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Sovereign Debt Crises: Solidarity and Power

Steven ROSEFIELDE * and Yiyi LIU **

* *University of North Carolina at Chapel Hill, USA; stevenr@email.unc.edu*

** *University of North Carolina at Chapel Hill, USA; liuyiyitasha@gmail.com*

Abstract: This article disputes Tirole (2015)'s claim that competitively negotiated sovereign debt contracts with generous default provisions (sovereign solidarity) should reliably forestall sovereign debt crises. It shows using Tirole's framework that when exogenous shocks are large and their effects on the debtor and borrower countries differ, sovereign lenders may revise their attitude toward solidarity and become coercive. They don't have to behave this way, but when they do power plays a greater role in settling disputes than fair competition. Policymakers should not be misled into believing that the semblance of competition relieves them of the duty to encourage sovereign solidarity and restrain power seeking. The same principle holds more broadly in dealing with issues like European disunion and globalization.

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1. Introduction

EU sovereign debt has been mounting since the founding of the Eurozone, punctuated with periodic crises. Some defaults have occurred and others avoided with additional sovereign borrowings. Loans have included various subsidies in the spirit of 'sovereign solidarity'. The European Union endorses the principle of mutual assistance among its members. It is sometimes supposed that the sovereign solidarity approach is broadly effective even during crises. A close examination of the underlying theory however suggests the need for a more cautious evaluation, despite Jean Tirole's recent demonstration that optimal competitive, sovereign solidarity compatible debt crisis resolution compacts should normally be achievable, given restrictive assumptions about the size and distributional effects of exogenous shocks. This paper draws the opposite conclusion. It shows that when Tirole's model is generalized and omitted variables such as bad faith and coercion are included, creditors and debtors are unlikely to reach agreements that satisfy Tirole's assumptions, in part because sovereign solidarity is an attitude subject to change, especially during hard times. Debt crisis resolution consequently isn't a simple matter of principal and agent negotiating a meeting of the minds under competitive market rules. It requires artful psychological management aimed at preserving and strengthening sovereign solidarity; curbing bad faith and deterring adversarial self-seeking to achieve superior bailout solutions.

Tirole (2015) analyses the role sovereign solidarity can play in optimally resolving debt crises.

Sovereign solidarity may arise spontaneously among neighbours, more dependably among allies, and with special force in the European Union where sovereign member states are committed to 'supranationality'.[1] The crux of Tirole's demonstration is that debt crises in coalitions that advocate sovereign solidarity should be amenable to optimal competitive solutions that honor mutual assistance if exogenous symmetric stochastic shocks aren't too severe. This expectation was falsified in the latest round of the Greek Odyssey. The exogenous negative externalities that befell Greece could have been amicably managed, but Athens and Berlin failed to reach a voluntary meeting of the minds. Germany imposed austere terms of settlement on Greece.

This article clarifies why a voluntary optimal settlement wasn't realized within Tirole's sovereign solidarity framework by realistically softening a few key assumptions. The revised model is applicable to a broad range of anti-competitive international economic issues including beggar-thyneighbor tariffs, and non-negotiable sanctions.

The relaxed assumptions all involve asymmetric ex-post contracts with sovereign solidarity mandated joint or joint-and-several liability.[2] Asymmetry in Tirole's parlance represents a class of debt contracts that involve sovereign solidarity where the borrowing and lending needs of two countries (agent and principal) on the financial market differ. The agent is the sole borrower. The principal has no borrowing needs. It however has a conflict of interest with the agent to the extent that the principal serves as a potential secondary lender. This conflict is invisibly embedded in Tirole's ex-ante contracts and is supposed to be resolved in liquidity crises, default and bankruptcy proceedings as sovereign solidarity (mutual aid) dictates.[3] The optimal ex-ante debt instrument is a simple contract without joint, or joint-and-several liability. Liabilities caused by illiquidity, default and bankruptcy only appear in ex-post debt contracts shaped by sovereign solidarity. Ex-post liability settlement terms in Tirole's model are fixed by a parameter.[4] Forgiveness of interest and debt to the extent that they occur transfer wealth from the principal to the agent.

2. Sovereign solidarity, bad faith and coercion

2.1. Sovereign solidarity

The importance of sovereign solidarity in Tirole's model is best understood contextually. The EU's founding fathers were strongly motivated by post-war democratic socialism. Sovereign solidarity was their guiding light. The concept as democratic socialists employed it prioritized collective welfare above individual utility seeking market competition. Sovereign nations and people were supposed to subordinate their private aspirations to the community's needs. The magnitude of the sacrifice was left inexplicit, but it was generally understood that EU members should always err on the side of compassion and altruism rather than shackling those in dire straits to ex-ante contracts or mercenary ex-post interest and debt settlements.

From a formal modeling perspective, EU ex-ante sovereign debt contracts are intrinsically contingent. All contracts are expected to be rationally constructed and consummated in good faith. Debtors are expected to fulfill their contractual obligations. If they cannot do so in good conscience, the community is obligated by sovereign solidarity to forgive interest and debt in part or whole as compassion dictates.

The issue of how the principal should respond appropriately to the prospect of insolvency, default and bankruptcy when the agent acts in good faith boils down technically to whether the principal should be obligated by joint-and-several liability or limited liability. Joint-and-several liability potentially places the full default and/or bankruptcy burden on the principal's shoulders. The principal's moral obligation however becomes murkier if the agent acts in bad faith. The principal may decide to impose harsh terms of burden sharing when agents intend to defraud principals.[5]

2.2. Bad faith

Tirole's optimal competitive model presumes good faith, even though nations espousing sovereign solidarity sometimes seek anti-competitive advantage by accumulating debt with no intention of fully honoring their contractual commitments.[6] This is a practical concern ignored in Tirole's construct. Some German leaders fretting that Greece might be acting in bad faith and fearing contagion were unable to restrain themselves and threatened Athens with coercive sanctions,[7] despite Berlin's sovereign solidarity obligation to bail Greece out. Formally introducing bad faith into Tirole's sovereign solidarity framework isn't a small matter because the inclusion precludes optimal competitive outcomes by prioritizing bad faith over efficiency and justice.

3. Power

Tirole's model likewise excludes the possibility of sovereign coercion for the principal's benefit, even when agents act in good faith.[8] Sovereign nations however sometimes power-seek for their own advantage despite the requirements of the competitive social contract and sovereign solidarity. Power seeking not only violates Tirole's competitive axioms; anti-competitiveness places the role of sovereign solidarity in an altered perspective. Sovereign solidarity exists, but it is mutable and compassion could turn into hate.

4. Generality and inclusiveness

Tirole's model is sound for the special case he addresses: an optimally competitive debt settlement regime with implicit solidarity. Principal and agent take all pertinent factors into account when borrowing and lending in the international market for loanable funds using appropriate stochastic methods, assuming that externalities will be manageable enough for the agent to voluntarily participate and the principal to wager on joint-and-several liability solidarity in an ex-post asymmetric debt

settlement contract. The model however is misleading when its axioms don't apply; when bad faith and power-seeking outweigh sovereign solidarity.[9]

4.1. Generalizing Tirole's competitive sovereign solidarity model

Tirole's handling of sovereign solidarity debt settlement can be generalized both in ex-ante and ex-post contracting. The assumption of simple debt sovereign contracting can be broadened to permit principals and agents to negotiate any clauses they like about contingent illiquidity, default and bankruptcy liabilities. These provisions can be treated as binding or guidelines in the spirit of sovereign solidarity; but whatever intentions might be, sovereign solidarity requires compassionate ex-post debt settlement as crises drive home realities inadequately foreseen by ex-ante negotiators.[10]

To appreciate how widening Tirole's framework affects his results consider his asymmetric contract. It innocently assumes that the agent alone needs to borrow on the financial market, and faces liquidity, default and bankruptcy risks, but also is predicted on four dubious premises: 1) spillover effects from external shocks affect everyone equally; 2) sovereign solidarity assure that sanctions are compassionate, 3) principal and agent both act in good faith, 4) no one seeks anti-competitive advantage.

This inclusive version allows us to assign different spillover effects r_i to the principal and the agent, and permits the principal to impose non-compassionate contract compliance sanctions in the set of sanctions $c_i \in \{P, A\}$.

Berlin is strong and Athens is weak, an asymmetry that makes it possible for Germany to press for favorable debt settlements with conventional credible sanctions that violate the EU community's concept of sovereign solidarity. Why might Germany choose to ignore the EU solidarity pact and impose its own notion of sovereign solidarity in pressing settlement terms on Greece? There are two possibilities. First, Berlin may desire to broaden the concept of solidarity to include 'tough love'; that is, pressuring Greece to uphold its contractual responsibilities, even if this causes austerity. The motive is didactic and pecuniary. Second, Germany might try to establish a precedent that it is primus inter pares (first among equals) in EU affairs.

Berlin may prefer a stratified EU democratic process where the preferences of the powerful hold disproportionate sway. Whatever the motive, debt repayment in the general case may impose adverse terms on Greece that are incompatible with the EU standard of 'rational cooperation'. These behaviors expand the generality and inclusiveness of Tirole's model by intensifying the asymmetry in the principal- agent relationship and modifying the sovereign solidarity constraint.

Tirole's model also has important timing assumptions.

Date 1: Simple debt contract. In the case of asymmetric ex-ante pacts, Tirole assumes without any loss of generality that the agent borrows exclusively from the market which demands a payment t, even though the principal may be a participating lender. At date 1, the agent has no money, borrows b from the market, and values the debt at $R * b$. The parameter R measures the agent's demand for loanable funds. A borrowing contract specifies a sanction $c(d) \in [0,C]$ to foster compliance for varying debt

repayment levels *d*. It is transparent.

Date 2: Insolvency/Default/ Bailout. P offers A a contract specifying a transfer $t(d)$ conditional on A repaying d to investors. A then accepts or rejects this offer: $t(d)$ for all d in case of rejection. At date 2, the agent receives a random income equal to y with probability α (favorable state of nature, G) and 0 with probability $(1-\alpha)$ (unfavorable state of nature, B). The income is only observed by the agent. Income 0 is an incompressible minimum consumption standard (austerity) below which the agent is unwilling to go. Equivalently, the market and the principal are uncertain whether A is willing to belt tighten to repay the debt.

Repayment Decision: The agent chooses to repay d. If this is less than contractually stipulated, a sanction (financial penalty) $c(d)$ is levied. This assumes a commitment on the principal's part to enforce the penalty. If the agent ex-ante expects to be in a favourable state of nature $(\frac{1}{\alpha})$, it signs the optimal simple debt contract with debt $d = y$ (favourable state of nature) and sanction $c = y$). Otherwise, the agent refrains from borrowing. These choices can be evaluated relative to the externality free benchmark by comparing (R) and the inverse of the likelihood that the agent operates in the favorable state $(\frac{1}{\alpha})$.

5. Strengthening sovereign asymmetry

5.1. Ex-ante asymmetric externality

Let us now relax Tirole's uniform externalities assumptions for the principal and the agent, and analyse the consequences from Germany's perspective.

Tirole assumed that contractual sanctions in the asymmetric case (significant disparity in agent and principal wealth) would generate symmetric externalities and spillovers $r * c$ on both parties.

The total burden in the case of negative externalities and spillovers is the direct and indirect loan demand imposed on both countries. Recall sanction c_i on country i inflicts an externality $r * c_i$ on the other country, where the direct exceeds the indirect demand for loanable funds ($r < 1$). Unlike Tirole's modeling, we differentiate spillover effects for both principal and agent countries

$$\hat{c}_i^{\omega} = c_i^{\omega} + r_i c_j^{\omega}$$

Where the externality spillover r_i is country specific: $i \in \{A, P\}$.

Assume that externalities (spillovers) differ for the principal and the agent countries. Specifically, assume that the externality for the principal is greater than for the agent.

Assume further that $r_A = r < r_P$, that is, the principal's participation constraint is stronger due to the increased spillover than in Tirole's model, but that the size of the externality r is the same for the agent.

These assumptions induce the principal to offer the agent less favorable borrowing/settlement terms. They affect the principal's willingness to participate and create slack in the incentive compatible constraint.

The agent's problem is:

$max\{U_A = R(b+\tau) + \alpha(y - d_A^G - \hat{c}_A^G) + (1-\alpha)(-\hat{c}_A^B)\}$

Subject to $\hat{c}_A^{\omega} \in \hat{C}, \forall\, \omega$, and to the principal's and the market's participation constraints:

$$-\tau - \alpha(t^G + \hat{c}_P^G) - (1-\alpha)(t^B + \hat{c}_P^B)\, U_P^{LF} - b + \alpha(d_A^G + t^G) + (1-\alpha)\, t^B \geq 0$$

The incentive compatibility for the agent:

$d_A^G + \hat{c}_A^G \leq \hat{c}_A^B$

The feasibility constraint for the agent:

$d_A^G \leq y$

The analysis focuses on understanding how the principal incorporates asymmetric externalities into its utility function. The protocol has two 'breaking points'. The first establishes the agent's borrowing threshold on the financial market, taking account of the principal's voluntary ex-ante transfer τ; the second breaking point adjusts sanctions to take account of the generalized asymmetric externalities assumption. The principal has multiple options. It can increase or decrease transfers and sanctions depending on the precise form of its sovereign solidarity obligation function.

5.2. The linkage between externalities and sovereign solidarity

We start the analysis backward by analysing the principal's breaking point on the solidarity decision. The principal's lending role is underscored in our model by explicitly acknowledging its participation constraint and the agent's objective function. The principal's losses as secondary lender should be minimized for every level of sanction taking account of the relaxed incentive compatibility constraint.

The asymmetric spillover effects between principal and agent increase the likelihood of a breaking point. The principal can be patient below the tipping point, but not beyond. Markets that operate without any mutual aid obligation cannot save the day.

Asymmetric externalities and spillover effects impose greater costs on the principal than in Tirole's modeling. The principal's supplemental loss is: $(1-\alpha)(r_P - r)c_A^B$. For every given level of c_A^B, the participation constraint for the principal is more stringent. There are two possible channels for the principal to adjust the transfer (or add a transfer component) in response to the possibility of asymmetric externalities.

The first channel is through slacking the incentive constraint (allowing for incomplete financial disclosure), an adjustment that also endogenizes the effects of altered market sanctions on the agent.

$$d_A^G \leq \hat{c}_A^B = c_A^B + r_A c_P^B$$

The market sanction imposed on the agent in the unfavorable state is limited by the agent's income in the favorable state. If the externality is moderate then the principal's cost must increase pari passu, slackening the incentive compatible constraint.

The second channel operates through the principal's ability to reduce or increase transfers τ to the agent, depending on its sovereign solidarity obligation function, or the substitution of an alternative ethical standard like tough love. $-\tau - \alpha\,(t^G + c_P^G + r_P c_A^G) - (1-\alpha)(t^B + c_P^B + r_P c_A^B) \geq U_P^{LF}$.

The principal optimal response to default on an ex-ante contract is to minimize the cost of market sanctions $\varphi(\hat{c}_A) = \min_{\{(\bar{c}_A, \bar{c}_P)\hat{D} \mid \bar{c}_A = \hat{c}_A\}} [\bar{c}_P]$

The sanction on the principal is a function of the sanction on the agent. And it has the following properties: If c_A^B is within the bound C, the true spillover effects on the principal is bounded by $r_P * c_A^B \leq r_P * C$. Given $\hat{c}_P^B = c_P^B + r_P * c_A^B$, when $\hat{c}_A < C$, then $\varphi'(\hat{c}_A) = r_P$.

If c_A^B exceeds the bound C, the principal should directly consider the nominal sanction ($\hat{c}_A^B$)'s real effect on the sanction imposed when $C < \hat{c}_A < (1+r_A)C$, $\hat{c}_P^B = \frac{1}{r_A} c_A^B + \frac{1}{r_A} c_A^B + r_P * c_A^B$, then $\varphi'(\hat{c}_A) = \frac{1}{r_A}$.

With a large r_A (the externality borne by the principal is even greater, assuming assuming ($r_P > r_A$), the market sanction on the principal is a decreasing function of sanctions placed on the agent. This negative feedback should be anticipated and incorporated in the ex-ante contract. When the effect of the externality on the principal is moderate, the sanction on the principal (obligation to transfer) is an increasing function of the penalties levied on the agent.

Hence the externality-spillover threshold (the externality that the principal is willing to bear) is co-determined by the principal's desire to minimize sanctions and the burden of sovereign solidarity. If the externality is below the threshold, the principal obligated by sovereign solidarity offers the agent a bailout. If the externality exceeds the threshold, the principal pre-notifies the agent that default is unacceptable in the ex-ante pact. For Germany, if the effect of the externality is manageable, it will honor its solidarity commitment. Otherwise Greece will bear the consequences, even if Germany winds up in the final analysis shooting itself in the foot.

Now, let us consider how sovereign solidarity affects the agent's borrowing behavior. Recall, the agent is the sole borrower on financial market and the principal's borrowing role is secondary. The agent's borrowing need also has a 'breaking point'. It is determined by comparing the net marginal benefit of borrowing with acquiring a transfer from the principal.

When r_p is moderate, the marginal net benefit of borrowing for the agent is $(R_\alpha - 1)$. The net benefit

of not borrowing will be $(1-\alpha)\, r_p\, R$ [the ex-ante transfer to the agent is $(1-\alpha)\, r_p$ to the agent]. The agent's indifference condition is $(R\alpha-1) = (1-\alpha)\, r_p\, R$, hence the threshold for the agent borrowing is: $R^* = \frac{1}{(\alpha-(1-\alpha)\, r_p)}$.

When r_P is large, the principal refuses to offer an ex-post bailout. Asymmetric externalities and spillovers fix the no bailout point at $(1-\alpha)(r_p - r*)\hat{c}_A^B$. Therefore in equilibrium, with a binding incentive compatible constraint, the agent's sanction equals the repayment in the unfavourable state and the principal's sanction is the externality based on the repayment: $\hat{c}_A^B = d + r_P d$. The net benefit of borrowing will be $(R\alpha-1)\, d - (1-\alpha)(r_p - r_A)(1+r_p r_A)d$ and the net benefit of not borrowing (making do with the principal's ex-ante transfer) will be: $(1-\alpha)\, r_p\, Rd$, hence the indifference condition with different spillover effects is given by: $(R\alpha-1)d-(1-\alpha)(r_p - r_A)(1+r_p r_A)d = (1-)r_p\, Rd$. The new threshold is: $R^* = \frac{1+(1-\alpha)(r_P - r_A)(1+r_P r_A)}{(\alpha-(1-\alpha)\, r_P)}$.

Notice that if the principal's and the agents' spillover effects are the same, $r_P - r_A = 0$, then the moderate externality threshold applies. This is Tirole's case.

The agent's borrowing thresholds more generally given the principal's behavioral modifications are:

$$R^* = \begin{cases} \frac{1}{\alpha-(1-\alpha)\, r_P}; \ \alpha > (1-\alpha) r_P \\ \frac{1+(r_P - r_A)(1+r_P r_A)}{\alpha-(1-\alpha)\, r_P}; r_A - r_P \alpha \geq \alpha > (1-\alpha) \\ \infty \,; \text{otherwise} \end{cases}$$

When the spillover effects on the both principal and the agent are moderate, the breaking point for the agent's borrowing is the same as Tirole's case. When the spillover effects differ significantly, the threshold becomes more stringent. This means that the agent may only accept an unfavorable bailout under duress.

6. Artful debt crisis management

Tirole supposes that externalities and spillovers are symmetric for contracting principals and agents. This leads him to conclude that mutually amicable bailout settlements can be easily achieved even during times of crisis. This key symmetric assumption however is restrictive, not general. Dropping it negates his conclusion. As crises intensify, asymmetric externalities and spillovers not only reduce the likelihood of amicable solutions, but gradually change the rules of the game. Principals in sovereign solidarity pacts are generous when skies are blue. They become cautious when the barometer drops and may become callous in stormy weather. The nature and extent of these attitude changes depend on a

wide variety of cultural, ethical and situational factors. Nations that are attracted to tough love philosophies may choose to impose austerity on agents to eradicate bad habits, and may seek retribution if they suspect bad faith. Indulgent cultures by contrast may become more generous when they realize the extent of the agent's plight.

Debt crisis resolution consequently isn't a simple matter of principal and agent negotiating a meeting of the minds under competitive market rules. It requires artful moral-psychological management aimed at preserving and strengthening sovereign solidarity; curbing bad faith and deterring adversarial self-seeking. Generalizing Tirole's assumptions and including anti-competitive debt management stratagems to the core model illuminates these modalities and facilitates superior bailout solutions.

Formal proofs supporting the twin claims that asymmetric externalities may induce principals to discard sovereign solidarity and adopt tough love policies are provided in the appendix.

7. Conclusion

Good faith ex-ante bargaining in competitive environments under reasonable assumptions should enable participants to amicably cope with unexpected ex-post results under normal circumstances. However, when ex-post results impose onerous asymmetric burdens as they recently have on Greece, the mutual obligations that are the substance of solidarity may need to be re-negotiated. This qualification remains valid for the still festering Greek debt crisis and more broadly for a host of related conflicts including the dangers of EU disunion and de-globalization.

8. Appendix

Proposition 1. *Asymmetric externalities may induce principals to weaken or discard sovereignty solidarity.*

• *When* $R < R^*$*, the agent forgoes borrowing on the financial market.*

• *When* $R > R^*$ *and* $r_p \leq r^*$ $(d_A^\omega, c_A^\omega, c_P^\omega)$*, principal's solidarity takes the form of a simple debt ex-ante or ex-post bailout.*

• *When* $R > R^*$ *and* $r_p > r^*$ $(d_A^\omega, c_A^\omega, c_P^\omega)$*, the optimal pact may include harsh sanctions. Where the threshold* r^* *in the optimal pact is determined by all the exogenous parameters.*

The proof of proposition 1 is demonstrated by showing that the principal's sovereign solidarity is a function of asymmetric externalities. If externalities are tolerable, the principal abides by its sovereign solidarity obligations. If asymmetric externalities are deemed intolerable, the principal reduces its sovereign solidarity transfer offer.

Proposition 2. *The principal country will make it harder for the agent country to borrow when the*

spillover effects on the agent country becomes larger.

In Tirole's sovereign solidarity model, despite the principal's suspicions of the agent's indiscipline and bad faith, the principal must bail out the agent. This is because the principal cannot make credible precautionary threat there. When we relax the assumption of the same externality on both the principal and the agent, we find that the principal prefers infringing sovereign solidarity ex ante to accepting open ended obligations. To show the agent a tough love, the principal curbs the agent's need for loan by raising the bar on the financial market.

The principal's precautionary threat affects the agent's loan demand through the agent's borrowing threshold R^* where $R^* = \frac{1+(1-\alpha)(r_P-r_A)(1+r_P r_A)}{\alpha-(1-\alpha)r_P}$. and recall, the agent is able to borrow on the financial market when $R < R^*$. The credibility of the principal's ex- ante precautionary threat depends on the existence of the asymmetric externalities r_P–r_A. As the externality on the agent (r_A) increases, the asymmetry of externalities diminishes to zero, meaning $r_P - r_A \rightarrow 0$, and the precautionary effect on R^* declines pari passu. When the externality dispears, our model coincides with Tirole's. When the externalities on both countries equalize, an ex ante precautionary threat to raise the bar on agent's borrowing would not have an adequate effect on the agent. The agent knows that the principal would bail him out anyway ex post.

8.1. Proof of Proposition 1

Proof. The agent maximizes its expected utility with no discounting over the time. At date 1, the agent makes its borrowing decision. At date 2, financial markets learn that default may be in the cards, and the agent asks the principal for supplementary assistance. If this request is honoured, that agent's problem is solved. If no supplementary transfer is forthcoming, or the aid is inadequate, the agent assesses how much it should optimally borrow. The amount chosen depends directly on the principal's sovereign solidarity and indirectly on the scale of asymmetric externalities. The principal's willingness to serve as a secondary supplementary lender depends on the importance of sovereign solidarity in its utility function.

Recall, the upper bound of the principal's laissez-faire utility is as a function of the effective market sanction on the principal at the unfavorable state c_P^B; the effective market sanction for the agent at the unfavorable state c_A^B and the spillover effects on the principal r_P. $-\tau-\alpha(t^G+c_P^G+r_P c_A^G)-(1-\alpha)(t^B+c_P^B+r_P c_A^B) \geq U_P^{LF}$

We know based on the objective function that neither the agent nor the principal is sanctioned in the favourable state. If default occurs, the principal chooses the minimum of all feasible market sanction possibilities in its secondary lending capacity: $\varphi'(\hat{c}_A) = \min_{\{(\bar{c}_A,\bar{c}_P)\in\hat{C}\mid \bar{c}_A=\hat{c}_A\}}[\bar{c}_P]$.

The severity of the asymmetric externalities determines the specific forms and the path of solidarity. Recall, that the maximum punitive sanction level C is assumed to be greater than y. Given the spillover

effect of default r_i, the punitive sanction increases to $(1 + r_i)C$. This means that the market sanction on the principal may change from an increasing to a decreasing function depending on the magnitude of the market sanction imposed on the agent. If $\hat{c}_A^B$ is within the bound C, then $\varphi'(\hat{c}_A) = r_P$; If $\hat{c}_A^B$ exceeds the bound C, then $\varphi'(\hat{c}_A) = \frac{1}{r_A}$.

The agent should optimize its borrowing decision on the financial market at date1, taking the principal transfer offer into account. The borrowing threshold for the agent is:

$$R^* = \begin{cases} \frac{1}{\alpha-(1-\alpha)\,r_P}; \ \alpha > (1-\alpha)r_P \\ \frac{1+(r_P-r_A)(1+r_P r_A)}{\alpha-(1-\alpha)\,r_P}; r_A - r_P\alpha \geq \alpha > (1-\alpha) \\ \infty\,; \text{otherwise} \end{cases}$$

This proves proposition 1.

8.2. Proof of Proposition 2

Proof. Without the asymmetric externalities, the borrowing threshold is:

$$R^* = \frac{1}{(\alpha-(1-\alpha)r)}$$

With the asymmetric externalities, the borrowing threshold is:

$$R^* = \frac{1+(1-\alpha)(r_P-r_A)(1+r_P r_A)}{\alpha-(1-\alpha)\,r_P}$$

We can see clearly that as r_A approaches to r_P (based on the assumption that $r_A < r_P$), the two thresholds coincide, that is, the term $(1-\alpha)(r_P - r_A)(1+r_P r_A)$ vanishes. The impact of increasing spillover effects r_A on the agent's borrowing threshold is show in the derivative of the borrowing threshold with respect to r_A, when the spillover effects is greater on the principal than the agent $r_P > r_A$:

$$R^* = (1+(1-\alpha)(r_P-r_A)(1+r_P r_A))/(\alpha-(1-\alpha)r_P)$$

$$\frac{dR^*}{dr_A} = \frac{((1-\alpha)(r_P^2-2r_P r_A-1))}{(\alpha-(1-\alpha)r_P)^2}$$

$$< \frac{((1-\alpha)(r_P^2-2r_P r_P-1))}{(\alpha-(1-\alpha)r_P)}$$

$$=(1-\alpha)\frac{(-2r_P^2-1)}{(\alpha-(1-\alpha)r_P)}$$

$$<0$$

The last two inequalities hold, given the assumption that $\alpha > (1-\alpha)r_P$.

The agent knows when the spillover effect on the principal r_P is large, the principal tends to include threats in the threat ex- ante contract to raise the agent's borrowing threshold, but knows that the threat cannot be enforced in the ex-post contract if the principal is constrained (through τ) by sovereign solidarity rules of borrowing instead of taking the market sanction to bailout the agent ex post obligating it to accept its responsibility c_P^B.

Recall, $\hat{c}_A^B = c_A^B + r_A c_P^B$ is invariant. Unscrupulous agents therefore will be inclined to increase their borrowing as the spillover r_A increase because they know that when the asymmetry of externalities diminishes $r_p - r_A \rightarrow 0$ (as r_A increases), the principal must bail out the agent in Tirole's model. Consequently, principals that find open ended obligations unacceptable must consider options that infringe sovereign solidarity including tough love.

This proves Proposition 2.

Notes

[1] Rosefielde and Razin (2012), pp. 10-18.

[2] Tirole (2015), p. 2344. These conditions also arise in Tirole's symmetric category, but don't entail mutual aid because both nations are alike. This allows us to focus on Tirole's asymmetric case where sovereign solidarity applies, even though for completeness it should be noted that the symmetric alternative can be treated as a point on a continuum dividing solidarity-free from solidarity applicable zones.

[3] Tirole (2015), p. 2343.

[4] $e = ry$ where r is the spillover effect that is the same for both the principal and the agent and y is the GDP. Tirole (2015), p. 2343. Tirole's rule for determining ex-post liability is implicit in his mathematics. The principal's solidarity driven obligation to forgive interest and debt when liquidity crises, insolvency or bankruptcy strike doesn't appear in his ex-ante contract. It only appear in ex-post sovereign solidarity debt contracts as opaque agreements about the deviations from the mean of the negative externalities. If the ex-post deviations (windfall losses) are less than some sovereign solidarity forgiveness threshold, voluntary negotiation compels agents to bear the windfall losses. If it is greater, sovereign solidarity requires principals to forgive interest and debt according to an agreed formula. Tirole suggests that interest and debt forgiveness in this formula take account of the agent's "incompressible minimum standard of consumption" in the healthy state, but it is unclear how this caveat is operationalized or why the agent would agree if the "incompressible minimum standard of

consumption" were disregarded.

Tirole's rule is derived as follows. He assumes that the agent country consumes whatever it can borrow from the financial market ($b = \alpha d^G$, b is borrowing, α is the prior that the state is healthy and d^G is the repayment at the healthy state) with the liquidity need R. He assumes further that $d^G \leq y$ (the repayment is less than GDP in the healthy state), and that it is $y = 0$ in the unhealthy state. The 'incompressible minimum standard of consumption' at healthy state is (upper) bounded by αy and at the unhealthy state is (upper) bounded by 0). The lower bound is left blank, leaving the ex-ante agreed 'incompressible minimum standard of consumption' unspecified and its realism unevaluable.

Tirole assumes ry is the negative externality incurred by the agent and borne by the principal at the optimal. The agent's negative externality only binds the principal to forgive interest and debt (sanctions c_i^{ω} (d^{ω}) when the agent pays less than d, and ω indicates healthy/unhealthy state; where i represent P and A (principal and agent countries), and sanctions are assumed to be bounded by C, where $y \leq C$ to avoid strategic default (Triole misleading characterizes forgiveness as sanctioning).

The principal's crisis time obligation is determined by a given r at some agreed deviation of the windfall loss incurred by the agent from the expected mean value negative externality in the healthy state. The agent is required to assume the residual loss.

Tirole's failure to clarify the role played by the 'incompressible minimum standard of consumption' in the optimal ex-ante contract clouds his notion of sovereign solidarity. If the 'incompressible minimum standard of consumption' is binding regardless of the spillover effect (ry), then sovereign solidarity must be strong. If the principal's obligation is small, solidarity may be inconsequential. Forgiveness of interest and debt to the extent that they occur transfer wealth from the principal to the agent.

[5] Prospective negative externalities and spillovers may compel rational utility seeking sovereign nations to acquiesce to burdensome settlement terms.

[6] Razin and Rosefielde (2016). Veuger (2015).

[7] Grauwe (2010).

[8] Bulow and Rogoff (2015).

[9] The concept of sovereign solidarity itself can be expanded to encompass the notion of the public good, which is an intrinsic aspect of government's reason for being, implicitly included in the Lockean social contract that undergirds optimal competitive market models. Rosefielde and Mills (2015). These shortcomings are separable. Tirole's restrictive sovereign solidarity assumption can be generalized. The exclusion of bad faith and sovereign coercion can be repaired by adding omitted variables. See Rosefielde and Pfouts (2014).

[10] This is a variant of A. C. Pigou's famous concept of 'defective telescopic vision'.

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