is the maximum absolute time-series residual from these regressions. The third

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Clearly, maximum-likelihood h is reduced (increasing the likelihood) until it equals the largest absolute residual. Further reductions in h result in the collapse of the likelihood function to zero.

[15] All coefficients are significant at the 1 per cent level, though the estimates are obviously subject to omitted variable bias. Regressions are run from 1972 to 2002 using annual data from the World Development Indicators database.

column is the share of government consumption spending in 1999 (the inaugural year of Enhanced HIPC), or, for those countries that reached a decision point under the 1996 HIPC initiative, the average share of government expenditure between the HIPC decision-point and completion-point dates.[16] The fourth column is the GDP share of non-government expenditure, which equals 100 minus the third column. The fifth column is obtained by taking the expression for the optimal value of e attainable under the Krugman contract (equation *(6)*) and setting e equal to the supposedly-optimal level of effort observed in history (the fourth column). Given β and h, the implied value of λ is then calculated.

As a check of the appropriateness of the model, the sixth column calculates the second order condition (equation *(3)*) and the seventh column works out the first-best level of effort given β and λ (equations *(7)* and *(10)*). Based on these two tests, a number of countries (not shown in the table) with positive second order conditions were excluded from further analysis,[17] as were any countries that registered first-best optimal shares of private expenditure exceeding 100 per cent.[18]

Armed with these parameters, the size of the surplus to be divided can be calculated.

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[16] These are the dates at which debt relief starts, and ends, under the initial HIPC initiative. Liberia and Myanmar were excluded because they did not have appropriate data. Apart from the Enhanced HIPC countries, the government spending was averaged over the following periods: Bolivia 1997-98, Burkina Faso 1997-2000, Guyana 1998-99, Lao PDR 1998, Mali 1998-99, Mozambique 1998-99 and Uganda 1997-98. Although Somalia did not reach a decision point under the initial HIPC initiative, the 1984 share of government expenditure was used due to data limitations.

[17] These countries were Burkina Faso, Cameroon, Chad, Congo, Cote d'Ivoire, Ghana, Honduras, Lao PDR, Malawi, Mauritania, Senegal, Tanzania, Uganda and Zambia.

[18] These countries were Ghana, Madagascar, Mali, Mozambique, Rwanda, Burundi and Sudan.

Table 2: Calibrated Surplus

(Krug=Krugman, HIC=Hyper-incentive Contract, U=U_{Krug})

	a_{Krug}	a/b_{HIC}	b_{HIC}	e_{Krug}	e_{HIC}	*x/GDP Krug*	*x/GDP HIC*	HIC pay	$US GDP	ΔV	$ΔV
Benin	8.1	8.1	1.0010	90	92	16	17	0.01	2700	0.004	11
Bolivia	11.2	11.2	1.0004	86	87	22	23	0.01	7800	0.003	20
Ethiopia	5.2	5.2	1.0036	81	85	10	11	0.02	6060	0.010	59
Guyana	41.2	42.4	1.0246	81	92	81	91	1.20	717	0.581	416
Nicaragua	13.4	13.5	1.0075	81	86	27	28	0.11	4000	0.054	217
Niger	9.1	9.1	1.0020	85	88	18	19	0.02	2170	0.010	21
Sierra Leone	9.9	10.1	1.0155	89	97	20	22	0.18	783	0.086	67
Togo	21.3	21.7	1.0145	89	97	42	46	0.36	1380	0.173	238
CAR	10.0	10.0	1.0006	89	90	20	20	0.01	1050	0.003	3
Congo Dem.Rep.	10.1	10.1	1.0013	94	96	20	21	0.01	5710	0.007	38
Sao Tome & Principe	12.4	14.0	1.1070	70	92	23	30	1.67	50	0.810	41
Somalia	10.5	10.6	1.0093	83	89	21	22	0.11	917	0.054	49

The first column is the required repayment of the Krugman contract, given by equation *(5)*. The second column is the required repayment of the hyper-incentive contract, given by equation *(11)*. The reason it is higher than the required repayment in the Krugman contract is that the reservation utility used in the hyper-incentive contract is the utility available to the debtor under the Krugman contract. That being the case, the extra payment that debtors are expected to receive from a hyper-incentive payment (the expectation of equation *(12)*), must be offset with less forgiveness, to leave them with the same expected utility.[19] The third column gives the hyper-incentive parameter b (equation *(11)*). Naturally, the comparable 'parameter' for the Krugman contract is just unity. The fourth and fifth columns give the levels of effort under the Krugman and hyper-incentive contracts (equations *(6)* and *(10)*). Corresponding to each of these effort levels, there is model based predicted ratio of exports, based on the estimated version of

[19] The debtor also exerts more effort under the hyper-incentive contract, but they are rewarded with more export revenue for this.

equation *(1)*. The predicted ratios of exports-to-GDP with the Krugman and hyper-incentive (first best) effort levels are thus given in columns 6 and 7.

Column 8 evaluates equation *(12)* at the predicted level of exports using the first-best effort of column 5. This gives the amount (as a share of GDP) that would have to be paid to exporters under the hyper-incentive contract if the predicted value was the outcome. The US$ amount can be calculated using the ninth column, which gives the level of GDP for 2002.

The tenth column shows the change in the expected sum of the utilities (V) as we move from a Krugman contract to a hyper-incentive contract (equation *(7)*). Given the assumption that expected utility is unchanged for the debtor (prior to any lump sum transfers) the change in V is the expected size of the surplus. It is calculated by evaluating equation *(7)* under both contracts.

$$\Delta V = \{\beta e_{HIC} - \frac{e_{HIC}{}^2}{2\lambda} - L\} - \{\beta e_{Krug} - \frac{e_{Krug}{}^2}{2\lambda} - L\}$$

$$= \beta(e_{HIC} - e_{Krug}) + (\frac{e_{Krug}{}^2}{2\lambda} - \frac{e_{HIC}{}^2}{2\lambda})$$

As was noted earlier, these amounts (some of which are not trivial for a developing country) represent efficiency gains that can be divided up between the creditor and debtor. They average around $\$US_{2002}$ 100 million for each country.

Noteworthy country results are driven by the parameters in the equation for ΔV, and by the fact that the last column $\$\Delta V$ is measured in \$US values. Guyana gains so much from the switch to a hyper-incentive contract because the impact of changes in government spending on exports is high (its β in Table 1 is unity, much higher than the values for other countries). Since Guyana is highly efficient at transforming effort (cuts in government spending) into increases in exports, then it matters a great deal if effort is not at the optimal level. The other two countries that have high $\$\Delta V$ values, Nicaragua and Togo, have relatively open economies with high export-to-GDP ratios. Again, this makes for a large \$US value of optimal output.

5 Conclusion

This paper has shown how a hyper-incentive contract could improve upon Krugman's stylized debt forgiveness contract. The terms of the contract are not dissimilar to the original contract, but some efficiency gains are possible.

In making this case, it is argued that debt forgiveness has been pressed into the service of too many goals. The *single* instrument of debt forgiveness cannot achieve *both* the target level of welfare for the indebted country demanded by the proponents of debt forgiveness, and, the maximal creditor returns desired by those who want to see these countries improve their reputation in international capital markets. In principle, the hyper-incentive contract could achieve both.

In order to convey these core ideas, a calibration exercise has been undertaken to illustrate that significant gains (at least on the scale of a poor country budget) are possible. The calibration exercise has mapped the real world onto a very simple model structure, and it is naturally limited in a number of respects.

First, a more realistic modeling exercise would involve a multivariate model for exports, and, a correspondingly more complex contract. Second, a more nuanced measure of reform effort would be also be desirable, since reducing government spending is a crude, and often misleading, measure. Social welfare can be strongly influenced by government spending on basic services and infrastructure, and so the reductions implied by comparing columns 4 and 7 in Table 1 may be both infeasible and undesirable for particular countries.

Nevertheless, just as real-world HIPC debt forgiveness is much more complex than Krugman's stripped-down model, so it is to be expected that real-world hyper-incentive contracts would likewise require further development. It has been the purpose of this paper to make the case that that development may be worthwhile.

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Figure 1

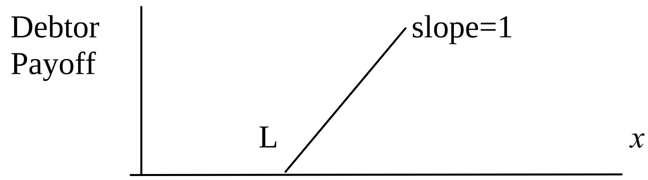

Figure 2

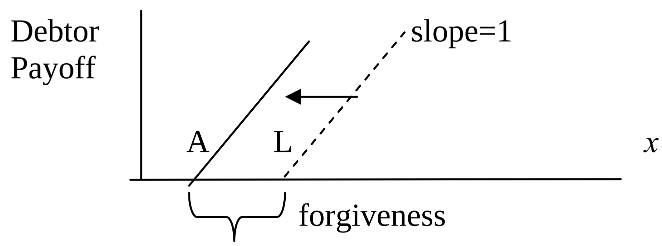

Figure 3

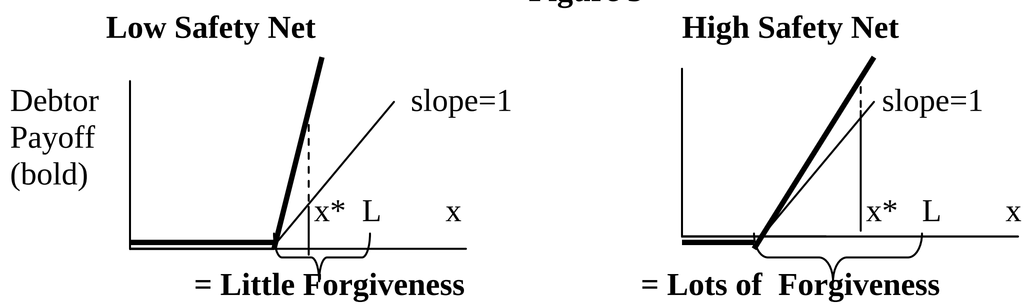
Low Safety Net
High Safety Net
Debtor
Payoff
(bold)
slope=1
x*
L
x
slope=1
x*
L
x
= Little Forgiveness
= Lots of Forgiveness

Figure 4

(i=interest rate, y=GDP)

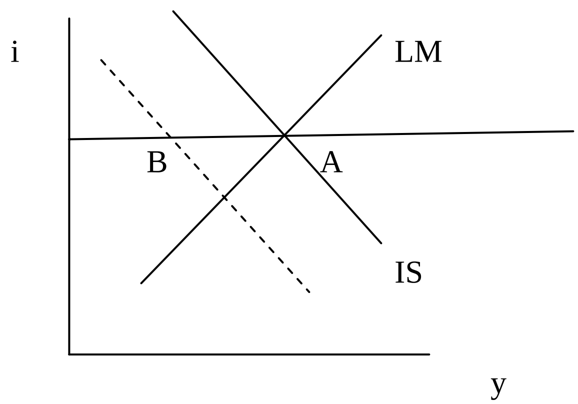

Table 1: Key Calibration Parameters

	β	h	G	e_{Krug}	λ	SOC	e_{HIC}
Benin	0.2	8	10	90	513	-0.4	92
Bolivia	0.3	12	14	86	334	-0.3	87
Ethiopia	0.1	6	19	81	668	-0.5	85
Guyana	1.0	52	19	81	92	-11.6	92
Nicaragua	0.3	15	19	81	264	-1.9	86
Niger	0.2	10	15	85	413	-0.6	88
Sierra Leone	0.2	12	11	89	438	-2.1	97
Togo	0.5	25	11	89	204	-4.4	97
Central African Rep.	0.2	10	12	89	398	-0.4	90
Congo, Dem. Rep.	0.2	11	6	94	451	-0.5	96
Sao Tome and Principe	0.3	19	30	70	284	-9.0	92
Somalia	0.3	12	17	83	356	-1.7	89

Table 2: Calibrated Surplus

(Krug=Krugman, HIC=Hyper-incentive Contract, U=U_{Krug})

	a_{Krug}	a/b_{HIC}	b_{HIC}	e_{Krug}	e_{HIC}	*x/GDP Krug*	*x/GDP HIC*	HIC pay	$US GDP	ΔV	$ΔV
Benin	8.1	8.1	1.0010	90	92	16	17	0.01	2700	0.004	11
Bolivia	11.2	11.2	1.0004	86	87	22	23	0.01	7800	0.003	20
Ethiopia	5.2	5.2	1.0036	81	85	10	11	0.02	6060	0.010	59
Guyana	41.2	42.4	1.0246	81	92	81	91	1.20	717	0.581	416
Nicaragua	13.4	13.5	1.0075	81	86	27	28	0.11	4000	0.054	217
Niger	9.1	9.1	1.0020	85	88	18	19	0.02	2170	0.010	21
Sierra Leone	9.9	10.1	1.0155	89	97	20	22	0.18	783	0.086	67
Togo	21.3	21.7	1.0145	89	97	42	46	0.36	1380	0.173	238
CAR	10.0	10.0	1.0006	89	90	20	20	0.01	1050	0.003	3
Congo Dem.Rep.	10.1	10.1	1.0013	94	96	20	21	0.01	5710	0.007	38
Sao Tome & Principe	12.4	14.0	1.1070	70	92	23	30	1.67	50	0.810	41
Somalia	10.5	10.6	1.0093	83	89	21	22	0.11	917	0.054	49