Smart Restructuring Tokens

Michael Anderson Schillig, Christoph Kletzer, Andrei Balcau*

Abstract: In this paper, we offer a restructuring solution for any firm that issues financial assets in tokenised form. We draw on the automated contractual restructuring proposals that were widely discussed at the beginning of the 1990. Based on blockchain's smart contract capability, we suggest the creation of smart equity and debt tokens with an embedded restructuring function, that if triggered will automatically provide the issuing firm with a reduced debt load and a more sustainable capital structure. Because investors will be much better able to appreciate their treatment in the restructuring context, the cost of capital for firms using our model should be much reduced. In addition to offering a scholarly discussion and legal analysis of the proposed solution, the paper forms the basis for an actual smart contract suite that technically implements the proposal.

Keywords: blockchain, smart contracts, restructuring, tokenisation, options

Introduction

In this paper we make the case for, develop, and implement a smart contract-based automated restructuring framework that can be used by any firm that issues equity and debt securities in tokenised form. It may be particularly useful for small and medium-sized enterprises for which statutory restructuring frameworks will often be too expensive and cumbersome. In addition to offering a scholarly analysis of the current shortcomings and how to address them, the paper forms the basis for an actual smart contract suite. This suite technically implements the proposal as a template that can be used and built on by any interested firm.[1]

---

* King's College London.
[1] The code and test results are available upon request.

The possibility to administer capital structures on the blockchain and thus opening them up to smart contract automation is now a reality in markets and is reflected in current legislative projects. The tokenisation of traditional debt and equity securities has become an important growth area[2] and promises enhanced liquidity and access to capital resources for smaller and medium sized enterprises.[3] Estimates suggest that by 2030 the amount of tokenised assets will have increased from 0.6% of global GDP to 10%, or 16.1 trillion dollars overall.[4] To accommodate and facilitate these developments, several jurisdictions have begun to update their general private and commercial law statutes.[5]

In the following section we justify the need for a tech-based solution in the restructuring context by taking stock of the emerging landscape for statutory restructurings. We highlight the insurmountable conflict at the heart of all statutory restructuring proceedings: the need for *ex ante* certainty of investors in terms of their treatment *ex post*, and the need for *ex post* flexibility to address collective action problems. Both needs cannot be simultaneously

---

[2] Many financial services providers experiment in this space and most of the issuances so far have been in digital bonds. For example, in 2023 Siemens issued the first digital bond using the public Polygon blockchain: "Siemens issues first digital bond on blockchain" (14 February 2023), *Siemens*, https:*//press.siemens.com/global/en/pressrelease/siemens-issues-first-digital-bond-blockchain*; both UBS AG and the City of Lugano launch native digital bonds on Swiss SDX: "UBS AG launches the world's first digital bond that is publicly traded and settled on both blockchain-based and traditional exchanges" (3 November 2022), *UBS, https://www.ubs.com/global/en/media/display-page-ndp/en-20221103-digital-bond.html* and "Benvenuta Lugano! The City of Lugano Issues its First Native Digital Bond on SDX with ZKB as Sole Lead Manager" (13 January 2023), *SDX, https://www.sdx.com/news/benvenuta-lugano/.*

[3] Notable examples of successful tokenised securities issues include Quadrant Biosciences, Mt Pelerin, and Blockpit AG. Overall, the tokenisation of equities has thus far not kept pace with to the issuance of tokenised debt securities (for example, by high-profile banks Goldman Sachs, HSBC, UBS, BNP Paribas, Santander). However, there are prominent initiatives in the pipeline that promise substantive movement in this space in the not-too-distant future: SDX, the digital asset arm of the Swiss stock exchange, for instance, is building an infrastructure to enable SMEs to issue tokenised securities without going public, including a dedicated central securities depository (CSD) for digital assets.

[4] Blockworks, "DeFi's next growth engine = Integration with Real World Assets", *Linkedin, https://www.linkedin.com/posts/the-blockworks-group_defis-next-growth-engine-integration-with-activity-7032409093575196672-rxQV?utm_source=share&utm_medium=member_ios*; R. Khan, "Asset Tokenization a Trillion Dollar Market: JP Morgan, Blackrock and Goldman Sach Think So" (29 June 2023), *Forbes https://www.forbes.com/sites/roomykhan/2023/06/29/asset-tokenization-a-trillion-dollar-market-opportunity-jp-morgan-blackrock-and-goldman-think-*so/?sh=76fec74f4ff0; see further "Citi GPS, Money, Tokens and Games: Blockchain's next Billion Users and Trillions in Value" (March 2023), *Citi GPS, https://ir.citi.com/gps/MG9DEWhoYvQJVWLM9Kr3%2BZmqjoztKJcyNHr83F9Wug2pzAGHPQKfp23RAMrkNts%2FJitXoTNqufOvegUjjXh0IA%3D%3D.*

[5] See Luxembourg: Law of 6 April 2013 on dematerialised securities, Article 1(11), and Projet de loi 7363 portant modification de la loi modifiée du 1er août 2001 concernant la circulation de titres; Liechtenstein: Gesetz vom 3. Oktober 2019 über Token und VT-Dienstleister (TVTG), and Liechtensteinisches Landesgesetzblatt Nr 301 (2. Dezember 2019); Switzerland: Bundesgesetz zur Anpassung des Bundesrechts an Entwicklungen der Technik verteilter elektronischer Register vom 25. September 2020, BBl 2020, 7801; and Germany: Gesetz über elektronische Wertpapiere (eWpG); also Lawtech UK, *Legal Statement on the issuance and transfer of digital securities under English private law* (February 2023).

maximised and we end up with an unhappy compromise that works reasonably well for large corporates with sufficient resources, but is mostly prohibitively expensive for small and medium-sized enterprises.

We then develop our smart contract-based restructuring solution by drawing on the widely discussed automated contractual restructuring frameworks developed by Barry Adler (and others) in the 1990s[6] and combining it with Bebchuk's option model [7] for designing entitlements that *ex post* perfectly match investors' *ex ante* expectations. On that basis we provide a template for a series of interacting smart contracts on Ethereum that implement our restructuring solution. A smart contract is simply computer code – software – running on a distributed network, like the Ethereum network (Ethereum Virtual Machine). This software can handle digital funds (eg ETH) according to its internal logic, the operation of which can be triggered by human agents through transaction messages or by being 'called' by other smart contracts. The internal structure of smart contracts is publicly accessible, and its logic can therefore be scrutinised and vetted by everyone with the necessary coding capabilities.[8]

Efficient Restructuring Frameworks for SMEs: An Elusive Goal

Modern restructuring frameworks are nothing more than an attempt to resolve the tension between the demands of *ex post* and *ex ante* efficiency. The former requires a quick and easy legal process, initiated sooner rather than later, that can easily overcome minority dissent and holdouts. The latter necessitates the protection of investors' property rights to

---

[6] Barry Adler, "Financial and Political Theories of American Corporate Bankruptcy" (1993) 25 Stan. L. Rev. 311; Barry Adler, "Finance's Theoretical Divide and the Proper Role of Insolvency Rules" (1994) 67 South. Calif. Law Rev. 1107; Adler, "A Theory of Corporate Insolvency" (1997) 72 N.Y.U. L. Rev. 343; Barry Adler, "A World without Debt" (1994) 72 Wash. U. L. Q, 811; Michael Bradley and Matthew Rosenzweig, "The Untenable Case for Chapter 11" (1992) 101 Y.L.J. 1043; Robert Rasmussen, "Debtor's Choice: A Menu Approach to Corporate Bankruptcy" (1992) 71 Tex. L. Rev. 51; Robert Rasmussen, "A New Approach to Transnational Insolvencies" (1997) 19 Mich. J. Int'l. L. 1; Robert Rasmussen, "Empirically Bankrupt" (2007) Colum. Bus. L. Rev. 179.

[7] Lucian Bebchuk, "A New Approach to Corporate Reorganizations" (1988) 101 Harv. Law Rev. 775; Bebchuk, "Using Options to Divide Value in Corporate Bankruptcy" (2000), National Bureau of Economic Research Working Paper 7614, 2.

[8] As soon as they are deployed, smart contracts cannot be changed any longer and they automatically follow their internal logic (subject, of course, to a possible 'backdoor' through which developers can reserve certain powers for themselves); see A. Antonopoulos and G. Wood, *Mastering Ethereum* (O'Reilly, 2019) p.127.

the greatest possible extent. The result is an unsatisfactory compromise that may work adequately for some large corporate debtors and creditors with sufficient resources. Overall, however, current restructuring frameworks are often perceived as cumbersome, time-consuming, and expensive, often prohibitively so for SMEs.[9]

Since the mid 1980s, corporate insolvency law reform in many jurisdictions has vigorously embraced the so-called 'rescue culture' with a view to preserving floundering businesses as functioning units.[10] The global financial crisis of 2007-2009 generated further reform efforts at both national[11] and regional levels.[12] In the course of the COVID-19 pandemic, these were tested to a limited extent due to generous state support for many businesses.[13]

Chapter 11 of the US Bankruptcy Code is widely perceived as the ultimate debt-restructuring mechanism for large publicly traded companies. Traditionally the complexities, costs and lengths of Chapter 11 proceedings have prevented SMEs from effectively utilising it.[14] Even the 2019 Small Business Reorganization Act ('SBRA')[15] excludes[16] many mid-sized companies from its simplified and streamlined procedures.[17] Chapter 11 has been a model for a series of law reforms in various countries, including France, Germany[18] and numerous other EU Member States,[19] culminating in Directive (EU) 2019/1023 on preventive restructuring

---

[9] The Insolvency Service, *Corporate Insolvency and Governance Act 2020 – Final Evaluation Report 2022* (19 December 2022) para 4.2.4. (available at *https://www.gov.uk/government/publications/corporate-insolvency-and-governance-act-2020-evaluation-reports*).; Horst Eidenmüller, "The Rise and Fall of Regulatory Competition in Corporate Insolvency Law in the European Union" (2019) 20 EBOR 547, 559.

[10] V. Finch, *Corporate Insolvency Law*, 2nd edn (CUP 2009) p.253; Eidenmüller, "The Rise and Fall of Regulatory Competition in Corporate Insolvency Law in the European Union", 550-551.

[11] R. Bork, *Rescuing Companies in England and Germany* (OUP 2012) pp.5-13 (para 1.10-1.26).

[12] Directive (EU) 2019/1023 of the European Parliament and of the Council of 20 June 2019 on preventive restructuring frameworks, on discharge of debt and disqualifications, and on measures to increase the efficiency of procedures concerning restructuring, insolvency and discharge of debt, and amending Directive (EU) 2017/1132 (Directive on restructuring and insolvency) [2019] OJ EU L 172/18.

[13] The Insolvency Service, *Corporate Insolvency and Governance Act 2020 – Final Evaluation Report 2022*, para 2.

[14] Nicole Cipriano, "The Big Short: How the Big Step of the Small Business Reorganization Act Fell Short" (2021) 50 Hofstra Law Rev. 145, 146.

[15] Small Business Reorganization Act of 2019, Pub. L. No 116-54, 133 Stat. 1079.

[16] To companies with debts not exceeding $3,024,725 (up until June 2024 the debt limit had been increased to $7,500,000): Coronavirus Aid, Relief, and Economic Security Act of 2020, Pub. L. No. 116-136, §113, 134 Stat. 281 (2020); COVID-19 Bankruptcy Relief Extension Act of 2021, Pub. L. No. 117-5, 135 Stat. 249; Bankruptcy Threshold Adjustment and Technical Corrections Act of 2022, Pub. L. No. 117-151, 136 Stat. 1298.

[17] Cipriano, "The Big Short: How the Big Step of the Small Business Reorganization Act Fell Short" 162-164.

[18] C. Gerner-Beuerle and M. Schillig, *Comparative Company Law* (OUP, 2019) p.948.

[19] G. McCormack, *The European Restructuring Directive* (Edward Elgar, 2021) pp.17-19.

frameworks,[20] replicating many features of Chapter 11. Hitherto, Chapter 11's impact on English law has been limited. However, the Corporate Insolvency and Governance Act 2020 ('CIGA') introduced a new restructuring plan process, implemented as Part 26A of the Companies Act 2006, which closely follows the trajectory of the tried and tested scheme of arrangement but allows for a cross-class cram down as its major innovation, bringing the process closer to Chapter 11.

Despite these legislative efforts, designing an effective restructuring framework has remained an elusive goal, in particular, for SMEs.

A business[21] will be worth 'rescuing' only if it is economically viable despite experiencing financial distress.[22] The latter must be resolved by changing the debtor entity's capital structure consisting of the financial assets – equity and debt – issued by the debtor.[23] Putting the capital structure on a more sustainable footing can be achieved through a negotiated debt reduction/extension and/or a debt to equity swap; alternatively, the viable parts of the business may be transferred to a new entity, leaving some (junior) creditors behind so that the new entity emerges with a much-reduced debt load; or a combination of both.[24]

Based on these considerations, a restructuring framework is efficient *ex post* – after financial distress has emerged – to the extent that it is likely to maximize the net asset value of the business.[25] The earlier restructuring efforts are initiated the more likely economic viability of the business can be retained.[26] The debtor company's management is in the perfect position to ascertain its financial and economic situation.[27] Accordingly, modern

---

[20] Directive (EU) 2019/1023 of the European Parliament and of the Council of 20 June 2019 on preventive restructuring frameworks, on discharge of debt and disqualifications, and on measures to increase the efficiency of procedures concerning restructuring, insolvency and discharge of debt, and amending Directive (EU) 2017/1132 (Directive on restructuring and insolvency), OJ EU L 172/18 26.6.2019.

[21] As distinct from the corporate entity that holds it which is not worth preserving in its own right; B. Adler, D. Baird and T. Jackson, *Bankruptcy: Cases, Problems, and Materials*, 4th edn (Foundation Press, 2007) pp.26-29

[22] T. Jackson, *The Logic and Limits of Bankruptcy Law* (HUP, 1986) p.2.

[23] Jackson, *The Logic and Limits of Bankruptcy Law*.

[24] K. Asimacopoulos and J. Bickle (eds.), *European Debt Restructuring Handbook* (Global Law and Business, 2013).

[25] Bebchuk, "Using Options to Divide Value in Corporate Bankruptcy".

[26] Horst Eidenmüller, "Contracting for a European Insolvency Regime" (2017) 18 EBOR 273, 285.

[27] *BTI 2014 LLC v Sequana SA* [2022] UKSC 25 per Lady Arden JSC at [304].

restructuring frameworks aim to incentivise management to initiate restructuring proceedings early with debtor-in-possession governance leaving incumbent management in control.[28] Additionally, these frameworks may relax the absolute priority rule enabling owner-managers to more easily retain a stake in the business. [29]

Following initiation, a decision must be made and implemented regarding the future of the business – either liquidation or financial reorganization, possibly combined with an organizational restructuring.

Depending on the order of priority, the various corporate stakeholders – management, holders of equity, senior (secured) creditors, and various classes of junior creditors – may all have conflicting interests: management and holders of equity may have a natural bias for continuation; whereas secured creditors my want to quickly liquidate their collateral; conversely, senior creditors may have acquired their claims with a view to taking over the company ('loan to own') or may collude with incumbent shareholders/managers to force out the junior creditors. How the various incentive structures play out is impossible to predict in advance and will largely depend on whether a constituency is 'in the money' or 'out of the money.' This raises the thorny issue of valuation, which is vital not just for stakeholders formulating their preferences, but also for plan confirmation and its enforcement on dissenting claim holders as well as the protection of minority rights.

A quick going concern sale puts a definitive market value on the business. However, market liquidity will often be constrained,[30] leaving a desktop valuation as the only option. This valuation may form the basis for the negotiation amongst the various constituencies as well as for the confirmation (or rejection) of a contested restructuring plan by the courts. Restructuring frameworks provide little if any guidance on how a valuation should be

---

[28] UK Companies Act 2006 sec. 901C; Directive (EU) 2019/1023 arts.4 and 5; 11 USC §301(a); 11 USC §1108.
[29] UK Companies Act 2006 sec. 901F, 901G; Directive (EU) 2019/1023 arts.10-11; 11 USC §§1126, 1129.
[30] The Insolvency Service, *A Review of the Corporate Insolvency Framework: Summary of Responses (September 2016) 540* (response by S Paterson) (available at *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/578524/Summary_of_responses_26-10-16_Redacted.pdf*).

conducted.[31] In particular, the widely used Discounted Cash Flow (DCF) method relies heavily on subjective assumptions that are impossible to test and is therefore susceptible to manipulation.[32] The resulting uncertainties frequently result in protracted negotiations and lengthy and costly litigation where a 'battle of the experts' can eat up valuable resources and prevent the speedy implementation of restructuring measures.[33]

Valuation uncertainty and the resulting disputes are one of the main reasons why negotiations may break down and a restructuring may be contested. Therefore, restructuring frameworks must provide a mechanism to overcome the deadlock. Through majority voting in classes of sufficiently similar claims, a restructuring plan can be imposed on dissenting minority claim holders. [34] A cross-class cram-down allows for the implementation of a restructuring plan against the wishes of an entire class or multiple classes. In the interest of *ex post* efficiency, class formation, voting and plan confirmation should minimize the duration of the process as well as its direct and indirect costs so that as little value as possible dissipates during the restructuring process.[35]

Consequently, the need for *ex post* flexibility mandates the power on the part of courts and/or certain majorities to extensively rewrite *ex ante* negotiated and agreed-upon investor entitlements. In that sense, *ex post* flexibility clashes with the demands of *ex ante* efficiency. To price their financial commitments correctly, investors must be able to ascertain *ex ante* how their entitlements will fare *ex post* in a restructuring process. Ideally, the negotiated or statutory order of priority should be respected, and the content and nature of their entitlements should be amendable only subject to their *ex ante* or *ex post* consent. Generally, the *ex ante* cost of capital will increase with the propensity of investors' property rights being adversely changed in deviation from the negotiated baseline.[36]

---

[31] For example, Directive (EU) 2019/1023, art.14 requires a 'properly qualified expert'; see further Kenneth Ayotte and Edward Morrison, "Valuation Disputes in Corporate Bankruptcy" (2018) 166 U. Penn. L. Rev. 1819, 1825; The Insolvency Service (n 59) 540; G O'Dea, *Restructuring Plans, Creditor Schemes, and Other Restructuring Tools* (OUP, 2022) p.247; *Re Virgin Active Holdings Ltd* [2021] EWHC 1246 (Ch).

[32] Ayotte and Morrison, "Valuation Disputes in Corporate Bankruptcy", 1826-1828.

[33] The Insolvency Service, *A Review of the Corporate Insolvency Framework: Summary of Responses (September 2016)* 541.

[34] UK Companies Act 2006 sec. 901C, 901F; Directive (EU) arts.8-10; 11 USC §§1122, 1123.

[35] Bebchuk, "Using Options to Divide Value in Corporate Bankruptcy", 3.

[36] Bebchuk, "Using Options to Divide Value in Corporate Bankruptcy", 3.

To ease the tension between these conflicting demands, restructuring frameworks contain safeguards that seek to protect against an inappropriate re-writing of investors' property rights. These may take the form of a 'best interest of the creditor' test[37] which subjects plan confirmation to the court making sure that under the plan dissenting creditors are no worse off than in the next best alternative, which may be piecemeal liquidation or a going concern sale. A cross-class cram-down may additionally require adherence to an absolute priority rule[38] or some form of relative priority rule.[39] Both tests tend to be very flexible and subjective,[40] and cannot prevent a substantial rewriting of any *ex ante* negotiated, or even statutory, orders of priority. The ensuing uncertainty will be priced into investors' lending decisions. Moreover, all these mechanisms rely on costly valuations accounting for much of the uncertainty involved. Investors can never be sure that they will participate in the restructured company's value in accordance with their negotiated property rights and will, accordingly, require *ex ante* compensation in the form of higher returns, pushing up the costs of capital.

Modern restructuring frameworks are unable to resolve this clash between the demands of *ex post* and *ex ante* efficiency. An uneasy compromise favours the former at the expense of the latter. As a result, the costs of capital are higher than they need to be. Moreover, the often lengthy negotiations[41] and disputes about asset values and value attribution are a drain on corporate resources that could otherwise benefit the rescue effort.

A Tech-based Solution: Smart Contract Restructuring

---

[37] UK Companies Act 2006, sec. 901G(3); Directive (EU) 2019/1023, arts.10(2)(d), 2(1)(6); 11 USC §1129(a)(7).

[38] No value to junior class unless the dissenting senior class is paid in full; 11 USC §1129(b); *Case v Los Angeles Lumber Products Co,* 308 US 106, 117 (1939): 'rule of full or absolute priority.'

[39] The dissenting senior class must not be treated less favourably under the plan than any other equally ranking class and must be treated more favourably than any junior class; Directive (EU) 2019/1023, art.11(1)(c).

[40] An important exception to the absolute priority rule concerns the infusion of 'new value'; *Bank of America National Trust and Savings Association v 203 North LaSalle Street Partnership* 526 US 434, 456-458 (1999).

[41] Prepacks can significantly enhance the speed of a restructuring, however the valuation problem remains, and creditor classes may be subjected to a (potentially unjustified) re-writing of their *ex-ante* agreed entitlements; hence, the regulatory anxiety surrounding the practice in some jurisdictions; e.g. The Administration (Restrictions on Disposal etc to Connected Persons Regulations) 2021, S.I. 2021/47.

Our solution is based on a system of interacting smart contracts. Investors' entitlements – in the form of equity and debt securities – are tokenised, that is represented and referenced by tokens as blockchain-based abstractions that can be 'owned' and transferred.[42] We rely on smart contracts as mere devices for the automated performance of contractual obligations. To have legal significance there must be an agreement between the parties in accordance with traditional contract or corporate law principles – the terms and conditions of our equity and debt securities.

To be operationalised, our smart contract restructuring solution must be able to satisfactorily identify and resolve 'financial distress', thereby addressing two fundamental problems:

(i)   *When and how* should the automated restructuring be triggered – the *Trigger Problem*; and

(ii)   *To what extent* are residual (equity) claims to be diluted and the relevant debt claims to be converted to restore financial viability – the *Valuation Problem*.

As for (i), as long as the creditors are being paid in full, they get exactly what they have bargained for. However, due to the problem of 'time subordination' – short-term creditors being paid at the expense of long-term creditors – the time for a restructuring has come when the firm has reached a state where it is more likely than not that it will be unable to generate sufficient cash flows to pay its debts as they fall due in the foreseeable future.[43] At this stage, to restore financial viability in accordance with (ii), a firm's debt load must be reduced – cancelled and converted – to such an extent that it will be more likely than not that projected future cash flows will be sufficient to service the restructured fixed claims as and when they fall due.

Consequently, the conceptual solution to both problems seems to critically depend on a determination of the firm's (discounted) future cash flows, and thus seems to require off-

---

[42] Antonopoulos and Wood, *Mastering Ethereum*, p.221.
[43] Douglas Baird, "The Initiation Problem in Bankruptcy" (1991) 11 Int'l Rev. L. & Econ. 223, 224.

chain data not directly available within the smart contract's deterministic on-chain execution environment. Any reliance on off-chain data to trigger and calibrate the smart contract, however, must appear to stop our project short from the outset. Why make the effort of translating the entire restructuring logic into a smart contract if all the difficulties and uncertainties that the usual restructuring process suffers from are simply reproduced at the smart-contract/real-world interface?

In what follows, we propose a smart contract design that solves the valuation problem without the need for any off-chain data. This solution of the valuation problem, in turn, will provide a satisfactory solution for the trigger problem by relying on the optimal incentivization of the constituency best placed to make the call.

Automated Contractual Restructuring

In the course of a vigorous 'contractualisation of bankruptcy' debate unfolding in the United States over the last 30 years,[44] scholars developed various models with a view to replacing, or enhancing, the traditional statutory process with an automated contractual restructuring.[45]

Perhaps most prominently, Barry Adler developed his 'chameleon equity' approach as an automatic *ex ante* restructuring device, with a view to avoiding the substantial costs emanating from the manoeuvring among claimants for strategic advantage under the current reorganization framework.[46] A Chameleon Equity firm would issue securities in tranches with a certain order of priority. Traditional equity would form the initial residual class. In ascending order of priority, Chameleon Equity classes representing fixed obligations would be added to complete the firm's capital structure. [47] If the firm is unable to pay any of its fixed obligations, the first class in descending order of priority that the firm cannot fully

---

[44] See footnote 20.
[45] Bradley and Rosenzweig, "The Untenable Case for Chapter 11"; and note, "Distress-Contingent Convertible Bonds: A Proposed Solution to the Excess Debt Problem" (1991) 104 Harv. L. Rev. 1857.
[46] Adler, "The Creditors' Bargain Revisited".
[47] Adler, "The Creditors' Bargain Revisited"327-328.

pay on time will be automatically converted to traditional equity. All classes with lower priority including initial equity will be wiped out; all classes of higher priority will remain unchanged.[48] Upon default, no asset valuation and no bankruptcy process would be necessary. The firm would emerge with a new capital structure, automatically, without incurring the costs of the statutory restructuring process.[49]
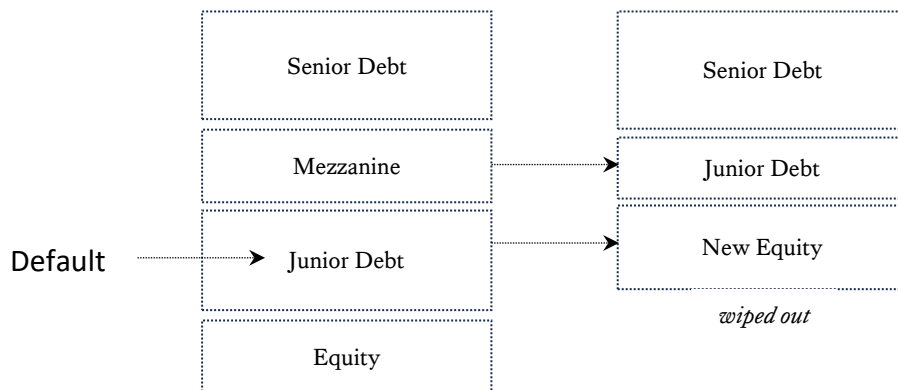

Figure 2

Adler's proposal has been subject to severe criticism: perpetually operating in a 'near default' situation where their entitlement may be wiped out may result in shareholders' underinvestment in risky, albeit positive net present value projects.[50] Moreover, liquidity would be a firm's main concern, resulting in the passing by of projects with variable cash flows regardless of their eventual payoffs and piecemeal voluntary liquidations and/or the issue of equity at fire sale prices as preferred strategies to avoid default.[51]

A less well-known proposal in the 1991 Harvard Law Review does not face these objections to the same extent.[52] Its 'distress-contingent convertible bonds' (DCCs) would automatically convert to equity upon a certain trigger event, directly and effectively improving the debt-equity ratio. Based on the terms of the underlying contract, as 'distress' ensues, a dollar nominal value of junior debt would 'collapse' into a dollar market value of equity. The

---

[48] Adler, "The Creditors' Bargain Revisited"323-326.

[49] Adler, "The Creditors' Bargain Revisited" 331; Adler "A Theory of Corporate Insolvency" 353.

[50] Donald Korobkin, "The Unwarranted Case Against Corporate Reorganization: A reply to Bradley and Rosenzweig" (1993) 78 Iowa Law Rev. 669, 716-721.

[51] Robert Rasmussen, "The Ex Ante Effects of Bankruptcy Reform on Investment Incentives" (1994) 72 W. U. L. Q., 1159, 1193-1200.

[52] Note: "Distress-Contingent Convertible Bonds: A Proposed Solution to the Excess Debt Problem".

greater the decline in equity value, the greater the number of DCC instruments to be continuously converted and the greater the number of shares into which each bond would be converted until financial distress ceases.[53] Assuming well-functioning public equity markets, the proposal's key indicator for distress (and its resolution) is the market price of equity.[54] Overall, a collapsing capital structure reduces the likelihood of distress and default so that the risk premium charged by bondholders should decline substantially, resulting in lower *ex ante* financing costs.[55] Importantly, the Harvard proposal operates in the shadow of statutory restructuring regimes: it seeks to resolve financial distress before a statutory restructuring becomes necessary which still serves as the ultimate backstop. Moreover, conversion is not tied to a single default, but the more severe condition of financial distress[56] and existing equity claims will be merely diluted.

The intuitive appeal of these proposals lies in their use of contractual devices to facilitate an automatic voluntary restructuring, thereby reducing the need for statutory reorganization processes and their embedded inefficiencies.[57] However, traditional contractual solutions are insufficient.[58] They have no proprietary effect and rely on expensive legal enforcement mechanisms. For example, under the Harvard proposal bond holders may challenge the trigger event and refuse to exchange their debt instruments for equity. Similarly, fixed-claim Chameleon equity holders may seek, and be granted, individual enforcement of their claims, contrary to the contractual stipulations. The blockchain technology with its smart contract capability fundamentally changes that, allowing for a truly automatic execution of claims and promises with proprietary effect.

Addressing the Valuation Problem: Bebchuk's option model

---

[53] "Distress-Contingent Convertible Bonds: A Proposed Solution to the Excess Debt Problem", 1870-1871
[54] "Distress-Contingent Convertible Bonds: A Proposed Solution to the Excess Debt Problem", 1870 footnote 76, 1871-1874.
[55] "Distress-Contingent Convertible Bonds: A Proposed Solution to the Excess Debt Problem", 1875.
[56] Korobkin, "The Unwarranted Case Against Corporate Reorganization: A reply to Bradley and Rosenzweig", 727-728.
[57] Korobkin, "The Unwarranted Case Against Corporate Reorganization: A reply to Bradley and Rosenzweig", 728.
[58] Adler, "The Creditors' Bargain Revisited" (2018) 1860.

For publicly traded companies, market data[59] could be relied on as the trigger for an automated restructuring. This data would be readily available off-chain and could be provided through either a centralized or decentralized oracle service.[60] However, for small and medium-sized enterprises no such readily available data points exist. The Harvard proposal suggests (for publicly traded companies with illiquid securities) to rely on some other balance sheet-based or income statement measure.[61] If publicly available, an oracle service could be relied on to collect the relevant data points and push them on-chain. This solution would be suboptimal: In addition to the general re-centralization and single-point-of-failure concerns whenever oracles are involved, the financial statements of SMEs are not normally independently verified through an audit, which opens the door to manipulation.

To overcome this roadblock, Bebchuk's approach for addressing the valuation uncertainty in corporate bankruptcy[62] seems to offer a way forward. Bebchuk's initial and modified proposals are meant as an improved auction process to take place within a statutory restructuring procedure. Its key insights can, however, be utilized for automated restructuring purposes: provided the ranking and nominal value of the relevant pre-restructuring entitlements is known, it is possible to design and distribute to the participants a set of rights that precisely matches their entitlements as a function of the company's true value (V), even though this value remains unknown.[63]

Take a company with nominal $100 in senior debt, nominal $100 in junior debt, and 100 $1 par value common shares. Assume that the company is now in restructuring proceedings and the new capital structure consists of 100 units of securities[64] in total to be allocated to

---

[59] D. Duffie, *Contractual Methods for Out-of-Court Restructuring of Systemically Important Financial Institutions* in K. Scott, G. Shultz and J. Taylor (eds), *Ending Bailouts as We Know Them* (Hoover Institution Press, 2009) pp.109, 114-115.

[60] Oracles are systems that can provide data points external to the blockchain network to smart contracts with a view to enable their on-chain execution; Antonopoulus and Wood, *Mastering Ethereum*, p. 253. A centralised oracle is essentially maintained by a trusted third party; decentralised oracles may take the form of Shelling-point oracles where token holders vote on an event or data point subject to game-theoretical incentives, or rely on decentralized oracle networks where decentralised data providers may operate an M-of-N data provision scheme.

[61] A negative cash flow over an extended period is a common indicator of financial distress, as may be a high debt to equity ratio (or debt to book value); note "Distress-Contingent Convertible Bonds: A Proposed Solution to the Excess Debt Problem" 1870 footnote 76, 1876.

[62] Bebchuk, "A New Approach to Corporate Reorganizations".

[63] Bebchuk, "A New Approach to Corporate Reorganizations", 782-784.

[64] Bebchuk, "A New Approach to Corporate Reorganizations", 782.

the corporate constituencies. Thus, if we take the value of the restructured company to be V, the per unit value would be V/100.

In a first, and basic, step we can precisely model the value attributable to our corporate constituencies as a function of V even though V remains unknown (provided we are certain of the nominal value of their claims and the order of priority). Thus, for any V of below $100 (V<100), senior debt would be entitled to V (or the entire 100 units): if the company would be liquidated at that moment, all remaining value would go to senior debt as first ranking creditors. For any V of $100 and above (V >= 100), senior debt would be entitled to $100. As for junior debt, for any V of 100 and below they would get nothing (as senior debt would take priority); for any V exceeding 100 but falling short of 200, they would be entitled to V-100: in a liquidation junior debt would receive whatever is left after paying off senior debt; and for any V of 200 and above, they would be entitled to 100 (after paying $100 to senior debt). Finally, for any V of 200 and below, our common shareholders would be entitled to zero; and for any V exceeding 200 they would be entitled to V-200 representing the residual claim.

	V <= $100	$100 < V <= $200	V > $200
Senior Creditors	V	$ 100	$100
Junior Creditors	0	V - $100	$100
Shareholders	0	0	V - $200
TOTAL	V	V	V

Bebchuk's second insight is that even though we do not know V, we can design and distribute to the participants entitlements in relation to the units of the restructured company that would end up giving each participant exactly what they originally contracted for. These entitlements take the form of a combination of various call options[65] with strike

---

[65] A call option is a (contractual) right (but not an obligation) to buy a certain asset (the 'underlying') for a specified price (the 'strike price') on or by a certain date (the 'expiration date'). The buyer of a call option holds the 'long side' of the option contract, they can 'exercise' the option on or by the expiration date and if they do they must pay the strike price to obtain the underlying asset (unless the option is cash settled in which case they would be paid the net balance equal to the value of the underlying minus the strike price). The seller of a call

prices depending on the order of priority and the nominal value of the different tranches of debt.

The above pay-out logic can be modelled by allocating specific rights to different tranches. Accordingly, in case of restructuring senior debt would be allocated Senior Creditor Rights (SCRs) replacing their original claims. Now, it would fall to the restructured company to decide if these SCRs are to be redeemed for a price equal to the nominal value of senior debt (or the pro rata share of individual senior creditors). To the extent they are not redeemed, senior debt can exchange their SCRs on par for the units of the restructured company. This logic is equivalent to senior debt being long a call option on all the securities units of the restructured company with a strike price of zero and simultaneously holding the short side of a call option on these securities units with a strike price of the nominal value of senior debt (in our example $100). In other words, senior debt will end up with V unless the restructured company has sufficient funds to redeem the SCRs (exercise its call option with a strike price of $100) in which case senior debt will walk away with $100.

A similar logic applies to junior debt and equity (common shares): junior debt receives Junior Creditor Rights (JCRs) which are equivalent to being short a call option on the restructured company (more precisely: it's securities units) with a strike price of $200 (or $2 per unit), and long a call option with a strike price of $100 (or $1 per unit). If the former is exercised, the junior debt must essentially 'buy' all units from senior debt for $100 (who walk away with the nominal value of their debt) and sell them to the company for $200, ending up with net $100 and being paid in full; if the latter is exercised, junior debt will end up with V-100 (with the strike price going to senior debt who walk away with $100). The shareholders receive Share Options (SOs) which are logically equivalent to being one call option long on (one unit each of) the restructured company at a strike price of $200 ($2 per option and unit); in other words, when all Share Options are exercised and the strike prices paid, all creditors – senior and junior – will be paid in full and equity will end up with V, owning all securities units of the restructured company.

---

option holds the 'short side': when the option is exercised, they must procure the underlying and transfer it to the option buyer in exchange for the strike price (unless the option is cash settled in which case they pay the net balance); see C. Firth, *Derivatives Law and Practice* (Sweet & Maxwell, 2023), para.1.017.

Through calibrating the expiration dates of these options, equity can be incentivised to either exercise their SOs or let them expire. To the extent that SOs are exercised, SCRs and JCRs will be redeemed and creditors either paid in full or receive adequate pro-rata entitlements in the restructured company. Under this model, every participant always receives precisely what is due to them in accordance with their pre-restructuring entitlements. The model works for capital structures of any complexity and can easily accommodate the partial exercise of embedded options within different classes; preferential and secured creditors can be easily accommodated by defining V as being subject to their entitlements.[66]

Designing our smart contract solution

We can now design our smart contract restructuring solution. Consider a firm with the following capital structure where V is unknown:

Assets	Liabilities $		Post restructuring entitlement as a function of V
V	Secured	10	[Suppliers (with retention of title)]
	Preferential	10	[Employees; Tax authorities]
	Senior	10	$0 \leftrightarrow V \leq 20 \| V - 20 \leftrightarrow V < 30 \| 10 \leftrightarrow V \geq 30$
	Junior	10	$0 \leftrightarrow V \leq 30 \| V - 30 \leftrightarrow V < 40 \| 10 \leftrightarrow V \geq 40$
	Equity ($1 common) 10		$0 \leftrightarrow V \leq 40 \| V - 40 \leftrightarrow V > 40$

Based on traditional contractual arrangements between the firm and its various investor classes, capital structure debt (Senior and Junior) and Equity are tokenized and issued through a smart contract (the Capital Structure Smart Contract - CSSC) with an embedded restructuring function. When the company experiences financial distress, CSSC's restructuring function will be triggered. Note that this will be at a time when the firm is not yet in default or insolvency, although it is more likely than not that in the foreseeable future it will be unable to pay its debts as and when they fall due. When the restructuring function

---

[66] Bebchuk, "A New Approach to Corporate Reorganizations", 788-790, 800-803.

is called, all equity and Junior debt will be cancelled (the respective tokens 'burned,' and the token balances set to 'zero'); at the same time New Equity Tokens ('NET') will be issued, at an exchange rate of $1 nominal junior debt/$1 par value old equity for $1 par value new equity. The NETs will be credited to a separate smart contract address, the Restructuring Smart Contract ('RSC').

The firm immediately emerges with a much-reduced debt load; old equity has been diluted. The new capital structure looks as follows:

Assets	Liabilities $		Value as a function of V
V	Secured	10	[Suppliers (with retention of title)]
	Preferential	10	[Employees; Tax authorities]
	Senior	10	$0 \leftrightarrow V \leq 20 \vert V - 20 \leftrightarrow V < 30 \vert 10 \leftrightarrow V \geq 30$
	Junior	0	$0 \leftrightarrow V \leq 30 \vert V - 30 \leftrightarrow V < 40 \vert 10 \leftrightarrow V \geq 40$
	NET ($1 common)	20	$0 \leftrightarrow V \leq 40 \vert V - 40 \leftrightarrow V > 40$

When its restructuring function is triggered, the CSSC will call the RSC as a second interlinked smart contract, which will generate a set of new tokenized entitlements, and allocate them to the previous holders of equity and junior debt. These entitlements are rights with embedded options on the NETs.

Specifically, each incumbent equity holder will receive a Shareholder Call Option (SCO) that entitles the holder to purchase their fraction of the New Equity Tokens for a strike price equal to their pro rata fraction of the total nominal amount of Junior debt, as described above.[67] The SCO is time-limited and must be exercised, say, two weeks from when the restructuring has been triggered. A shareholder exercises their SCO by sending the respective transaction message and funds (in the form of supported stablecoins) to the RSC. The shareholders as the residual claimants are best placed to appreciate the firm's long-term potential. It will be on their behalf that management may trigger the restructuring

---

[67] Bebchuk, "A New Approach to Corporate Reorganizations", 800-801.

function. Accordingly, shareholders should have time to obtain the necessary liquidity in advance. Each member of the class of junior debt will receive a Junior Creditor Right (JCR). A JCR may be redeemed for the holder's pro rata fraction of the total amount of junior debt. For any JCR not redeemed, the holder will be entitled to exchange the JCR for their pro rata fraction of NETs.[68] These rights must be exercised, by sending the respective transaction message to the RSC, upon expiry of the SCOs. This time frame should be sufficient for junior creditors to carry out due diligence and obtain the necessary information. Any remaining NETs that have not been claimed will be burned. Redemption of JCRs is managed by the RSC with the funds received following the exercise of any SCOs, which will be used pro rata to redeem JCRs.
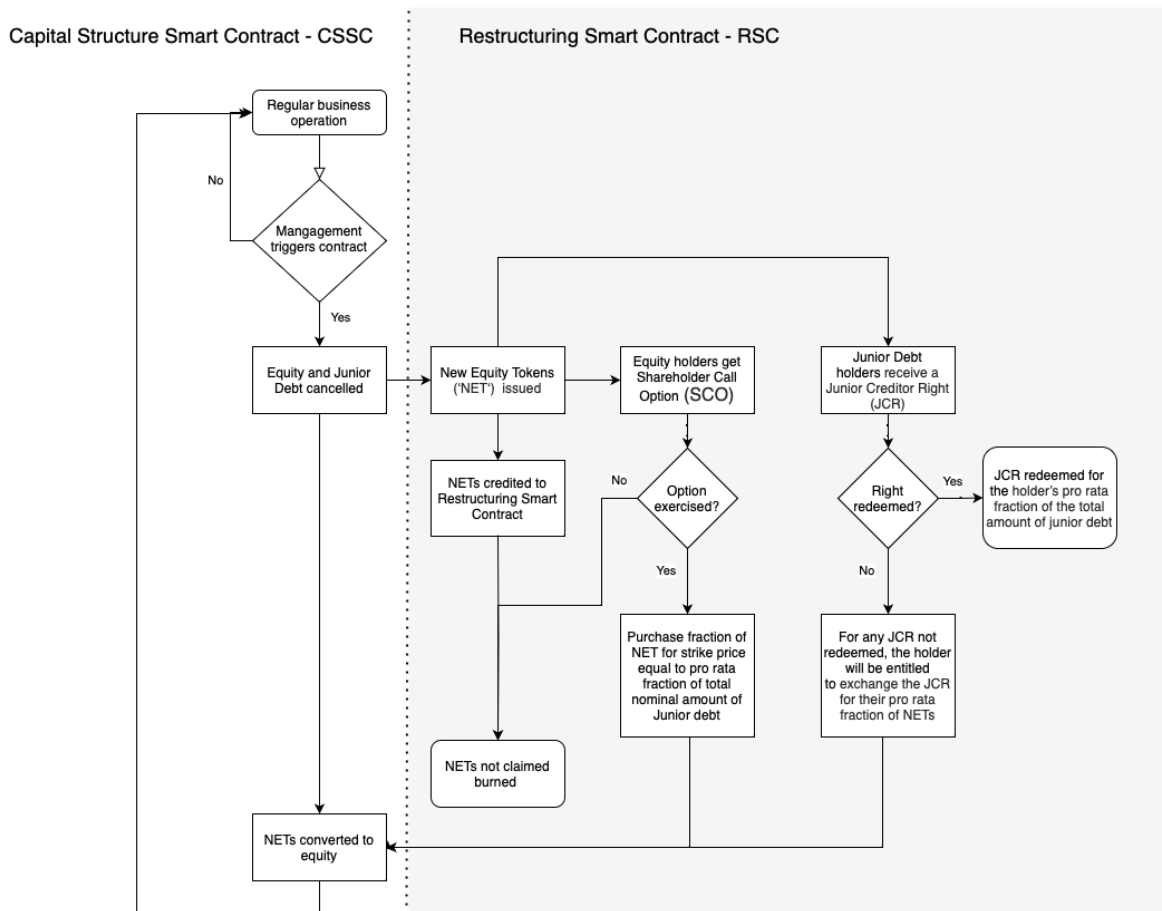
We begin with asset values of 55 and values of debt and equity securities as shown below:

---

[68] Or of all classes above the respective intermediate class.

Assets	Liabilities $		Value
55	Secured	10	10
	Preferential	10	10
	Senior	10	$10 \leftrightarrow V \geq 30$
	Junior	10	$10 \leftrightarrow V \geq 40$
	Equity ($1 common)	10	$15 = V - 40 \leftrightarrow V > 40$

Now assume that the firm's financial situation deteriorates, asset values drop to 45, and restructuring is triggered.[69] Immediately, the capital structure will 'collapse' to look as follows:

Assets	Liabilities $		Value
45	Secured	10	10
	Preferential	10	10
	Senior	10	$10 \leftrightarrow V \geq 30$
	Junior	0	$10 \leftrightarrow V \geq 40$
	NET (1$ common)	20	$15 = V - 30 \leftrightarrow V > 30$

Note that the NETs have a value of 15 of which 10 are attributable to the previous holders of junior debt and the remaining 5 to old equity. If the latter believe in the firm's future potential and want to remain in control, they can exercise their SCOs for a strike price of 10, and obtain 10 worth of NETs. With the funds received, the RSC will redeem the JCRs for 10, and the remaining unclaimed NETs will be burned. The resulting capital structure and attribution of value looks as follows:

Assets	Liabilities $		Value
45	Secured	10	10
	Preferential	10	10
	Senior	10	10

---

[69] See further below on The Trigger Problem.

	Junior	0	10 in cash after redemption of JCRs
	NET (old equity)	10	15 (but net 5 after paying strike price of 10)

If old equity does not want to thraw good money after bad, their SCOs will expire, the junior creditors will exchange their 10 worth of JCRs for 10 worth of NETs and take over the firm. Old equity would book a loss of 5, benefiting junior debt which would get more than what they bargained for. Consequently, old equity are incentivized to exercise their SCOs to the tune of 5. In that case, 5 worth of JCRs will be redeemed, and the rest exchanged for NETs, resulting in the following capital structure and value attribution:

Assets	Liabilities $		Value
45	Secured	10	10
	Preferential	10	10
	Senior	10	10
	Junior	0	5 in cash after redemption of JCRs
	NET (old/junior)	10	15 (old: net 2.5 after paying strike price of 5) / (junior: 7.5)

Old equity are worse off, and junior debt are better off, but old equity can easily avoid this outcome by exercising their SCOs and obtain the previous result.

Following the first round of restructuring and exercise of SCOs, redemption rights and JCRs, our firm emerges with the following capital structure:

Assets	Liabilities $		Value
45	Secured	10	10
	Preferential	10	10
	Senior	10	$10 \leftrightarrow V \geq 30$
	Equity (§1 common)	10	$15 = V - 30 \leftrightarrow V > 30$

Say the firm's financial condition continues to deteriorate, and restructuring is triggered again. The process outlined above will now be repeated: equity and the next highest debt class (senior debt) will be cancelled, and New Equity Tokens will be issued; equity holders will receive SCOs, and the relevant debt class will receive JCRs, each with embedded options as detailed above. Assuming a drop of asset values to 35, the value attribution for our collapsed capital structure would look as follows:

Assets	Liabilities $		Value
35	Secured	10	10
	Preferential	10	10
	Senior	0	$10 \leftrightarrow V \geq 30$
	NET (old/senior)	20	$15 = V - 30 \leftrightarrow V > 30$

If old equity are confident, they can exercise their SCOs, the JCRs will be redeemed, senior creditors will walk away with 10 in cash and old equity with 10 NETs worth 15, leaving them with net 5. Alternatively, equity will exercise only 5 worth of SCOs, redeeming 5 worth of JCRs, with the remaining 5 being exercised, resulting in the following capital structure and value attribution:

Assets	Liabilities $		Value
35	Secured	10	10
	Preferential	10	10
	Senior	0	5 in cash after redemption of JCRs
	NET (old/senior)	10	15 (old: net 2.5 after paying strike price of 5) / (senior: 7.5)

Should the fortunes of the firm improve, new tranches of tokenized capital structure debt may be issued which would subsequently be subject to the same restructuring parameters. However, where the tranches of capital structure debt have been exhausted, no further automated restructuring is possible; still leaving the option of a traditional statutory restructuring and eventual insolvency proceeding.

Our smart contract solution resolves the tension between the *ex post* and *ex ante* efficiency requirements. No class of creditor will ever be worse off following an automated restructuring than what they have bargained for, respecting the principle of absolute priority and preserving *ex ante* efficiency. The certainty of this (baseline) outcome, in combination with the transparency of treatment in an automated restructuring, should reduce *ex ante* financing cost, as it should reduce the consequent risk of distress and default. Equity holders may be worse off in certain circumstances but only if they misjudge the firm's asset value and fail to fully exercise their SCOs. However, as they are in the best position to evaluate the firm's potential well in advance of triggering an automated restructuring, they can explore financing solutions and come prepared. Where they end up worse off, this is the price to pay for bringing (junior) creditors in as sharers of any downside (and upside) risk. *Ex post*, there is no need for a rewriting of investors' property rights. Individual entitlements will be preserved, and it is within the power of individual investors to pursue their interests within the pre-negotiated priority framework. The flipside of this empowerment is the individual responsibility to assess the firm's viability and decide on the extent of any future involvement post restructuring.

One may object that our solution, just like Bebchuk's model, only works because we assume that the nominal value (and order of priority) of all tranches of debt is known (although the value of the firm remains unknown). In practice, there may be significant contingent and yet unspecified preferential debts, notably tax liabilities. However, this is not a weakness because restructuring will be triggered well in advance of actual insolvency at a time when higher ranking tranches are most likely in the money. Our automated restructuring only affects the tokenised capital structure debt. In fact, restructuring may be triggered precisely with a view to preventing insolvency and rescuing a company that expects to be liable for an unspecified amount in torts, environmental clean-up costs or taxes that without a much-reduced debt load would put the continuation of the business at risk. Moreover, like the Harvard proposal, our smart contract restructuring solution operates in the shadow (and in advance of) the statutory restructuring and insolvency framework. Should it transpire that any contingent liabilities are so high that even repeated rounds of our automated

restructuring are insufficient to remedy financial distress, resort can still be had to the available traditional restructuring mechanisms.

The Trigger Problem

Technically, restructuring is triggered simply by sending a transaction message to the CSSC, calling the restructuring function. However, when should restructuring be triggered and by whom? Both can be answered together. As Lord Reed emphasised in *Sequana*, the precise moment when a company becomes insolvent can be difficult to pinpoint, and a test of 'likely to become insolvent' is even more vague and indeterminate.[70] It is clear, however, that the firm's management is best placed to assess the firm's financial situation and spot signs of financial distress. In fact, they are obligated to stay on top of any warnings if the cash reserves or asset base of the company have been eroded so that the creditors may not get paid when due.[71]

Management should trigger restructuring with a view to preventing insolvency, and even the likelihood of insolvency, as soon as default is on the horizon. This requires a business judgment as to whether the firm can trade out of its difficulties without triggering restructuring or whether an automated restructuring is necessary to save the firm. Our smart contract restructuring solution does not relieve management of having to make that judgment call. It does however set incentives to pull the trigger at the right time. At the time when restructuring should be triggered, management (must) act in the best interest of the shareholders.[72] Moreover, in SMEs there is often no 'separation of ownership and control.'

Acting in the best interest of equity, management have every reason to pull the trigger when financial distress ensues. Equity will not be wiped out automatically, on the contrary, it can retain full control of the firm by exercising its SCOs and has every informational advantage to be able to do so. On the other hand, short of paying junior creditors in full, equity holdings will be diluted, and value may be redistributed to the junior creditor class.

---

[70] *Sequana* at [85].
[71] *Sequana* at [305].
[72] *Sequana* at [83].

This is essential, however, for incentivising shareholders to properly assess the going concern potential of their company and exercising their SCOs accordingly.

Nothing is lost if management wait too long, and restructuring is only triggered when the company is or is close to insolvency.

Assets	Liabilities $		Value
25	Secured	10	10
	Preferential	10	10
	Senior	10	$5 = V - 20 \leftrightarrow 20 \leq V < 30$
	Junior	10	$0 \leftrightarrow V \leq 30$
	Equity ($1 common)	10	$0 \leftrightarrow V \leq 40$

Here, management has allowed the company to become hopelessly insolvent. Following the restructuring trigger, it would be irrational for equity to exercise their SCOs so that Junior Debt will likely end up with worthless shares in the company, which will then go through a statutory restructuring or insolvency process. Equity and Junior debt are out of the money and will receive nothing; Secured and Preferential will be paid in full and senior debt will end up with whatever is left after the higher-ranking tranches have been paid. This is simply the statutory framework picking up the pieces.

But what if the trigger is pulled too soon, at a time when the company is (still) financially healthy?

Assets	Liabilities $		Value
55	Secured	10	10
	Preferential	10	10
	Senior	10	$10 \leftrightarrow V \geq 30$
	Junior	10	$10 \leftrightarrow V \geq 40$
	Equity ($1 common)	10	$15 = V - 40 \leftrightarrow V > 40$

If equity have done their due diligence, they will exercise their SCOs for 10 and Junior debt will be redeemed. Equity will end up with 10 common shares now worth 25; but net 15 after paying the strike price on their SCOs. The creditors cannot complain. The firm is not in default and creditors will be paid in accordance with their contractual *ex ante* agreements (including any early repayment charges). In an automated restructuring, they will never be worse off than agreed and may even be better off. Shareholders are more vulnerable. Although they will never be worse off economically, by triggering a restructuring too early (or maliciously) shareholders can be forced to obtain the liquidity necessary for exercising their SCOs (or selling them). Given that the company is financially healthy this shouldn't be too difficult. Still, there could be situations where shareholders are unfairly disadvantaged. However, several mitigating factors ensure that the trigger will not be pulled lightly: in the solvent company, corporate directors and managers are accountable to the shareholders. The latter appoint the former in the first place, so shareholders are not in position to complain when their appointees turn out to be less than perfect. Moreover, managers and directors risk being removed by the shareholders following a restructuring, and the new shareholders may also be the old ones if they exercise their SCOs – and management can never be sure that this won't be the case. In addition, there is the potential liability for breach of fiduciary duties when triggering restructuring maliciously or with ulterior motives, and there is the potential reputational damage for those involved.

To be clear, by solving the valuation problem, our smart contract restructuring solution addresses the conflict between *ex ante* and *ex post* efficiency in a corporate restructuring scenario. For now, it has nothing to say about fraudulent managers who engage in transactions at an undervalue, preferences or unlawful distributions. To curb these behaviours, we rely on the general law of directors' duties and insolvency law-based remedies,[73] and if need be, criminal law. These existing remedies and mechanism reinforce our built-in incentives to encourage triggering restructuring at the 'right' time.

---

[73] e.g. Insolvency Act 1986, sec. 214, 246ZB ('wrongful trading'); sec. 238 ('transactions at an undervalue'); sec. 239 ('preferences'); sec. 423 ('transactions defrauding creditors').

Conclusion

Due to the valuation problem, statutory restructuring frameworks are incapable of solving the clash between the needs of *ex ante* and *ex post* efficiency, not least for small and medium sized enterprises. Restructuring law is therefore ripe for disruption through a tech-based solution. We have developed a smart contract-based restructuring solution that operates by relying on incentives and without the need for external data feeds. It derives normative legitimacy from its traditional corporate/contractual underpinnings: the agreements between the firm and its investors. Moreover, it relies on statutory restructuring and insolvency law as the default option in the shadow of which it operates. Our goal was to design and implement a smart contract restructuring solution that works and could be used by any firm that issues equity and debt in tokenised form.

We leave open the question of whether and to what extent our solution in its current form complies with the minutiae of corporate law and securities regulations applicable in any particular jurisdiction. Given the overall tendency to accommodate the tokenisation of financial assets this will only be a matter of time if it isn't already the case. From a technological perspective our smart contract restructuring solution works in addressing the valuation problem more satisfactorily than existing legal frameworks. This should facilitate its adoption also from a regulatory perspective. It may not yet be fully compatible with legal or regulatory requirements – at least not everywhere. In the end, however, commercial and regulatory pragmatism will prevail and eventually accommodate what works best.