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GLOBALIZATION AND COOPERATIVE RELATIONS

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ABSTRACT

Globalization and Cooperative Relations*

Globalization – improved access to integrated, anonymous markets – is claimed to crowd out cooperative relations: from reciprocal exchange to lifetime employment, from relational governance to corruption/collusion. We study how agents' intertemporal preferences and their access to markets interact and affect their ability to sustain generalized cooperative relations. The aversion to intertemporal substitution, a regular feature of real world agents, facilitates cooperation by decreasing the evaluation of short-run gains from unilateral defections and by increasing that of losses from punishment phases. Access to goods' markets and 'money' may then hinder cooperation by undoing these effects, allowing agents to save and reallocate short-run gains from defections in time at some cost. With their positive return on capital (savings), financial markets make cooperation even harder to sustain, unless the market interest rate is sufficiently below agents' discount rate or there are sufficiently strong income fluctuations. Then financial markets may in fact facilitate relations, by increasing cooperating agents' debt capacity and allowing them to smooth fluctuations along the cooperative equilibrium path.

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1 Introduction

Why should "globalization" – improved access to integrated, anonymous markets – undermine long-term cooperative relations? This paper tackles the question with a special focus on improved access to financial markets and instruments. It identifies a new channel through which improved market access may affect the sustainability of cooperative relations: the interaction between agents' intertemporal preferences, and their ability to reallocate consumption in time.

That globalization might crowd out various types of cooperative relations is a main theme in current policy debates, and is an argument of "anti-global" activists; but it is also suggested by a surprising number of apparently unrelated informal observations and econometric studies.

When traditional, isolated communities get in contact with more developed market institutions, an internal breakdown of cooperation typically occurs. The phenomenon has been often observed in the management of common pool resources, and the same appears to happen to "reciprocal exchange relations".[1]

In developed countries, unions support the anti-global movement because globalization is perceived to undermine implicit long-term employment relations (firm-workers cooperation).[2] Correspondingly, it is often argued that Japanese firm started to abandon their celebrated lifetime employment arrangements since Japan opened to foreign finance and competition (e.g. Edward Lincoln, (1999); see also Takao Kato (2001)).

Related concerns are those of Robert Putnam (2000) and Dora Costa and Matthew Kahn (2001) about the erosion of "social capital" in the US – the country with the most

[1] Narpat Jodha (1985, 1990, 1995) finds that for the Indian villages in the ICRISAT sample, controlling for other factors, the closer are organized markets (towns), the faster is the erosion in the common resource pool. Similar examples are discussed by Partha Dasgupta (1993) and Jean-Marie Baland and Jean-Pierre Platteau (1996). Rachel Kranton (1996) reports a number of historical episodes and sociological case studies where the introduction of more sophisticated methods of exchange, or the development of nearby spot markets, led to a breakdown of traditional long-term exchange relations.

[2] A view that finds support in Henry Farber's (1997) and Marianne Bertrand's (1998) econometric studies.

developed markets in the world.[3] And Shuhe Li (1999) suggests that the 90s' financial liberalization in East Asia led to a breakdown in relation-based governance arrangements between firms, financing institutions and the state; and thereby to a loss of control on "moral hazard" and "risk shifting" temptations that ultimately led to the crisis.

Of course, cooperation is not always for the good. Federico Bonaglia et. al. (2001) find that countries' integration in international markets is associated with lower corruption;[4] and many argue that continental/Japanese product markets are less competitive (more cooperative/collusive) than those of Anglo-Saxon countries, where financial markets are substantially more developed (e.g. Yoshiro Miwa, 1996; Maki Atsushi, 1998).

Why then, should improved access to developed markets erode cooperative relations?

The mechanism identified in this paper is rather intuitive. It is a well known fact that real world agents are strongly averse to intertemporal substitution.[5] This widespread preference, it turns out, greatly facilitates cooperation, in two ways: it reduces agents' evaluation of short-run gains from unilateral defections from the agreed actions; and it increases their evaluation of the losses they incur when punished for their defection.[6] The access to anonymous markets for goods – and thereby to "money" as a medium to preserve value in time – may then make cooperation harder to sustain by contrasting the effects of agents' intertemporal preferences. It increases the attractiveness of unilateral defections and softens the threat of punishment phases by allowing a defecting agent to save and improve the intertemporal allocation of short-run gains from defection. The access to developed financial markets will have an even stronger effect because of the positive return on capital (savings) they offer. To put it differently, improved access to efficient anonymous markets, particularly financial ones, may confer "liquidity" – and thereby value – to short-run gains from defection, strengthening the temptation to defect

[3] Social capital can be defined as the density of the network of cooperative relations linking members of a community/organization (see James Coleman (1990) and Giancarlo Spagnolo (1999a, 2000)).

[4] Which, being illegal, must be supported by long term self-enforcing agreements.

[5] Estimates of the coefficient of absolute aversion to intertemporal substitution range between 2 and 10; see for example Robert Hall (1988), Larry Epstein and Steven Zin (1991), or Angus Deaton (1992).

[6] This first, general finding is important on its own, and might contribute to explain why such preferences are so common in our world.

in long-term relations.

This, however, is not the whole story. Besides allowing to smoothen consumption across time periods, "external" financial markets may give agents access to a different interest rate than their subjective one. We show that when the market interest rate is sufficiently lower than agents' discount rate and financial transactions are perfectly enforceable, the access to financial markets may end up facilitating cooperative relations by increasing cooperating agents' debt capacity more than a defecting agent's one. Also, when agents are subject to sufficiently strong income fluctuations, both along and out of the equilibrium path, one can find situations where the access to financial markets increases the value of cooperating more than that of defecting. Among the extensions, we also show that limited enforcement of loan contracts tends to harm cooperative relations, as it limits cooperating agents' debt capacity relatively more that defecting agents' one.

The methodology used to make these points is rather unconventional and of interest on its own. The phenomenon of cooperation in strategic situations which – in their static structure – resemble a Prisoner's Dilemma is very well understood thanks to three decades of work on infinitely repeated games.[7] However, most studies in this field adopt the standard game-theoretic approach by which the stage-game's payoffs are in the form of subjective (von Neuman-Morgenstern) utility. This approach allows for a parsimonious description extremely useful in the analysis of complex strategic situations, but real world phenomena may not always be reduced to a game as usually defined without losing some of their interesting features. In contrast, here we distinguish between the "material payoffs" (or "outcomes") generated in the strategic interaction, and agents' evaluation of such payoffs through their preference systems. This allows to study how aspects of the real world such as intertemporal preferences and opportunities to access markets affect agents' ability to cooperate (or collude).

[7] Classical references include James Friedman (1971), Robert Aumann and Lloyd Shapley (1976), Ariel Rubinstein (1979), Drew Fudenberg and Erik Maskin (1986), and Dilip Abreu (1986, 1988). Drew Fudenberg and Jean Tirole (1991, Ch.5) and Fudenberg (1993) provide excellent surveys of the literature.

1.1 Related work

Of course we are not the first to address the relation between agents' access to anonymous spot markets and their ability to sustain cooperative relations. An already established explanation why markets may hinder cooperative relations is that better spot markets improve the value of "exit" – agents' fallback position when a relation breaks down – thereby reducing agents' ability to discipline cooperation with the threat of terminating the relation. This explanation, already suggested by Albert Hirschman (1970), was modeled by Bentley McLeod (1988) in relation to effort in work-teams (see also McLeod and James Malcomson (1989)); underlies George Baker et al.'s (1994) and Klaus Schmidt and Monika Schnitzer's (1995) models of the interaction between implicit and explicit contracts; and is the focus of Kranton's (1996) model of reciprocal exchange.[8]

A second, non-exclusive explanation why market access may crowd out cooperative relations has been put forward in Spagnolo (1999a,b), where it is shown that there are typically "economies of scope" in cooperation: payoffs from the many relations agents are normally involved with tend to be substitutable, which facilitates cooperation by reinforcing threats and reducing incentives to defect. When such complementarities between relations are present, by replacing even one of the relations that link members of a network – e.g. because market exchange is more efficient than that particular relation – markets may cause the collapse of all the remaining relations.

The mechanism identified in the present paper hinges exclusively on markets' role as instruments for the intertemporal allocation of wealth. Therefore, its effects do not contrast, but rather add to the just mentioned effects identified in previous work.

To clarify the distinction between the mechanism unveiled in this paper and the first, more established one mentioned above, we can borrow terminology from Olivier Compte et al.'s (2002) analysis of mergers and collusion. When arguing that better spot markets soften the threat of terminating a relation by increasing payoffs obtainable *outside* the

[8]This argument is very general, and appears in several recent papers, among which Baker et al.'s (2002) analysis of relational contracts and property rights; John McLaren and Andrew Newman (2001) study of globalization and risk sharing; McLeod and Malcomson's (1998) analysis of efficiency wages vs. bonus contracts; and Canice Prendergast and Lars Stole's (1997) work on "monetizing" social exchange.

relation, MacLeod, Baker et al., Kranton, etc. are dealing with agents' *punishment concern*; i.e. with how markets affect the size and evaluation of material payoffs obtained during the *punishment* phase. By noting that access to money and markets may affect cooperative relations by allowing agents to choose a different intertemporal allocation for the consumption of short-run gains from defections, this paper is dealing mainly with agents' *deviation concern*; i.e. with how markets affect a defecting agent's allocation and evaluation of the material payoffs obtained *within* the relation with a *defection.*

In this sense, the second part of this paper is related to Jeremy Bulow and Kenneth Rogoff's (1989) observation that a country's ability to save and buy cash-in-advance insurance contracts at a fair price after defaulting on sovereign debt undermines its own ability to issue debt. True, Bulow and Rogoff's (1989) model and results are very different from ours. They model how the access to alternative financial instruments for consumption smoothing affects a country's ability to smoothen consumption through international debt; and the crucial assumption in their model is that debt is sovereign in the most extreme sense, that no sanction other than exclusion from further borrowing is available to lenders to enforce debt repayment. Applied to an international environment, our results explain instead how the access to anonymous financial markets affects a group of countries' ability to sustain policy cooperation on any other (non-financial) issue, from trade to defence, from the environment to fiscal policy. And our results are derived under the specular assumption to their one, i.e. that financial transactions (including debt) are perfectly enforceable; an assumption under which Bulow and Rogoff's (1989) result simply vanishes.[9] Nevertheless, their work and Section 3.2 of this paper are very close

[9] To be sure, in an extension (Section 4.2) we also consider their limited enforceability assumption. For readers not familiar with their work, Bulow and Rogoff (1989) consider a detailed model of sovereign debt where a country is subject to an *exogenous* stochastic shock and may borrow on international financial markets to substitute for insurance. When fairly priced insurance and deposits are available after defaulting on debt, further access to financial markets has no value; hence the threat of exclusion from further borrowing cannot induce any debt repayment. In their model, therefore, it is *defecting* players that have no use of financial markets. Here we consider a general environment where agents face repeatedy a social dilemma. The aversion to intertemporal substitution is shown to facilitate cooperation. The demand for smoothing consumption through goods or financial markets is *endogenously*

in spirit: they both suggest that the increased flexibility allowed by more sophisticated and anonymous market institutions may undermine agents' ability to commit to a future course of action (repaying international debt there, any form of cooperation here).

The reminder of the paper unfolds as follows. In Section 2 we introduce the model and characterize the effects of agents' intertemporal preferences. In Section 3 we let agents gain access to goods' and financial markets. In Section 4 we consider three natural extensions: non stationary environments, limited enforceability and renegotiation-proof strategies. Section 5 concludes with a few remarks.

2 Substitution and cooperation

We begin by introducing a stylized model of a generalized cooperative relation where agents' intertemporal preferences and material payoffs from the relation are not yet merged into subjective payoffs. We then proceed to characterize the effects of agents' intertemporal preferences on their willingness to sustain cooperative relations.

2.1 A simple model

Consider a generic strategic interaction with material payoffs, a *material payoffs game* G defined by a finite set N of agents, finite sets of actions A_i from which each agent $i \in N$ can choose, with $\Omega = \prod_{i=1}^{N} A_i$, and *material payoff functions* π_i, $\pi_i : \Omega \to R$. We can think of G as a non contractible exchange with potential hold-up, a team production problem, a common property exploitation problem, or any other interaction among those discussed in the introduction sharing the strategic structure of a Prisoner's Dilemma.

The material payoff game $G = (N, \Omega, \pi)$ generates different games G_U when agents with different preferences over material payoffs $U(\pi)$ are called to play it.[10] We will

generated by a player's decision to defect. And it is *cooperating* players that have little use of financial markets.

[10] In the remainder of the paper the absence of a subscript will mean either that the symbol refers to the whole set or vector of indexed objects - for example, $A = \{A_1, A_2, ..., A_N\}$ - or that, because of symmetry, there is no difference in the variable in question for the different players. The subscript $-i$

confine attention to agents whose instantaneous preferences can be represented by utility functions that are monotonic transformations of their material payoff functions, such that $U' > 0$.[11]

Assume that as in a Prisoner's Dilemma, G_{π} – the game generated by linear preferences $U(\pi) = \pi$ – has at least one symmetric pure strategy Nash equilibrium which keeps agents at their security material payoff level $\underline{\pi}_i$. This equilibrium will be also a Nash equilibrium of any other game G_U, as pure strategy Nash equilibria of static games are unaffected by monotonic transformations of the payoff functions, which lead to ordinally equivalent games.

For this class of strategic interactions – which includes most models of implicit/relational contracts, of common pool and public good management games – a permanent reversion to the static Nash equilibrium is an "optimal punishment" (in the sense of Abreu (1988)): if cooperation cannot be sustained under this threat, it cannot be sustained under any other credible threat. We can then characterize the effects of agents' attitudes toward intertemporal substitution and the opportunity to access goods' and financial markets by focusing on the set of equilibria sustainable in subgame perfect equilibrium by the threat of interrupting cooperation forever (the "grim trigger" strategies introduced by Friedman (1971)).[12]

Abusing notation, let $\hat{\pi}_i(a_{-i})$ denote agent i's material payoff from choosing a best response to other agents' action profile a_{-i}, and let $r > 0$ denote agents' common intertemporal discount rate and δ, with $\delta = \frac{1}{1+r} < 1$, their discount factor. Then G^{∞} will denote the discounted *material payoffs supergame* originated by the infinite repetition of $G = (N, \Omega, \pi)$, and $G^{\infty}(U)$ the supergame which has $G(U)$ as stage-game,

will be used to indicate a vector in which the i-th component is missing.

[11] To save on notation I focus on the symmetric case, with $U_i = U \ \forall i \in N$, the asymmetric case leading to equivalent results (the pooled incentive compatibility constraint for the N players is more stringent the more concave is each agent's instantaneous utility function).

[12] Obviously, our results also apply to the many models that focus on grim trigger strategies because they are simple, although not optimal. Moreover, in Section 4.3 we show that the results continue to apply when agents use the (still optimal) asymmetric "repentance" strategies discussed by Joseph Farrell and Eric Maskin (1989), Eric van Damme (1989), and Paul Segerström (1989), which make cooperative agreements more robust towards renegotiation and mistakes.

so that each agent i at any time τ maximizes the additively (time) separable objective function $V^{\tau} = \sum_{t=\tau}^{\infty} \delta^{t-\tau} U(\pi_i^t)$.

Material payoffs and actions are obviously assumed non contractible throughout the paper, otherwise the dilemma could be explicitly contracted out and no self-enforcing cooperative relation would be required.

2.2 Intertemporal substitution and cooperative relations

Within the above framework, a given stationary stream of material payoff $\left\{\pi_i^*, \pi_{-i}^*\right\}_{t=\tau}^{\infty}$ can be supported in subgame perfect Nash equilibrium in $G^{\infty}(U)$ (for example by "grim-trigger" strategies) if and only if

$$U(\pi_i^*) \geq (1-\delta) U\left[\hat{\pi}_i(a_{-i}^*)\right] + \delta U(\underline{\pi}_i) \tag{IC.1}$$

for every agent i. We will need an unambiguous definition of a "more concave" function.

Definition 1 *A utility function U^a is* more concave *than another one U^b if U^a can be derived from U^b by a strictly concave monotonic transformation.*

Now it is possible to state the first result.

Proposition 1 *The more concave agents' instantaneous utility functions are, the less stringent are the conditions (IC.1) under which any stationary material payoff stream $\left\{\pi_i^*, \pi_{-i}^*\right\}_{t=\tau}^{\infty}$ can be supported in subgame-perfect Nash equilibrium in $G^{\infty}(U)$.*

Proof: Please see the Appendix.

From the deterministic point of view of this paper the strict concavity of the instantaneous utility function implies aversion to intertemporal substitution, that is, a preference for smooth time paths of material payoffs, given the level of the discount factor. From a static point of view, the strict concavity of the instantaneous utility function implies decreasing marginal utility of material payoffs. An agent with a strictly concave instantaneous utility function has a relatively lower valuation of the short-run material gains from deviating from a cooperative equilibrium, as his marginal utility is

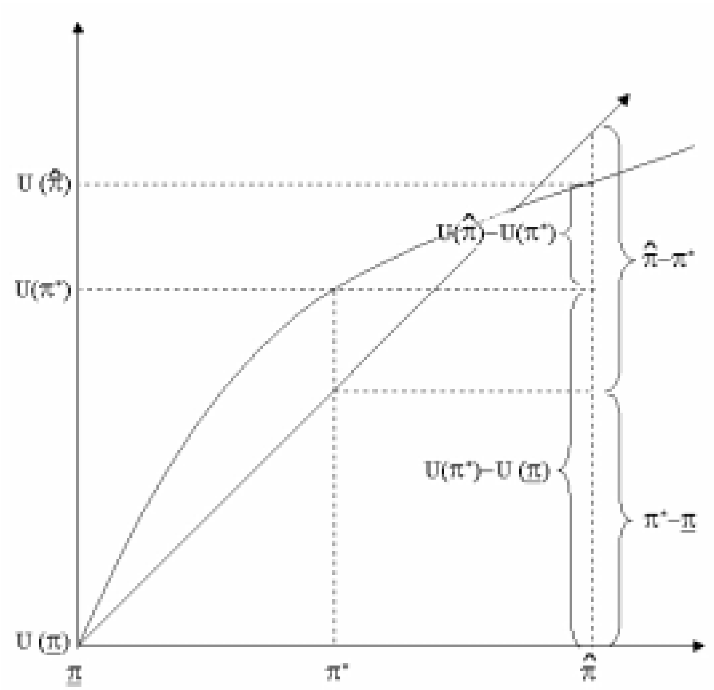

Figure 1: Intertemporal preferences and incentives to sustain cooperation.

low at high levels of material payoffs. Conversely, the expected losses of material gains from the breakdown of cooperation have a relatively higher value for an agent averse to intertemporal substitution, since at lower levels of material payoffs he has a relatively higher marginal utility of material payoffs. These two effects both make cooperation easier to sustain.

These effects can perhaps be better appreciated by rearranging (IC.1) as

$$U_i(\hat{\pi}_i(a^*_{-i})) - U_i(\pi^*_i) \leq \frac{\delta}{1-\delta}\left[U_i(\pi^*_i) - U_i(\underline{\pi}_i)\right],$$

so that on the left side of the inequality we have the net short-run gains from unilaterally defecting, and on the right side the net expected losses from the punishment phase. Figure 1 shows how the strict concavity of the per-period utility function reduces the first and increases the second relative to a linear utility function.

For the sake of crispness, in the reminder of the paper we will often write that something "hinders" or "facilitates" cooperative relations, meaning that something makes the necessary and sufficient conditions (IC.1) for any stationary material payoff stream to be supportable in subgame-perfect Nash equilibrium in $G^{\infty}(U)$ more or less stringent.

3 Markets

Behind previous section's result lies the implicit assumption – shared by all repeated games models – that agents cannot transfer material payoffs from one period to another. Suppose this is due to material payoffs being perishable. How will agents' ability to cooperate be affected by an unforeseen innovation (say, a sudden fall in transport costs) which gives them access to a market where material payoffs can be exchanged against a less perishable good called money, or can be lent or borrowed to other agents at some positive interest rates?

The opportunity to reallocate material payoffs across time periods through markets transforms $G^{\infty}(U)$ into a dynamic game with agents' net savings or financial account as a state variable.[13] To summarize how the possibility of intertemporal substitution affect agents' willingness to cooperate in this modified environment it is useful to introduce some additional notation. We will let V^c and V^d denote the (discounted expected) values of the choices of continuing to cooperate ("c") and of unilaterally defecting ("d") respectively. This means that the necessary condition for cooperation being supportable in equilibrium can now be written as $V^c \geq V^d$. For example, in the absence of markets it was $V^c = \frac{U(\pi_i^*)}{1-\delta}$, $V^d = U\left[\hat{\pi}_i(a_{-i}^*)\right] + \frac{\delta}{1-\delta}U(\underline{\pi}_i)$, and $V^c \geq V^d$ is the compact version of condition IC.1. In addition, we will let ΔV^h, with $h \in \{c, d\}$, denote the change in V^h caused by the gained opportunity to access a market (one for material payoffs in the next subsection, a financial market in the following two ones), so that access to the market makes cooperation harder to sustain when $\Delta V^c < \Delta V^d$, and easier to sustain when $\Delta V^c > \Delta V^d$.

[13]Infinite dynamic games are often referred to as stochastic games and contain repeated games as a (degenerate) subclass. See Dutta (1995) for an encompassing discussion and an equilibrium characterization.

3.1 Goods' markets and money

Consider first the effect of an unexpected innovation that allows each agent to access, incurring a fixed cost of C material payoffs, an infinitely lived, anonymous market where material payoffs can be exchanged at a constant price against a non perishable good that delivers no intrinsic utility, called *money.* One can state the following.

Proposition 2 *Suppose agents are averse to intertemporal substitution ($U'' < 0$), and let $\overline{C}$ be such that $U'(\hat{\pi}_i(a^*_{-i}) - \overline{C}) = \frac{U'(\pi_i)}{1+r}$. Then the opportunity to access a market for material payoffs and money at cost $C \geq 0$ hinders cooperative relations when $C < \overline{C}$; it does not affect them when $C \geq \overline{C}$. Formally:*

$$C < \overline{C} \Rightarrow \Delta V^c = 0, \Delta V^d > 0; \;\; C \geq \overline{C} \Rightarrow \Delta V^c = \Delta V^d = 0.$$

Proof: Please see the Appendix.

If the costs of saving (market transaction cost C plus the cost of delaying consumption) are small enough, an agent who unilaterally defects from cooperation can increase his life-time utility by selling on the market part of the short-run gains from deviation and saving for the future. An agent planning to stick to cooperation, instead, expects others to do the same and therefore a constant flow of material payoffs in time. Since he discounts the future and saving is costly, this agent would prefer a consumption path decreasing in time, hence he has no use for goods' markets and money. By making unilateral deviations relatively more attractive, the innovation makes cooperative relations harder to support.

Note that by the same logic, the introduction of any other technology for storage and saving material payoffs would have analogous effects on agents' ability to cooperate. Of course, when some material payoffs perish during the storage/saving process, or when the "currency good" used to transfer material payoffs across periods is subject to depreciation, the negative effect on agents' ability to cooperate will be reduced, the more the stronger the depreciation.

3.2 Perfect financial markets

What if our agents obtain unforeseen access to full-fledged financial markets that allow them to save and borrow at some interest rates? To tackle this question we will assume throughout that all agents face the same interest rates on financial markets (no discrimination between agents), that the no-Ponzi-game condition must always be satisfied,[14] and that each agent can keep (some or all of) his financial transactions secret if he wishes to.[15] We focus here on financial markets that are perfect in the following two senses:

(a) *All financial transactions are perfectly enforceable;* if a lender is not repaid, say, he can enslave the borrower (where being slave delivers infinitely low utility while having slaves increases utility);

(b) *Agents can save and borrow at the same interest rate*, denoted by i.

Assume for the moment that the market interest rate i equals agents' intertemporal discount rate r, as in a closed economy in stationary equilibrium. From the point of view of one agent, the choice between sticking to cooperation and defecting is isomorphic to an investment choice since sticking to cooperation, as investment, requires foregoing present material payoffs (short-run gains from defecting) in order to increase future material payoffs (future gains from cooperation). *Fisher's Separation Theorem* (Fisher (1930); Hirschleifer (1958, 1970)) tells us that with perfect financial markets optimal investment maximizes expected returns, and thereby agents' intertemporal wealth (the discounted flow of material payoffs), independent of agents' intertemporal preferences (U).[16] This means that when financial markets are perfect an agent will stick to a

[14] The no-Ponzi-games condition prevents agents from raising an infinite amount of debt by servicing/repaying old debt with new and increasing debt issues. Formally, the condition is $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^{T} D_i^{t+T} \leq 0$, where D_i^{τ} denotes player i's total debt in period τ.

[15] This is a natural assumption, and the only sensible one to understand the effects of access to anonymous markets. It excludes standard precommitment effects of financial contracts by allowing agents to secretly renegotiate/undo any financial transaction other agents may have observed.

[16] This is of course the case because perfect financial markets allows agents to freely optimize the intertemporal allocation of consumption of any amount of wealth according to their specific preferences, while higher wealth allows for higher consumption in all periods.

cooperative agreement if and only if the discounted flow of material payoffs obtained by cooperating is larger than that obtained by defecting unilaterally and then receiving forever the minimum amount of material payoff he can guarantee himself in any case $\underline{\pi}_i$, that is if

$$\pi_i^* \geq (1-\delta)\hat{\pi}(a_{-i}^*) + \delta\underline{\pi}_i. \tag{IC.2}$$

This is the usual condition for cooperation being supported by agents with linear utility functions, with or without access to markets, and by Proposition 1 we know that it is more stringent than the condition for agents with strictly concave utility functions. We can therefore state the following.

Proposition 3 *Suppose agents are averse to intertemporal substitution. Then, the opportunity to access a perfect financial market with $i = r$ hinders cooperative relations. Formally:*

$$i = r \Rightarrow \Delta V^c = 0, \ \Delta V^d > 0.$$

Proof: Please see the Appendix.

Again, an agent who deviates from a cooperative equilibrium can exploit the opportunity offered by perfect financial markets by saving and costlessly reallocating consumption from the period of the defection, where material payoffs are high and marginal utility from their consumption low, to those of the punishment phase, where they are low and marginal utility from their consumption is high. This increases the ex ante value of the choice to deviate. On the contrary, agents who stick to cooperation have no use of financial markets, as the constant flow of material payoffs from cooperation is already an optimal intertemporal allocation.

3.3 External financial markets

The standard assumption that the market interest rate coincides with agents' subjective discount rate is a reduced form for an internal credit market of a closed economy in stationary equilibrium, where the market interest rate is endogenous and cannot do more than reflect agents' intertemporal preferences. However, globalization is also a story of agents/communities gaining access to external credit markets, whose interest rate is exogenous and may well differ from community members' subjective discount rate.

Maintaining other assumptions, let now i differ from r, and let $\rho = \frac{1}{1+i}$ denote the market discount factor. Fisher's Separation Theorem now implies that an agent will stick to a cooperative agreement rather than defecting if and only if the *market* value of the flow of material payoffs obtained by cooperating discounted at market interest rate (the "intertemporal" or "life-time" wealth of an agent that cooperates), is larger than that obtained by an agent that defects and is then kept at his security material payoff level forever. The relevant condition for cooperation being sustained is then

$$\pi_i^* \geq (1-\rho)\hat{\pi}(a_{-i}^*) + \rho\underline{\pi}_i. \tag{IC.3}$$

Comparing conditions (IC.1), (IC.2) and (IC.3) we obtain the following.

Proposition 4 *Suppose agents are averse to intertemporal substitution and obtain access to perfect financial markets with interest rate i different from the subjective discount rate r. Then a positive and sufficiently low level of the market interest rate $\underline{i} < r$ exists such that:*

1. *When $i > \underline{i}$, the access to perfect financial markets hinders cooperative relations, the more the higher is i. Formally:*
$$i > \underline{i} \Rightarrow \Delta V^d > \Delta V^c, \frac{\partial(\Delta V^d - \Delta V^c)}{\partial i}\,|_{i>\underline{i}} > 0.$$
2. *When $i < \underline{i}$, the access to perfect financial markets facilitate cooperative relations, the more the smaller is i. Formally:*
$$i < \underline{i} \Rightarrow \Delta V^d < \Delta V^c, \frac{\partial(\Delta V^d - \Delta V^c)}{\partial i}\,|_{i<\underline{i}} > 0.$$

Proof: Please see the Appendix.

The point here is that when $i \neq r$ the access to perfect financial markets brings about two innovations: the ability to reallocate material payoffs in time, and a different intertemporal discount rate. When $i > r$, the result obtained in the previous section is reinforced by an even stronger return from defecting unilaterally and saving part of the short-run gains from defection for future consumption ($\Delta V^d > 0$, $\Delta V^c = 0$). When $\underline{i} < i < r$ market access has a positive effect on both the value of defecting ($\Delta V^d > 0$) and that of cooperating ($\Delta V^c > 0$). As before, it enhances the value of defecting by allowing a defecting agent to save part of short-run gains from defection for future consumption. In addition, the lower market interest rate increases cooperating agents' debt capacity, the amount they can borrow against future gains from cooperation. And borrowing increases cooperating agents' intertemporal utility since with $i < r$ their optimal intertemporal consumption path is strictly decreasing in time. As long as $\underline{i} < i < r$, this second "positive" effect dampens but does not outweight the first "negative" effect ($\Delta V^d > \Delta V^c$). When $i = \underline{i}$ the two effects perfectly balance each other and cancel out ($\Delta V^d = \Delta V^c$). When $i < \underline{i}$ the increased debt capacity of cooperating agents dominates ($\Delta V^d < \Delta V^c$), hence the access to financial markets ends up *facilitating* cooperative relations.

4 Extensions

4.1 Non-stationary environments

Following most previous work on implicit/relational contracts, we have been focusing on a perfectly stationary environment. It is now worthwhile to consider a simple non-stationary environment, since in such environment agents planning to cooperate may use financial markets to smooth payoffs fluctuations along the cooperative path, increasing their intertemporal utility even when $i = r$.[17] Suppose static payoffs fluctuate in a

[17] Building on the result in Section 2.2 of this paper, Ingela Ternström (2001) and Spagnolo (1999) introduce fluctuations in a fashion similar to Rotemberg and Saloner's (1986) model of "price wars during booms." They find, among other things, that agents sufficiently averse to intertemporal substitution have the greatest incentive to deviate in periods in which payoffs are relatively low, reverting Rotemberg and Saloner's result. They do not address, however, how market access affect agents' ability to sustin cooperation.

perfectly forecastable way, so that attitudes towards risk do not interfere with substitution issues. In particular, consider and additive cyclical component such that in each *even* periods all agents receive $\theta^e > 0$ additional material payoffs. With no access to financial markets the necessary and sufficient conditions cooperation being supportable in equilibrium in all periods are

$$U(\hat{\pi}_i(a^*_{-i}) + \theta^e) - U(\pi^*_i + \theta^e) \leq \delta \frac{U(\pi^*_i) - U(\underline{\pi}_i)}{1-\delta^2} + \delta^2 \frac{U(\pi^*_i + \theta^e) - U(\underline{\pi}_i + \theta^e)}{1-\delta^2}, \quad \text{(IC.e)}$$

$$U(\hat{\pi}_i(a^*_{-i})) - U(\pi^*_i) \leq \delta \frac{U(\pi^*_i + \theta^e) - U(\underline{\pi}_i + \theta^e)}{1-\delta^2} + \delta^2 \frac{U(\pi^*_i) - U(\underline{\pi}_i)}{1-\delta^2}, \quad \text{(IC.o)}$$

where (IC.e) is the relevant incentive compatibility condition in even periods, and (IC.o) is the relevant one in odd ones.

The strict concavity of U implies decreasing differences, which imply that the left hand side of (IC.e) – the net gains from defections – is strictly smaller than that of (IC.o), and that the right hand sides of (IC.e) – net losses from the punishment phase – is strictly larger than that of (IC.o).[18] That is, condition (IC.e) is always less stringent than (IC.o), so that without market access cooperation is supportable in all periods if it is so in odd periods.[19] One can then state the following.

Proposition 5 *Suppose agents are subject to perfectly forecasted additive income fluctuations, receiving $\theta^e > 0$ additional material payoffs in (say) even periods. If agents' aversion to intertemporal substitution is sufficiently low that $\frac{U(\hat{\pi}_i(a^*_{-i}))-U(\pi^*_i)}{U(\hat{\pi}_i(a^*_{-i}))-U(\underline{\pi}_i)} > \left(\frac{\hat{\pi}_i(a^*_{-i})-\pi^*_i}{\hat{\pi}_i(a^*_{-i})-\underline{\pi}_i}\right)^2$, and θ^e is sufficiently large, then the access to perfect financial markets with $i = r$ may facilitate cooperative relations by relaxing the incentive compatibility condition for odd periods (IC.o). Otherwise, the access to perfect financial markets with $i = r$ hinders cooperative relations.*

[18] A function $f(x)$ displays decreasing differences if for any x', x'' with $x' > x''$, the difference $f(x'+\sigma) - f(x''+\sigma)$ decreases when the parameter σ increases (see e.g. Fudenberg and Tirole 1991, p. 490).

[19] Note the contrast with Rotemberg and Saloner's (1986) result. Here agents have a stronger incentive to defect in odd periods, in relatively "bad" states, as then they value the material gains from defections more $U(\hat{\pi}^*_i) - U(\pi^*_i) > U(\hat{\pi}^*_i + \theta^e) - U(\pi^*_i + \theta^e)$ and the tougher periods of the punishment phase (where $\theta^e = 0$) are further away in time.

Proof: Please see the Appendix.

Decreasing differences imply that absent financial markets, condition (IC.2) is always more stringent than (IC.e) and – when income fluctuations are sufficiently strong and the concavity of the objective function moderate – condition (IC.o) is more stringent than (IC.2). When agents' discount factor is such that (IC.2) is satisfied but (IC.o) is not, cooperation in all period is not an equilibrium outcome without access to financial markets, while it becomes so when agents have access to financial markets, so that (IC.2) becomes relevant. In other words, by allowing agents to smooth fluctuations in the equilibrium and punishment phases financial markets makes defections in odd periods less attractive, and may thereby facilitate cooperative relations even when $i = r$.

4.2 Limited enforcement

We have worked under the assumption that the access to financial markets comes together with the perfect enforceability of all financial transactions. As already mentioned, this working assumption is different from, and does not imply that of verifiability-contractibility of agents' actions or material payoffs in the underlying supergame. It requires that lenders (credit markets/institutions) can privately exert sufficiently strong direct sanctions against borrowing agents that default on loans, and have the ex-post (e.g. reputational) incentives to exert these sanctions.[20]

Perfect enforceability is probably the most appropriate working assumption for deposit contracts (for agents' ability to save, in our model), the repayment of which being usually guaranteed by the strong reputational concerns of financial intermediaries, long term agents with multiple opponents. On the contrary, a robustness check with alternative assumptions on the enforceability of loans to private agents (on agents' ability to borrow) is due. In this section we will maintain that agents can safely save by investing in financial markets, and ask how limited enforceability of loans to private agents affects

[20] With verifiable actions or material payoffs the problem of cooperation would disappear alltoghether, since agents could write a contract that penalizes defections or reallocate material payoffs so that the efficient actions, "cooperation", would be implemented at any discount rate.

previous sections' results.

Limited enforceability can take many different forms, depending on which fraction of an agent's future material payoffs can be sized by creditors after he defaults on debt, and at what cost. Here we will only consider the assumption specular to that of perfect enforceability: that the only sanctions available to lenders to enforce repayment of loans is the exclusion from further access to credit, as in Bulow and Rogoff's (1989) celebrated model of sovereign debt.

In our environment, the only reason why agents want to borrow is to anticipate consumption of future material payoffs from the relation. After consumption has been properly smoothed, agents have no further need of borrowing. This implies that the threat of exclusion from further borrowing is an empty one, as is the case in Bulow and Rogoff (1989) when an actuarially fair cash in advance insurance contract is available after default. Then, when the time to reduce consumption to repay a consumed loan comes about, agents will find it optimal to default on debt. They will be excluded from further borrowing, but they obtain a net increase in lifetime consumption. Since this is known to borrowers, no debt repayment can be sustained by the threat of exclusion from further borrowing, hence agents cannot borrow. We can then state the following.

Proposition 6 *Suppose loan repayment is enforced by the threat of exclusion from further lending in case of default. Then:*

1. *In stationary environments, the access to financial markets hinders cooperative relations when* $i > i^{\min} = \frac{(1+r)U'(\hat{\pi}_i(a^*_{-i})) - U'(\underline{\pi}_i)}{U'(\underline{\pi}_i)}$, *where* $i^{\min} < r$, *and does not affect them otherwise.*

2. *When agents are subject to income fluctuations, as described in Section 4.1, Proposition 5 applies only if cooperative relations begin in high income periods.*

Proof: Please see the Appendix.

That is, when the environment is rather stationary and lenders have no sanctions to enforce loan repayment besides exclusion from further borrowing, the access to markets can never facilitate cooperative relations. When income fluctuations are sufficiently strong, access to financial markets can still facilitate relations by allowing cooperating agents to save in high income periods for low income ones. For this to happen, however, agents must now wait for a high income period to begin their cooperative relation.

Intermediate assumptions, such that some fraction of the future flow of material payoffs can be sized by lenders if an agent defaults on its debt, should lead to intermediate statements, the role of borrowing being reinforced the better is the enforceability of loans. Regarding which enforceability assumption is most appropriate, the answer varies wildly even between the examples discussed in the introduction. When $G^{\infty}(U)$ is a collusive game between two oligopolistic firms, the stream of future material payoffs (profits) are linked to a set of legally defined assets, the firm, that can be sized through bankruptcy after default on debt. Then the situation is most closely represented by the initial, perfect enforcement assumption. When, on the other hand, $G^{\infty}(U)$ is a common pool game within an isolated community, where individual property rights are just not defined, or when it is an illegal game (e.g. a corruption relation), or in any other case where future material payoffs cannot be easily alienated through legal means, then the situation is most closely represented by this subsection's limited enforcement assumption.

4.3 Alternative punishment strategies

As is well known, grim-trigger strategies are not robust with respect to ex post renegotiation. However, it is easy to show that all previous results apply when G has the structure of a Prisoner's Dilemma and agents adopt the renegotiation-proof "repentance" strategies proposed by Segerström (1988), van Damme (1989) and Farrell and Maskin (1989). These strategies require an agent who defected to "repent" – by "cooperating" for one or more periods in which opponents play "defect" – after which cooperation can restart.

Proposition 7 *All results stated in this paper apply when agents sustain cooperation in (weak) renegotiation-proof equilibrium through optimal asymmetric finite-length punishment phases that reward punishers.*

Proof. Please see the Appendix.

It can also be easily shown that the results are reinforced by assuming the strength of the punishment to be bounded by some finite renegotiation costs as suggested by Andreas Blume (1994) and Barbara McCutcheon (1997). The reason is that given a level of renegotiation costs, the more averse to intertemporal substitution agents are, the more they value the finite renegotiation costs which are concentrated in time, and the stronger the renegotiation-proof punishment can be.

4.4 Other potential extensions

Perfectly forecastable fluctuations are not common in reality. It would be interesting to extend the present framework to a genuinely stochastic environment, where agents' attitudes toward risk come into play. To have an idea of the additional effects that may then be at work, consider a Bertrand supergame with stochastic demand, where each period uncertainty resolves before risk averse agents choose prices. In this particularly simple case agents' risk aversion only (negatively) affects their evaluation of future gains from cooperation, since agents' security levels and short-run gains from defections are not affected by demand uncertainty. Then, attitudes toward risk and toward intertemporal substitution would affect agents' ability to cooperate in opposite direction, while the access to a market for insurance would unambiguously facilitate cooperation. More generally, uncertainty may also affect agents' security levels and short-run gains from cooperation (when uncertainty resolves after agents' choice of actions), and keeping track of all these effects appears a challenging task for future research.[21] Future work could also consider asymmetric information *à la* Ed Green and Robert Porter (1984), and characterize how aversion to risk and to intertemporal substitution and access to goods, financial and insurance markets affect agents' ability to sustain cooperative relations when punishment phases occur with positive probability on the equilibrium path.

[21] In this case the von Neumann-Morgenstern framework does not allow one to disentangle agents' attitudes toward risk from their attitudes toward intertemporal substitution, and a more sophisticated model of dynamic preferences under uncertainty – e.g. the one introduced by Kreps and Porteus (1978) – must be used. To avoid confusion I am pursuing these issues in a strictly related but distinct paper.

5 Concluding Remarks

We have studied how agents' intertemporal preferences and their ability to access markets, particularly financial ones, affect the sustainability of cooperative relations in different environments. We found that agents' aversion to intertemporal substitution tends to facilitate cooperative relations by decreasing agents' evaluation of short-run gains from defections and increasing that of losses from punishments. Goods' markets and money may then hinder cooperation by allowing agents to reallocate short-run gains from defections in time at a cost. By allowing for free intertemporal reallocation of material-payoffs, financial markets hinder cooperative relations, unless the market interest rate is substantially lower than agents' subjective discount rate and loans are perfectly enforceable. In this case, as well as when agents are subject to very strong income fluctuations, access to financial markets may end up facilitating relations.

These last cases, however, appear rather special ones. Overall, our results appear to support the view that better access to – or better functioning – anonymous markets, in particular financial ones, may make cooperative relations harder to sustain (thereby intensifying competition). To put it like Hirschman (1970), markets may harm cooperative relations by improving agents' "exit" option. Previous work has focused on how "improved exit" limits the threats that agents can use to discipline cooperation. This paper has shown that markets may also "improve exit" in the sense of increasing agents' evaluation of short-run gains from defections, encouraging them to "take the money and run".

Although the effects unveiled in this paper and those discussed in previous work reinforce each other, in the sense that they all point – through different channels – to a negative relation between improved market access and sustainability of long-term cooperative relations, we consider the issue all but settled. Much more work is needed. The access to anonymous, integrated markets may influence agents' behavior in several other ways than those modelled until now. And the final effect of globalization on cooperative (and competitive) relations will depend on the relative strength of *all* the forces at play.

6 Appendix

Proof of Proposition 1. Consider any monotone increasing utility function $g(\pi)$, with $g' > 0$. When $U_i = g$ agent i's incentive compatibility constraint when equilibria are supported by an optimal punishment (in the sense of Abreu, 1986, 1988) becomes

$$g(\pi_i^*) \geq (1-\delta) g\left(\hat{\pi}(a_{-i}^*)\right) + \delta g(\underline{\pi}_i). \tag{IC.g}$$

Let $\underline{\delta}^g$ be the lowest discount factor at which condition (IC.g) is satisfied, such that $g(\pi_i^*) = (1-\underline{\delta}^g) g\left(\hat{\pi}(a_{-i}^*)\right) + \underline{\delta}^g g(\underline{\pi}_i)$. Consider any other utility function h that is a strictly concave transformation of g, so that $h = f(g)$ and for some f with $f' > 0$, $f'' \leq 0$, and $f''(g(\pi_i')) < 0$ for some π_i' s.t. $\hat{\pi}(a_{-i}^*) > \pi_i' > \underline{\pi}_i$, leading to the condition

$$h(\pi_i^*) \geq (1-\delta) h\left(\hat{\pi}(a_{-i}^*)\right) + \delta h(\underline{\pi}_i). \tag{IC.h}$$

Define $\underline{\delta}^h$ as the lowest discount factor at which (IC.h) is satisfied, so that

$$h(\pi_i^*) = (1-\underline{\delta}^h) h\left(\hat{\pi}(a_{-i}^*)\right) + \underline{\delta}^h h(\underline{\pi}_i) = (1-\underline{\delta}^h) f\left[g\left(\hat{\pi}(a_{-i}^*)\right)\right] + \underline{\delta}^h f\left[g(\underline{\pi}_i)\right].$$

By concavity

$$\begin{aligned}
(1-\underline{\delta}^h) f\left[g\left(\hat{\pi}(a_{-i}^*)\right)\right] + \underline{\delta}^h f\left[g(\underline{\pi}_i)\right] &< f\left[(1-\underline{\delta}^h) g\left(\hat{\pi}(a_{-i}^*)\right) + \underline{\delta}^h g(\underline{\pi}_i)\right] \Leftrightarrow \\
f\left[g(\pi_i^*)\right] &< f\left[(1-\underline{\delta}^h) g\left(\hat{\pi}(a_{-i}^*)\right) + \underline{\delta}^h g(\underline{\pi}_i)\right] \Leftrightarrow \\
g(\pi_i^*) &< (1-\underline{\delta}^h) g\left(\hat{\pi}(a_{-i}^*)\right) + \underline{\delta}^h g(\underline{\pi}_i) \Leftrightarrow \\
\underline{\delta}^h &< \underline{\delta}^g,
\end{aligned}$$

which implies that condition (IC.h) is less stringent than condition (IC.g). *Q.E.D.*

Proof of Proposition 2. State variables (agents' savings) and market transactions do not affect material payoff functions, hence the best response structure of the material payoff game G, $\pi_i : \Omega \rightarrow R$, does not change with market access and $(\underline{\pi}_i, \underline{\pi}_{-i})$ remains a static Nash equilibrium outcome and agent i's minimax material payoff of each stage of the dynamic game. Since in any continuation subgame of the dynamic game each agent can secure himself at least the minimax continuation material payoffs stream $\{\pi_i^t = \underline{\pi}_i\}_{t=\tau}^{\infty}$, no punishment can be built to discipline defections that delivers a lower continuation utility than that generated by such stream. And since agents' minimax $\underline{\pi}_i$ is a Nash equilibrium outcome at each stage, an infinite sequence of minimax material payoffs is a Markov-perfect equilibrium outcome of the overall dynamic game. Hence a minimax punishment path that keeps defecting agents at their security levels, a time-average material payoff of $\underline{\pi}_i$, remains both feasible and optimal (in the sense of Abreu, 1988) after agents gain access to markets, and continues to determine the necessary conditions under which cooperation can be supported in subgame-perfect Nash equilibrium.

When agents discount future at the positive rate r and earn no interest rate on savings the Euler equation for intertemporal utility maximization is $U'(c_i^t) = \frac{1}{1+r}U'(c_i^{t+1})$ $\forall t$, where c^t is the amount of material payoffs allocated to (consumed in) period t. The Euler equation implies $c_i^t > c_i^{t+1}$ $\forall t$, hence independent of C for an agent who sticks to cooperation expecting to earn the stationary flow of material payoffs $\{\pi_i^t = \pi_i^*\}_{t=0}^{\infty}$ the option of selling part of the material payoffs today and buying additional material payoffs in the future is always strictly dominated by that of consuming all immediately. It follows that the access to a market for material payoffs cannot increase the value of the expected gains from cooperation and $\Delta V^c = 0$. The period in which an agent defects unilaterally from cooperation he receives $\hat{\pi}_i(a_{-i}^*)$, and in periods following the defection he expects a time-averaged material payoff of at least $\underline{\pi}_i$. When $U'(\hat{\pi}_i(a_{-i}^*) - C) < \frac{1}{1+r}U'(\underline{\pi}_i)$, a deviating agent can then increase lifetime utility V^d by selling some fraction of short-run gains from the unilateral deviation on the market and buying it back the next period, hence $U'(\hat{\pi}_i(a_{-i}^*) - C) < \frac{1}{1+r}U'(\underline{\pi}_i) \Rightarrow \Delta V^d > 0$. When $U'(\hat{\pi}_i(a_{-i}^*) - C) \geq \frac{1}{1+r}U'(\underline{\pi}_i)$ saving material payoffs reduces a defecting agent's lifetime utility, hence $U'(\hat{\pi}_i(a_{-i}^*) - C) \geq \frac{1}{1+r}U'(\underline{\pi}_i) \Rightarrow \Delta V^d = 0$. *Q.E.D.*

Proof of Proposition 3. Again, state variables (agents' financial assets and liabilities) and market transactions do not affect material payoff functions, so $(\underline{\pi}_i, \underline{\pi}_{-i})$ remains a Nash equilibrium outcome and agent i's static minimax on each stage of the dynamic game. This implies that the minimax punishment path that keeps defecting agents at their security level of a time-average material payoff of $\underline{\pi}_i$ remains feasible and optimal after agents gain access to financial markets, and continues determining the necessary conditions for cooperation being supported in equilibrium.

The Euler equation for intertemporal utility maximization is now $U'(c_i^t) = U'(c_i^{t+1})$, which implies $c_i^t = c_i^{t+1}\ \forall t$. An agent who sticks to cooperation expects to earn a stationary flow of material payoffs $\{\pi_i^t = \pi_i^*\}_{t=0}^{\infty}$, which is already an optimal intertemporal allocation that cannot be improved upon through market transactions, hence $\Delta V^c = 0$. The period in which an agent defects unilaterally from cooperation he receives $\hat{\pi}_i(a_{-i}^*)$, while in periods following the defection he expects a time-averaged material payoff of at least $\underline{\pi}_i$. With perfect financial markets and $i = r$ the deviating agent can optimally reallocate these payoffs in time to consume a constant amount equal to the overall time-average material payoff from defecting $(1-\delta)\hat{\pi}_i(a_{-i}^*) + \delta\underline{\pi}_i$ which, since by concavity $U((1-\delta)\hat{\pi}_i(a_{-i}^*) + \delta\underline{\pi}_i) > (1-\delta)U(\hat{\pi}_i(a_{-i}^*)) + \delta U(\underline{\pi}_i)$, implies $\Delta V^d > 0$. *Q.E.D.*

Proof of Proposition 4. From (IC.3) we have

$$V^d - V^c \equiv (1-\rho)\hat{\pi}(a_{-i}^*) + \rho\underline{\pi}_i - \pi_i^* \equiv \frac{i}{1+i}\hat{\pi}(a_{-i}^*) + \frac{1}{1+i}\underline{\pi}_i - \pi_i^*,$$

which by inspection implies $\frac{\partial(\Delta V^d - \Delta V^c)}{\partial i} > 0$ for any positive i. From Proposition 3 we know that when $i = r$, so that $\rho = \delta$ and (IC.3)≡(IC.2)[22], condition (IC.3) is strictly more stringent than (IC.1), i.e. $i = r \Rightarrow \Delta V^d > \Delta V^c$. For any $i > r$, $\rho < \delta$ implies that (IC.3) is more stringent than (IC.2) which is more stringent than (IC.1), hence $i \geq r \Rightarrow \Delta V^d < \Delta V^c$. Since the right hand side of (IC.3) is strictly decreasing in i, by gradually reducing i below $i = r$ one makes (IC.3) continuously less stringent, and finds a level $\underline{i} < r$ at which (IC.3) is equivalent to (IC.1), i.e. s.t.

$$\pi_i^* - (1-\underline{\rho})\hat{\pi}(a_{-i}^*) - \underline{\rho}\underline{\pi}_i = U(\pi_i^*) - (1-\delta)U\left[\hat{\pi}_i(a_{-i}^*)\right] - \delta U(\underline{\pi}_i),\ \text{with}\ \underline{\rho} = \frac{1}{1-\underline{i}} \Leftrightarrow$$

[22] That is,

$$\pi_i^* - (1-\rho\left|_{i=\underline{i}}\right.)\hat{\pi}(a_{-i}^*) - (\rho\left|_{i=\underline{i}}\right.)\underline{\pi}_i = U_i(\pi_i^*) - (1-\delta)U_i\left[\hat{\pi}_i(a_{-i}^*)\right] - \delta U_i(\underline{\pi}_i).$$

$$\underline{i} = \frac{\pi_i^* - \underline{\pi}_i - \left[U_i(\pi_i^*) - (1-\delta)U_i\left[\hat{\pi}_i(a_{-i}^*)\right] - \delta U_i(\underline{\pi}_i)\right]}{\hat{\pi}(a_{-i}^*) - \pi_i^* + \left[U_i(\pi_i^*) - (1-\delta)U_i\left[\hat{\pi}_i(a_{-i}^*)\right] - \delta U_i(\underline{\pi}_i))\right]}.$$

It is immediate to verify (by substituting $U_i(\pi_i) = a\pi_i + b$) that when $U_i(\pi_i^*)$ is linear $\underline{i} = r$, and that $\underline{i}$ decreases when the concavity of U and/or r increase (then the term $\left[U_i(\pi_i^*) - (1-\delta)U_i\left[\hat{\pi}_i(a_{-i}^*)\right] - \delta U_i(\underline{\pi}_i)\right]$ becomes larger). Since with $i = \underline{i}$ it is $\Delta V^d = \Delta V^c$, and gradually reducing i below $\underline{i}$ one still makes (IC.3) continuously less stringent than (IC.1), $i < \underline{i} \Rightarrow \Delta V^d < \Delta V^c$. *Q.E.D.*

Proof of Proposition 5. Suppose agents obtain access to perfect financial markets with $i = r$. From Fisher's Separation Theorem we know that agents will behave optimally by maximizing discounted sum of expected material payoffs. Then the relevant conditions (IC.e) and (IC.o) must be modified by substituting the function $U(x)$ with its argument x (replacing $U(\pi_i^*)$ with π_i^*, $U(\underline{\pi}_i + \theta^e)$ with $U(\underline{\pi}_i + \theta^e)$, and so forth) after which both conditions simplify down to (IC.2). This immediately leads to the following.

Lemma 1 *The access to financial markets always makes the incentive compatibility condition for even periods (IC.e) more stringent.*

Proof. To compare condition (IC.e) with (IC.2), consider the incentive compatibility condition for the hypothetical case where agents receive θ^e in all periods

$$U(\hat{\pi}_i(a_{-i}^*) + \theta^e) - U(\pi_i^* + \theta^e) \leq \delta \frac{U(\pi_i^* + \theta^e) - U(\underline{\pi}_i + \theta^e)}{1-\delta^2} + \delta^2 \frac{U(\pi_i^* + \theta^e) - U(\underline{\pi}_i + \theta^e)}{1-\delta^2}. \tag{IC.θ}$$

When agents gain access to perfect financial markets only material payoffs matter and all shocks cancel out, so (IC.θ) becomes (IC.2). And by Proposition 1, the strict concavity of U implies that (IC.θ) is strictly more stringent than (IC.2). Now compare conditions (IC.e) and (IC.θ). These conditions differ only in their first term on the right-hand side, which is larger for (IC.e) as the concavity of U implies decreasing differences. This, in turn, implies that (IC.e) is always less stringent than (IC.θ), and therefore than (IC.2). Hence the access to financial markets always makes the incentive compatibility condition for even periods more stringent. ■

To compare conditions (IC.o) and (IC.2) we can use the intermediate comparison with (IC.1) – which we know less stringent than (IC.2) by Proposition 1 – and rephrase all conditions in terms of the lower bound of discount factors at which they are satisfied. Condition (IC.2) can be rewritten as $\delta \geq \underline{\delta} = \frac{\hat{\pi}_i(a^*_{-i})-\pi^*_i}{\hat{\pi}_i(a^*_{-i})-\underline{\pi}_i}$, and (IC.1) as $\delta \geq \underline{\delta}^U = \frac{U(\hat{\pi}_i(a^*_{-i}))-U(\pi^*_i)}{U(\hat{\pi}_i(a^*_{-i}))-U(\underline{\pi}_i)}$, where $\underline{\delta} > \underline{\delta}^U$ by Proposition 1. Condition (IC.o) differs from (IC.1) only in its first term on the right-hand side, which is smaller for (IC.o) since the strict concavity of U implies decreasing differences. This in turn implies that fluctuations make (IC.o) less stringent than (IC.1). As long as U is strictly concave and monotone increasing, as assumed, decreasing differences imply

$$\lim_{\theta^e \to \infty} \frac{U(\pi^*_i + \theta^e) - U(\underline{\pi}_i + \theta^e)}{1-\delta^2} = 0.$$

Hence, for a sufficiently large θ^e, condition (IC.o) can be approximated by

$$U(\hat{\pi}_i(a^*_{-i})) - U(\pi^*_i) \leq \delta^2 \frac{U(\pi^*_i) - U(\underline{\pi}_i)}{1-\delta^2} \Leftrightarrow \delta \geq \underline{\delta}^o = \sqrt{\frac{U(\hat{\pi}_i(a^*_{-i})) - U(\pi^*_i)}{U(\hat{\pi}_i(a^*_{-i})) - U(\underline{\pi}_i)}} = \sqrt{\underline{\delta}^U}.$$

Since $\underline{\delta}^U < 1$, $\underline{\delta}^o = \sqrt{\underline{\delta}^U}$ implies $\underline{\delta}^U < \underline{\delta}^o$. Hence when U is sufficiently concave to make $\sqrt{\underline{\delta}^U} < \underline{\delta}$ (Proposition 1 only implies $\underline{\delta}^U < \underline{\delta}$), (IC.o) is less stringent than (IC.2) independent of the shock θ^e, which – together with Lemma 1 – implies that market access always makes cooperation harder to sustain. When $\sqrt{\underline{\delta}^U} > \underline{\delta}$, one can find a sufficiently large θ^e such that condition (IC.o) is more stringent than (IC.2), so that market access makes cooperation easier to sustain in odd periods. When this is the case, and $\sqrt{\underline{\delta}^U} > \delta > \underline{\delta}$, cooperation in all periods was not sustainable without market access ($\sqrt{\underline{\delta}^U} > \delta$ implies that (IC.o) is not satisfied), and becomes sustainable with market access and $i = r$ ($\delta > \underline{\delta}$ implies that (IC.2) is satisfied). *Q.E.D.*

Proof of Proposition 6. (1) Consider the stationary environment of Section 3. When $i > r$ no agent wishes to borrow in any case, hence limited enforceability of loans to private agents changes nothing with respect to Proposition 4: since $r > \underline{i}$, $\Delta V^d > \Delta V^c$ and statement 1 of Proposition 4 applies. When $i < r$, an agent that cooperates does not wish to save and cannot borrow, hence $\Delta V^c = 0$. On the other hand, when $i < r$ but

$U'(\hat{\pi}_i(a^*_{-i})) < \frac{1+i}{1+r}U'(\underline{\pi}_i)$, that is when $r > i > i^{\min}$, a defecting agent cannot borrow but finds it convenient to save, hence $\Delta V^c > 0 = \Delta V^d$. When $i < i^{\min}$ neither cooperating nor defecting agents wish to save and can borrow, hence $\Delta V^c = \Delta V^d = 0$. Statement 1 follows.

(2) Consider the non-stationary environment outlined in Section 4.1, where agents receive $\theta^e > 0$ extra material payoffs in even periods. When agents start cooperating during an odd (low income) period, limited enforcement prevents them from borrowing against future payoffs to relax condition (IC.o). Given Lemma 1, this implies that the access to financial markets cannot facilitate cooperation. When agents start cooperating during an even period, they can still optimize their intertemporal consumption path by saving at rate $i = r$ part of current material payoffs, thereby relaxing condition (IC.o) (reducing the incentives to defect) for the following odd period. Then the proof of Proposition 5 applies and statement 2 follows. *Q.E.D.*

Proof of Proposition 7. Since G has the structure of a Prisoner's Dilemma, there exist a vector of actions $\mathbf{a}^{pi} = \left\{a_i^{pi}, a_{-i}^{pi}\right\}$ such that $\pi_i^{pi}(a_i^{pi}, a_{-i}^{pi}) < \pi_i^*$ and $\pi_{-i}^{pi}(a_i^{pi}, a_{-i}^{pi}) \geq \pi_{-i}^*$. We know from van Damme (1989) and Farrell and Maskin (1989) that absent access to markets agents can then sustain cooperation through a weakly renegotiation-proof punishment phase that is payoff-equivalent to grim trigger strategies but has finite duration T. This punishment phase is such that after a defection by agent i the action profile $\mathbf{a}^{pi}$ is played T periods with (observable) probability p after which cooperation is restored, where $\left(pU(\pi_i^{pi}) + (1-p)U(\pi_i^*)\right)(1-\delta^T) + \delta^{T+1}U(\pi_i^*) \geq U(\underline{\pi}_i)$, so that absent access to markets asymmetric strategies can always be built such that $V_{GT}^d = V_{RP}^d$ (where GT stands for grim-trigger and RP for renegotiation-proof). Since the cooperative equilibrium outcome path is the same under both strategies, i.e. $V_{GT}^c = V_{RP}^c$, Proposition 1 also applies when cooperation is supported by asymmetric renegotiation-proof strategies.

From $\underline{\pi}_i$ being i's minimax material payoff, what agent i can always guarantee himself, it follows that $V_{GT}^d \leq V_{RP}^d$. In Propositions 2 and 3 access to markets has been shown to hinder cooperation by increasing V_{GT}^d while leaving V_{GT}^c unaffected. Since $V_{GT}^c = V_{RP}^c$, it follows that market access also does not affect the value of cooperating when agents use renegotiation-proof strategies. And since without market access it is $V_{GT}^{d} = V_{RP}^{d}$ and generically $V_{GT}^{d} \leq V_{RP}^{d}$, when access to markets increases V_{GT}^{d} it must also increase V_{RP}^{d}. Hence Propositions 2 and 3 also apply when cooperation is supported by asymmetric renegotiation-proof strategies. An analogous reasoning ensures that Propositions 4 to 6 also continue to apply. *Q.E.D.*

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