Breakable commitments:
present-bias, client protection and bank ownership forms

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Abstract

We study a consumer protection problem that survives even where present-biased consumers are sophisticated and informed. Consumers demand commitment but their future selves and their banks may be tempted to renegotiate contracts. To prevent this, parties must rely on endogenous commitment strategies that distort contract terms. In such contexts, strategic governance/ownership decisions may expand contracting possibilities by constraining banks' ability to profit from renegotiation. Such equilibria are however vulnerable to collapse under competition. The model helps explain contracts and ownership forms in microfinance and consumer banking, and frames policy debates on measures against excessive refinancing and overindebtedness in these sectors. JEL Codes: O16, D03, D18

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1 Introduction

When do financial intermediaries provide the commitment services to help present-biased consumers stick to long-term savings accumulation and/or debt management plans? When instead might financial intermediaries try to profit by opportunistically pandering to those same consumer biases? Hyperbolic discounters – consumers with present-biased and dynamically inconsistent preferences – struggle to stick to long-term plans. Strotz (1956) was the first to formalize the idea that sophisticated hyperbolic consumers – those who correctly understand how their own changing preferences may lead future selves to try to undo earlier laid consumption plans – might demand and benefit from commitment contracts and other devices that constrain their future choices.[1] Financial arrangements ranging from automatic payroll deduction savings plans and fixed amortization mortgages to the high-frequency repayment provisions of microcredit loans for the poor have been interpreted as featuring built-in commitment mechanisms that work by imposing inflexibility or otherwise making terms costly to change. Empirical evidence from several contexts suggests positive demand takeup and asset accumulation impacts in response to the introduction of new financial commitment products in several contexts.[2]

The demand for commitment is one thing, but contracting for its supply may be difficult or costly. In particular, why should a financial intermediary's own promise of commitment be believed and not renegotiated? The bank understands that the consumer who demands commitment contracts in one period will in later periods, with new preferences, willingly pay to renegotiate or refinance its terms – with the same bank or possibly a new one. Bank profits may be increased by pandering to such demands and most courts would judge any such renegotiation legal and voluntary.[3]

The perception that present-bias and opportunistic renegotiation (or a failure of commitment) might spoil or distort the operation of markets seems to be suggested by the language that often accompanies analyses of financial expansions or crises: descriptions of 'overindebtedness' in the market for microcredit, of 'rollover debt traps' in payday lending, and of 'equity raids' in mortgage refinance markets via excessive costly refinancings. Blame for such perceived problems is variously placed on both the consumer and the financial intermediary: on consumers for weak self-control and succumbing to present-bias and intermediaries for profiting by pandering to those biases in socially destructive ways. Firms'

[1]For related reasons, naive consumers who underestimate how their future preferences will change, may also be advantaged by certain public regulations or certain forms of private paternalism of organizations that constrain individuals actions (Spiegler, 2011).

[2]See for example Ariely & Wertenbroch (2002), Thaler & Benartzi (2004), Ashraf *et al.* (2006), Bauer *et al.* (2012). Bryan *et al.* (2010) provide asurvey overviews of this literature.

[3]In most countries including the United States courts will not penalize voluntary renegotiation, on the principle that there is no injured promisee (see discussion in Laibson, 1997, p448)

behavior in turn is often blamed on failures of 'governance' and failure of regulators to offer consumer protections. Though behavioral analyses of such situations are typically framed in terms of failure to protect 'naive' hyperbolic discounters who fail to understand how their own changing future preferences leave them vulnerable to exploitation, the issues also affect sophisticates.

In this paper, we take seriously the threat of opportunistic renegotiation that cannot be deterred via exogenous mechanisms. We show who this may lead to distorted contracting and lost trade, with associated loss of consumer welfare and/or firm profits, even in the case of sophisticates. This in turn may have implications for market organization and firm ownership and capital structure to the extent that these also shape firm and consumer incentives and may be strategically manipulated to shape outcomes.

In the first part of this paper, we take as exogenous the costs associated with voluntary contract renegotiation. Lower renegotiation costs imply greater fragility of commitment contracts. We study a canonical consumption smoothing contract design problem to derive a parameterized spectrum of endogenous commitment contracts for both naive and sophisticated consumers under competition or monopoly.

In the first part of this paper we study a canonical consumption smoothing contract design problem to study a parameterized spectrum of costly endogenous commitment contracts for both naive and sophisticated consumers under competition or monopoly in each period. The relative parsimony of the framework allows us to derive some well known results but also to provide analytical clarification of some general mechanisms and contract design features that may have been missed or obscured in prior work because commitment technologies have typically been either assumed to be non-renegotiable, or modeled in more elaborate and somewhat intractable ways. Our framework is simple enough that several key results can be described in graphical analysis that could be taught to and understood by advanced undergraduates.

To understand what is gained by this simplification, consider the following framing of the classic paper by Laibson (1997) that studied how sophisticated hyperbolic discounters might place wealth into low return illiquid investments to limit their future selves from raiding saved resources. The credibility of such commitment–i.e. the assurance that this plan will not be undone by future selves–depends on two interrelated factors. First, it should be costly to undo the plan (in this case, illiquid assets can only be accessed with a delay) and second, the consumption-savings path should sufficiently accommodate future selves' preferences that undoing the plan will not provide them with sufficient gains as to offset the costs. Implicit in the setup is a tradeoff between the cost of breaking commitment and the need to accommodate future selves' preferences. But the nature of the commitment technology in the above paper makes this tradeoff difficult to identify and analyze.

The contributions of our paper can be viewed in this context. Observe that concerns about the undoing of plans are not merely applicable to settings with imperfect saving/borrowing technologies; they also apply to explicit commitment contracts between two parties (the consumer and a bank) since these could be renegotiated, possibly at a cost. We develop a simple framework to parsimoniously parameterize this contract design tradeoff.

First, we show how the feasibility of first-best 'full-smoothing commitment contract' depends on the cost of renegotiation and market structure.[4] Second, we establish a number of non-obvious properties of the second-best 'imperfect-smoothing commitment contract' that is implemented when the first-best is not credible. Our innovation, in contrast to much of the related literature, is to take seriously the fact that after a contract is signed, future action sets include the rewriting of contracts. Any credible contract must therefore satisfy a 'no-renegotiation' constraint.

Third, we show how firms may choose to make changes to firm ownership and capital structure as a costly strategy to provide endogenous consumer protection to expand captured profits and trade with sophisticated present-biased consumers. We show how these choices depend crucially on market structure. This argument is similar to the theory of commercial non-profits based on asymmetric information due to Hansmann (1996) and formalized by Glaeser & Shleifer (2001) and others, but set on new behavioral micro-foundations and with no need for asymmetric information. Our framework also moves beyond the simple 'for-profit/non-profit' dichotomy of this earlier literature to explore a whole spectrum of 'hybrid' ownership firms (e.g. for-profit financial intermediaries variously owned and controlled by 'social' as well as private investors). We argue that this theory helps make sense of many of the ownership and capital structures observed in consumer banking intermediaries in the United States and other now developed countries historically as well as in microfinance to this day. The sensitivity of equilibrium contracts to changes in market structure can also help make sense of several recent episodes where increased competition and rising 'commercialization' were observed to precede periods of rising refinancing, multiple borrowing and indebtedness, followed by financial crash or political backlash, as in the case of the 2010 microfiance crisis of Andra Pradesh. Microfinance industry funded campaigns such as the 'Smart Campaign'[5] have for example been launched using slogans such as "[p]rotecting clients is not only the right thing to do; it's the smart thing to do." These campaigns seek to appeal for and certify compliance with financial intermediaries' publicly adherence to consumer protection principles to prevent aggressive loan sales and protect clients from being led to situations of 'overindebtedness.'

The paper makes clear how the above results depend crucially on consumer type (sophis-

[4]Under hyperbolic discounting, there is no obvious measure of welfare. We define 'full smooting' or 'first-best' as the contract that maximizes the discounted utility of the initial signatory.

[5]See http://smartcampaign.org/

ticated or naive), market structure (monopoly or competition), and costs of renegotiation. While stylized and limited to one of many mechanisms the model makes a number of compelling points relevant to ongoing policy debates and is able to explain some stylized facts while generating sometimes counterintuitive empirical predictions. Our goal is to provide a novel streamlined framework that is useful for and compatible with extensions that introduce additional real-world factors.

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1.1 Outline of arguments

We work with a quite general three-period consumption smoothing model for a present-biased consumer with quasi-hyperbolic preferences that allows for saving (repayment) or borrowing (dissaving) in each period. In each contracting scenario the consumer's period zero-self (henceforth 'Zero-self') has a bias for present consumption but wants to smooth future consumption across periods one and two. She correctly anticipates that her later period-one 'One-self' will have a change of preferences that will lead her to want to 'raid savings' and/or take on new debt to drive up period one consumption at the expense of period two consumption, thereby undoing Zero-self's early intent to balance consumption across the two periods. In every case the equilibrium contract will be the subgame perfect Nash equilibrium of a game where Zero-self chooses a contract first anticipating One-self's reactions, possibly limited by the Bank's exogenously or endogenously enforced commitment to agree to not renegotiate with One-self.

In Section 2 we describe a consumer who faces an income stream that, in the absence of a bank ('autarky'), can be rearranged to provide imperfect consumption smoothing at best. We describe banks that have access to funds at a competitive interest rate, and can offer the Zero-self consumer a 3-period contract. The extent to which contract terms can be enforced in future periods depends on some non-pecuniary renegotiation cost κ, which is borne by the bank and can be interpreted as a concern for the consumer's well-being or own reputation.

We then build a framework for analyzing equilibrium contracts as the outcome of a Stackelberg-type game where Zero-self moves first while anticipating One-self's best response. As an example, we derive the equilibrium contract when the banks have high renegotiation costs (so that contract terms are always respected). This yields the first-best contract from Zero-self's perspective–she is able to allocate consumption across periods 1 and 2 in accordance with her own preferences without conceding to One-self's present-bias. We label this contract the 'full-smoothing commitment contract,' though it should be clear that the 'full-smoothing' part is judged against Zero's preferences. We compare full-smoothing commitment contracts under competition and monopoly.

Section 3 formalizes the renegotiation problem. If κ is small, neither a monopolist nor competitive banks can credibly offer full-smoothing commitment contracts. This is because any sophisticated Zero-self consumer will understand that their future One-self and the bank stand to share gains from breaking any would-be commitment full-consumption smoothing contract. The only commitment contracts that will be considered credible and therefore capable of expanding the contract space are those that can satisfy a 'no-renegotiation' constraint that makes them self-enforcing.

We show that if renegotiation costs κ are below particular cutoff levels $\bar{\kappa}$, full-smoothing commitment contracts will not be offered in equilibrium. The cutoffs are more stringent under competition than under monopoly. This difference–the relatively greater feasibility of full-commitment under monopoly–is not due to any superior ability to commit on the part of a monopolist. It is due rather to the fact that monopolies offer less consumption than do competitive contracts to begin with. At lower levels of consumption, the potential period 1 gains from renegotiation are also lower, thus making renegotiation less profitable and hence commitment more feasible.

In Section 4, we derive contracts when the 'no-renegotiation' constraint binds. We first focus on sophisticated hyperbolic discounters. The Zero-self can enter into a multi-period contract that helps bind her One-self to contract terms only to the extent that the bank's commitment can be endogenously enforced (i.e. the bank's ex-post gain in profits from breaking their commitment must fall short of any direct renegotiation costs κ). The 'imperfect-smoothing commitment contract' represents a compromise between Zero-self's and One-self's preferences–consumption allocations between periods 1 and 2 must be tilted sufficiently in favor One self as to make renegotiation unprofitable but the extent of this tilt will be governed by the renegotiation cost. This reduces the potential gains to trade between consumers and banks, and contracts will result in lower bank profits (monopoly) or lower consumer discounted utility (competition).

We characterize the shapes of contracts.[6] All else equal, under monopoly imperfect-smoothing commitment contracts involve larger loans (or reduced savings) compared to full-smoothing. Under competition, the comparison is ambiguous. We explain this contrast between monopoly and competition using the intuition of income and substitution effects (from the consumer's perspective, a weakening of commitment has only substitution effects under monopoly while it has both substitution and income effects under competition).

Section 4 finally turns to naive hyperbolic discounters who fail to anticipate the extent

[6] We are able to provide quite complete characterizations of optimal contracting scenarios under the assumption of monopoly or competition in the market for period-zero banking contracts with or without the assumption of enforceable exclusive contracts in later periods. We can provide exact closed-form solutions for contract terms for CRRA utility functions for most of these cases including renegotiation-proof contracts when $\kappa = 0$. For the $\kappa > 0$ cases where closed form solutions cannot be directly obtained we can nonetheless characterize some important contract properties and solve for contracts numerically.

to which contracts may be renegotiated. Now, Zero-self is offered a contract in which consumption in periods 1 and 2 strongly tilted towards period 2. This maximizes the potential gains from renegotiation. Under monopoly, this is achieved through a small loan (or high savings) since the consumer believes her future to be better than it will turn out to be. So, the naive consumer is not targeted with large loans; instead, she is offered a small teaser loan that will subsequently be rolled over in a manner that resembles some aspects of payday lending. Under competition, again initial loan/savings sizes are ambiguous since anticipated gains from renegotiation must be distributed back to the consumer.

In Section 5, banks may explore commercial nonprofit status as a mechanism to more credibly commit to not opportunistically exploiting the weaknesses of its sophisticated time-inconsistent clients. By operating as a nonprofit (or as a 'hybrid' bank), the bank agrees to face legal or governance restrictions on how any profits generated from any such opportunistic renegotiation can be distributed and enjoyed. The bank can now credibly convince the sophisticated consumer that it will be less likely to renegotiate the contract in the future. This allows the bank to offer the consumer an initial contract that maintains the restrictions on future consumption patterns that the consumer demands, raising the contracting surplus and therefore how much can be ultimately extracted by the bank's stakeholders.

A firm's decision about whether to adopt nonprofit status rests on a trade-off. As a non-profit, the firm has an opportunity to extract greater surplus from the consumer (by providing commitment), but now faces restrictions on the ability of managers and shareholders to enjoy this surplus. In the case of monopoly, the bank will adopt nonprofit status if the following is true: non-profit restrictions should be sufficiently severe that the bank is able to extract more surplus from the consumer, but should not be so severe that it is unable to enjoy the surplus. That nonprofit firms may survive even in the absence of motivated agents or asymmetric information is, to the best of our knowledge, a novel result.

This trade-off is also sensitive to market structure. Under competition, a lender's ability to provide effective commitment through non-profit status depends on the exclusivity of contracts. When long-term contracts can be made exclusive, the tradeoff disappears and all active firms function as non-profits. This is because of the zero-profit condition–since firms do not make profits anyway, there is nothing to lose from switching to non-profit status. On the other hand, there are profits to be gained–if all other firms are for-profit, a firm could make positive profits by offering superior commitment as a non-profit (this is valuable even if its enjoyment of these profits is limited).

When contracts are not exclusive, commitment generated through non-profit status becomes impossible to achieve. Since non-profit firms would make zero profits anyway, each firm has an incentive to switch to for-profit status so it can take advantage of the opportunity to re-finance *other* banks' loans. As a result, for-profit firms must be active in equilibrium, and their presence will eliminate the possibility of non-profit commitment.

This can partly explain a key difference between traditional monopolistic non-profit microfinance, which is rigid, and say competitive commercial credit card lending which offers refinancing flexibility (credit card punishments gain salience because they are *less* strict, not more).

1.2 Context and Related Literature

1.2.1 Commitment as a form of Consumer Protection

Concerns about excessive refinancing and 'over-indebtedness' have been raised especially in the lead up and wake of financial crises. On the eve of the mortgage banking crisis in 2007, over 70 percent of all new subprime mortgage loans were refinances of existing mortgages and approximately 84 percent of these were 'cash out' refinances (Demyanyk & Van Hemert, 2011). In the market for payday loans in the United States economists and regulatory observers express concern not so much that fees are high (the typical cost is 15% of the amount borrowed on a 2 week loan) but rather that 4 out of 5 payday loans are 'rolled over' or renewed rather than paid off resulting in very high total loan costs and placing many people into very difficult debt management situations (DeYoung *et al.* , 2015).

Problems of consumer protection are typically analyzed through two channels: naive or uneducated consumers and their failure to correctly anticipate fees and punishments (see Gabaix & Laibson (2006), Armstrong & Vickers (2012), and Akerlof & Shiller (2015) for related arguments), and bank's moral hazard (see Dewatripont & Tirole (1999) and Oak & Swamy (2010)). We argue that, given the growing evidence of time-inconsistent preferences,[7] a bank's ability to provide credible commitment should also fall under this umbrella–sometimes consumers *want* punishments or fees to limit renegotiation.

In recent years, especially in light of crises in consumer credit markets, there has been renewed emphasis on consumer protection and better governance and regulation in banking.[8] One particular outcome of concern has been borrower over-indebtedness, an issue that has been at the center of recent microfinance repayment crises in places as far-flung as Morocco, Bosnia, Nicaragua and India, as well as the 2008 mortgage lending crisis in the United States. In each of these cases the issue of refinancing or the taking of loans from multiple lenders emerges.

[7]See, for example, Laibson *et al.* (2003), Ashraf *et al.* (2006), Gugerty (2007), and Tanaka *et al.* (2010).

[8]In the US, the Consumer Financial Protection Bureau was set up in 2011 under the Dodd–Frank Wall Street Reform and Consumer Protection Act. In India, the far-reaching Micro Finance Institutions Development and Regulation Bill of 2012 was designed to increase government oversight of MFIs in response to the credit crisis in the state of Andhra Pradesh, and the perception that lax consumer protection and aggressive lending practices had led to rising over-indebtedness and stress.

Journalistic and scholarly analyses of such situations, including the recent mortgage crisis in the United States, have often framed the issues as problems of consumer protection, suggesting that many lenders designed products to purposefully take advantage of borrowers who have limited financial literacy skills and are naive about their self-control problems. Informed by such interpretations, new regulations introduced in the wake of these crises have swung toward restricting the terms of allowable contracts, for example by setting maximum interest rates and limiting the use of coercive loan recovery methods.

We place consumers' struggles with intertemporal self-control issues at the center of the analysis, but argue that borrowers may be more sophisticated in their understanding of their own time-inconsistency than is often assumed. From this perspective, 'predatory lending' is not primarily about tricking naive borrowers into paying more than they signed up for with hidden penalties or misleading interest rates quotes, but about offering excessive flexibility and refinancing of financial contracts in ways that limit or undermine the commitments to long term consumption and debt management paths that borrowers themselves may be attempting to put in place.[9]

Here, a bank that promises to be rigid and is then flexible could be seen as hurting, rather than helping, the consumer. We take seriously the bank's ex-post considerations and derive conditions under which it would renegotiate.

In this sense, our paper complements some others that demonstrate how commitment can be undone in related settings. Gottlieb (2008) shows how competition leads to inefficient outcomes in immediate rewards goods. Heidhues & Koszegi (2010) study the mistakes of partially naive borrowers in competitive credit markets. Mendez (2012) analyzes predatory lending with naive consumers.

1.2.2 Commercial Non-profits in finance

The idea that firm ownership might be strategically chosen to solve or ameliorate 'contract failure' problems dates back at least to Arrow (1963) and is one that has been articulated most clearly in the work of Henry Hansmann (1996). Hansmann argued that in markets where the quality of a product or service might be difficult to verify, clients may rationally fear that investor-led firms will be tempted to opportunistically skimp on the quality of a promised product or service, or reveal a hidden fee, and this can greatly reduce or even eliminate contracting. In such circumstances becoming a 'commercial non-profit' may be a costly but necessary way to commit the firm to not act opportunistically, hence enabling trade.

[9] Bond *et al.* (2009) discuss evidence of predatory lending in the context of mortgages. In 2016 the Consumer Financial Protection Bureau put forth a proposal to protect payday loan consumers including limits on the number and frequency of re-borrowings, available at `http://files.consumerfinance.gov/f/documents/CFPB_Proposes_Rule_End_Payday_Debt_Traps.pdf`.

Hansmann gives as a primary historical example the development of consumer saving, lending and insurance products in the United States and Europe. Life insurance in the United States for example has until quite recently always been dominated by mutuals. Rate payers could not trust investor-led firms to not act opportunistically by, for example, increasing premiums or by skimping or reneging on death benefit payouts. Mutuals on the other hand had little incentive to cheat clients to increase shareholder dividends as the clients themselves are the only shareholders. Mutuals therefore enjoyed a distinct competitive advantage until sufficient state regulatory capacity developed.

In the present analysis we begin by following Hansmann in defining nonprofits by the legal restrictions faced by them, setting aside other ways (such as motivation) in which they might be different from for-profit firms.[10] In this view "[a] nonprofit organization is, in essence, an organization that is barred from distributing its net earnings, if any, to individuals who exercise control over it, such as members, officers, directors, or trustees."[11] Glaeser & Shleifer (2001) have formalized Hansmann's central argument to show that when a firm cannot commit to maintaining high quality, it might choose to operate as a commercial nonprofit rather than as an investor-led for-profit in order to credibly signal that it has weaker incentives to cheat the consumer on aspects of unobserved product quality. As Hansmann describes it, firm ownership form adapts endogenously as a "crude form of consumer protection" in unregulated emerging markets where asymmetric information problems are rife. Bubb & Kaufman (2013) modify this model so that the non-contractible quality issue is on hidden penalties, which are incurred with certainty by some borrowers. All of these models are built rely on some form of asymmetric information or contract verification problem.

A contribution of our paper is to argue that a theory of ownership form can be built on behavioral micro-foundations even in environments with no asymmetric information and with sophisticated forward-looking agents. We believe this is an important element for understanding the development of consumer finance in developed countries historically as well as the current shape of microfinance today where non-profit and 'hybrid' forms still dominate the sector in most developing countries (Cull *et al.* , 2009; Conning & Morduch, 2011). Hybrid ownership forms include the many microfinance firms that, though technically incorporated as for-profit financial service providers, are in fact dominated by boards where, by design, social investors or client representatives exert substantial governance control. Hybrid forms such as these would appear to confer many of the benefits of non-profit status (specifically, credible commitment to consumer protection) with fewer of the costs (in particular,

[10] Hence we abstract away from other considerations for nonprofits, as in Besley & Ghatak (2005), McIntosh & Wydick (2005), and Guha & Roy Chowdhury (2013). Nonetheless our modeling framework can be adapted to include these considerations.

[11] In practice, nonprofit firms also enjoy certain benefits that are denied to for-profit firms (see, for example, Cohen, 2015). But for the purposes of Hansmann's (and our) argument, it is the *restrictions*, not benefits, that generate improved outcomes.

unlike a pure non-profit they can and do issue stock to outside investors although usually in a manner that does not lead to challenge control).

1.2.3 Market Structure and Governance Choice

Commenting upon a major microfinance crisis in the state of Andhra Pradesh in India, veteran microfinance investor and market analyst Elizabeth Rhyne (2011) describes the build up of "rising debt stress among possibly tens of thousands of clients, brought on by explosive growth of microfinance organizations . . ." fueled by the rapid inflow of directed private lending and new equity investors who, because they "paid dearly for shares in [newly privatized] MFIs . . . needed fast growth to make their investments pay off ."

She goes on to lay the blame on "poor governance frameworks" for behaviors that included "loan officers [that] often sell loans to clients already indebted to other organizations." In her view, Indian MFIs might have avoided their problems and followed the model of leading microfinance organizations in other countries like Mibanco (Peru) and Bancosol (Bolivia) which "were commercialized with a mix of owners including the original non-governmental organization (NGO), international social investors (including development banks), and some local shareholders. The NGOs kept the focus on the mission, while the international social investors contributed a commercial orientation, also tempered by social mission." These are the types of hybrid ownership forms, along with nonprofit firms, that we argue can provide surplus building consumer protection through a reduced incentive to renegotiate. Rhyne's argument is that a number of Indian state regulations made it difficult for such hybrid ownership forms to rise organically in India. As our model makes clear, these governance choices are highly dependent on market structure, and nonprofits may survive better under monopoly than under competition.

2 The model: setup

There are three periods, $t \in \{0, 1, 2\}$. In any period t, the consumer's instantaneous utility from consumption level c_t is given by a CRRA function defined over all non-negative consumption:

$$u(c_t) \equiv \frac{c_t^{1-\rho}}{1-\rho} \tag{1}$$

with some $\rho > 0$ as the coefficient of relative risk aversion.[12]

We model the consumer 'as a sequence of temporal selves ... indexed by their respective periods of control over the consumption decision Laibson (1997, p.451)'. Given a consump-

[12] When $\rho = 1$ the function becomes $u(c_t) = ln(c_t)$.

tion stream $C_t \equiv (c_t, .., c_2)$, the period-$t$ self's discounted utility is:

$$U_t\left(C_t\right) \equiv u\left(c_t\right) + \beta \sum_{i=t+1}^{2} \delta^{i-t} u\left(c_i\right) \tag{2}$$

This describes quasi-hyperbolic preferences, with a standard exponential discount factor $\delta \in (0, 1]$ and a hyperbolic discount factor $\beta \in (0, 1)$. In any period t, the individual (henceforth referred to as the "t-self") discounts the entire future stream of utilities by β. As a result, when faced with any tradeoff between consumption in periods t and $t + x$, the t-self places greater relative weight on period-t consumption than her earlier selves would have done.

The consumer could be sophisticated (her time-inconsistency is common knowledge across all t-selves) or naive (she believes her future selves to be exponential discounters with a discount factor of δ). (O'Donoghue & Rabin, 2001).

The Zero-self begins with an endowment of claims to an arbitrary positive income stream over the three periods, $Y_0 \equiv (y_0, y_1, y_2)$. Her objective is to or rearrange this into a preferable consumption stream C_0 to maximize $U_0(C_0)$ in (2) using what financial contracting or other saving/borrowing strategies as may be available.

In the absence of access to the financing and commitment-services offered by a bank the consumer rearranges her income into her autarky consumption stream which delivers a corresponding autarky utility denoted U_0^A. The simplest assumption is that this autarky consumption stream corresponds to the endowment income stream. More realistically, the autarky consumption stream is what might be achieved via the more limited financing and commitment services available via informal banking or self-commitment strategies.

Section 2.1.1 defines Zero-self's benchmark optimal consumption smoothing stream C_0^F and associated utility level U_0^F which is what could be achieved if she had perfect access to borrowing and saving at competitive interest rates with the commitment required to make sure the contract is not renegotiated. In general, there are many reasons why autarky consumption plans might fall short of this optimum. For example, if the consumer's income is back-heavy, borrowing constraints might mean she must consume income as it arrives. If her income is front-heavy she may be able to construct a somewhat smoothed consumption stream but there may be technological restrictions to saving that place the return to savings well below the market rate – the insecurity of storing cash at home being one obvious explanation. More pivotal to our analysis, however, is that even with access to perfectly secure savings, a consumer with time-inconsistent preferences cannot trust her later selves to follow her optimal consumption path. While remaining deliberately agnostic about autarky technologies, the rest of the paper focuses on the reasonable and interesting case where $U_0^A < U_0^F$ and there are therefore potential gains to financial contracting with a new intermediary.

The consumer will have the option to contract with one or many risk-neutral banks, depending on whether the market structure is monopolized or competitive. Each bank can access funds at interest rate opportunity cost r. At this market interest rate, the present value of the consumer's income stream can be defined as:

$$y \equiv \sum_{i=0}^{2} \frac{y_i}{(1+r)^{i-t}} \tag{3}$$

A period 0 financial contract may be interpreted as the consumer exchanging income stream Y_0 in exchange for a new consumption path C_0. The bank will participate if and only if the profits it can earn, $\Pi_0(C_0; Y_0)$, are expected to be non-negative, where profits are defined as:

$$\Pi_t(C_t; Y_t) \equiv \sum_{i=t}^{2} \frac{(y_i - c_i)}{(1+r)^{i-t}} \tag{4}$$

The contract will involve borrowing (dissaving) or savings (repaying debt) in period t depending on whether $(c_t > y_t)$ or $(c_t > y_t)$, respectively. To simplify the analysis, we start by assuming contracts can only be initiated in period 0.[13] However, an existing contract may be renegotiated by the consumer and the original bank or possibly a new one in period 1. If this happens, we assume the bank incurs a non-monetary cost, $\kappa \geq 0$. We could interpret this to include a concern for reputation or some other impact on the social preferences of its owners.[14]

2.1 Optimal commitment contracts

We first characterize optimal consumption-smoothing contracts under the assumption that the consumer can bind their latter selves to not renegotiate the term of the contracts with the same bank or other banks. We do this for the case of competition and monopoly. The credibility of the bank's own commitment to not allow the consumer to renegotiate the contract ultimately must rest on the assumption that the bank has credibly bonded itself to face a deterrent penalty in the event of renegotiation. We will derive expressions for the minimum size of the deterrent penalty required to sustain optimal consumption smoothing.

[13] This assumption is explored and lifted in Section 6.

[14] We discuss the source and nature of such costs in section 5. The bank could incur additional monetary costs as well but we assume these to be 0 as they can be netted out and do not affect the analysis in any important way.

2.1.1 Optimal commitment contracts under competition

A consumer with time-inconsistent preferences cannot trust her latter selves to stick to her preferred consumption plans. In this simple three-period setting Zero-self's concern is that her later One-self will try to divert resources earmarked for period 2 consumption to boost period 1 consumption instead. Like a Stackelberg-leader in a Cournot game, Zero-self's strategic saving/borrowing choices are affected by her anticipation of One-self's best response. A bank may be able to act as a strategic partner to Zero-self by offering contracts with commitment services to help restrict or otherwise control the consumer's later selves' best responses.

With an exclusive full-commitment contract the consumer faces no self-control problem. Zero-self chooses a contract that commits her One- and Two-selves to follow the chosen consumption plan. This contract design problem is solved as a standard utility maximization problem subject to an inter-temporal budget constraint (or, subject to a financial intermediary's zero-profit condition). Zero-self chooses contract C_0 to solve:

$$\max_{C_0} U_0(C_0) \tag{5}$$

$$\text{s.t.} \quad \Pi_0(C_0; Y_0) \geq 0 \tag{6}$$

The familiar first-order necessary conditions are:

$$u'(c_0) = \beta\delta(1+r)u'(c_1) = \beta\delta^2(1+r)^2u'(c_2) \tag{7}$$

An increase or decrease to the term $\delta(1+r)$, which enters each expression above, essentially 'tilts' consumption to be more generally rising or falling over time as $\delta \gtreqless \frac{1}{1+r}$. As this across-the-board tilt will not alter key tradeoffs of interest (unlike the degree of present-bias β parameter which does) we shall impose the assumption that $\delta = \frac{1}{1+r} = 1$ for the remainder of the analysis. This is without loss of generality and greatly unclutters the math. The simplified first-order conditions are:

$$u'(c_0) = \beta u'(c_1) = \beta u'(c_2) \tag{8}$$

Along with a binding budget or bank zero profit constraint the first-order conditions allow us to solve for the competitive full smoothing commitment contract C_0^F, so called because it assumes latter period selves are committed to not deviate from Zero-self's optimal plan. With CRRA utility, a closed form solution for C_0^F is easily found (36).[15] This contract has

[15] All CRRA derivations and closed-form solutions are in the appendix.

the property:

$$\beta^{\frac{1}{\rho}} c_0^F = c_1^F = c_2^F \tag{9}$$

Zero-self indulges her present bias (by tilting consumption toward herself) and then allocates remaining resources to be consumed evenly across the remaining two periods.

Consider a simple example where $\beta = 0.5$, $\rho = 1$ and endowment income has present value $\sum y_t = 300$. Zero-self's preferred commitment contract will be $C_0^F = (150, 75, 75)$. If the total income of 300 arrives evenly across periods as $Y_0 = (100, 100, 100)$ then this consumption plan would imply borrowing $c_0^F - y_0 = 50$ in period 0 to be repaid as equal installments of 25 in periods 1 and 2. Had the stream instead been $Y_0 = (200, 50, 50)$ the consumer would save 50 in period 0 to raise consumption by 25 in each of periods 1 and 2. We will return to this example below when Zero-self cannot enforce perfect commitment and will be forced to adapt to the reality that One-self may carry 'too much debt' or 'not save enough' relative to Zero's preferred choices.[16]

2.1.2 Commitment full-smoothing contracts under Monopoly

If instead of competition the bank has a monopoly in period 0, the analysis is similar except now we search for the bank's optimal contract which maximizes bank profits subject to a consumer participation constraint:

$$\max_{C_0} \Pi_0 \left(C_0; Y_0\right) \tag{10}$$

$$s.t.\ U_0 \left(C_0\right) \geq U_0^A \tag{11}$$

The first-order tangency conditions are the same as in the competitive case, given by expressions 8. Substituting these into Zero-self's participation constraint which must bind at a monopoly optimum, we solve for optimal monoply contract C_0^{mF} and corresponding bank profits $\Pi_0 \left(C_0^{mF}; Y_0\right)$. Closed form solutions for the CRRA utility case appear as appendix equations 37 and 38, respectively.

The terms of the optimal monopoly contract and bank profits will be determined by the consumer's autarky utility U_0^A. Consumption C_0^{mF} rises and profits fall with U_0^A. Since the monopolist fully extracts the gains to trade, consumption in each period under monopoly will be lower than under competition.

Conceptually, the equilibrium contract under competition will be found at the tangency between the highest iso-utility surface just touching the budget hyper-plane. Under

[16] These parameter values were chosen for expositional purposes. In particular $\rho = 1$ implies that period zero consumption will be the same with or without commitment but the analysis can be easily adapted to other cases.

monopoly, the optimum contract will be at the tangency point where the highest iso-profit plane just touching the iso-utility surface associated with Zero-self's reservation utility.

3 The Renegotiation Problem

We now get to questions at the heart of the paper: when is commitment credible, how is it sustained, and at what cost? At issue is the fact that One-self always prefers higher period 1 consumption than what Zero-self wants to build into a contract, so there are tempting potential gains to trade from breaking earlier contract commitments. The credibility of optimal commitment contract must therefore rest on the threat of a sufficiently costly punishment κ deterring the bank from engaging in such renegotiation. In this section we determine the minimum size of the punishment required.

The fraught nature of this potential renegotiation problem is depicted in Figure 1 for a case where renegotiation costs are set to $\kappa = 0$, or in other words where One-self and a bank can rewrite the terms of any contract at zero penalty. Assume – just for the sake of argument now – that the consumer had (naively as it will turn out) accepted a full-smoothing commitment contract C_0^* or C_0^{m*} in period zero, indicated as point F in the $c_1 - c_2$ plane. This contract satisfies Zero-self's optimality condition $u'(c_1) = u'(c_2)$ as indicated by the fact that Zero-self's indifference curve is tangent to the bank's iso-profit line. However One-self, who discounts period 2 utility more heavily, considers that this bundle gives too much consumption to period 2 as $u'(c_1) > \beta u'(c_2)$ and as can be seen by the fact that at F One-self's indifference curve is steeper than the bank's iso-profit line. With zero renegotiation costs there are gains-to-trade that can be shared from recontracting from F to any new tangency point (along the $c_2 = \beta^{\frac{1}{\rho}} c_1$ ray where One-self's first-order conditions are met) between point R_0 which is the contract least favorable to One-self (chosen if the bank could act as monopolist in period 1) and point P_0 which is the contract most favorable to One-self (chosen with competitive renegotiation). Zero-self would clearly be made worse off by this renegotiation away from her optimal contract F. Being a sophisticate she will only agree to a contract that deter the bank(s) from offering or agreeing to a contract renegotiation that could do her further harm.

3.1 Renegotiated contracts

Consider any candidate equilibrium contract C_0^0 and specifically the subgame played in period 1 from any continuation contract $C_1^0 = (c_1^0, c_2^0)$ inherited from period 0.

The period 0 design problem is to search for the best contract for the consumer (or for the bank in the case of monopoly) among contracts with continuation contracts that are subgame-perfect to avoid harmful renegotiations.

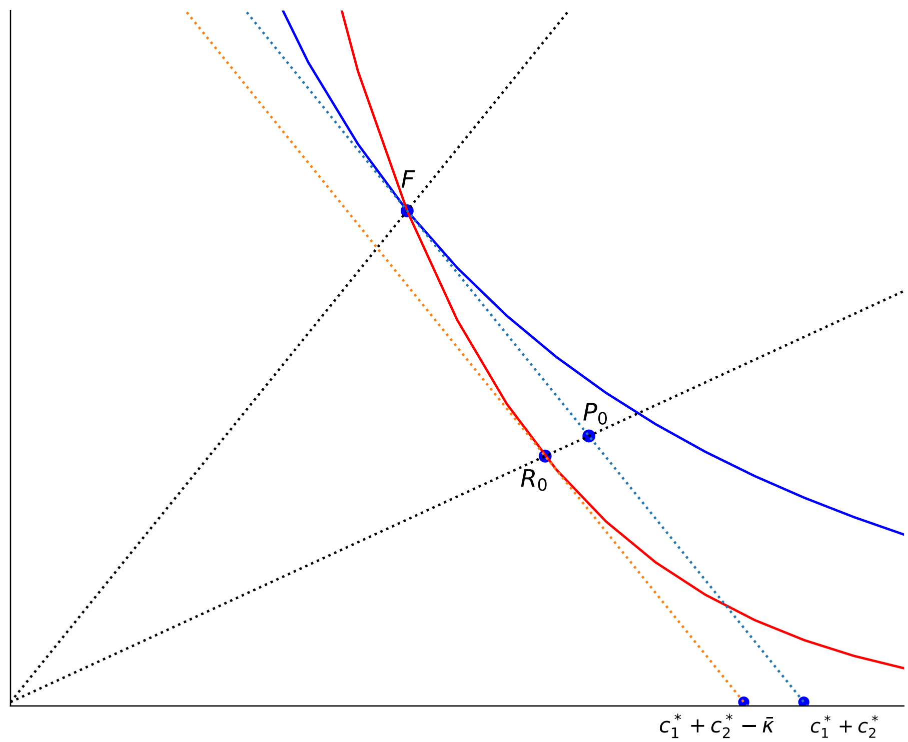

Figure 1: Optimal competitive contract and renegotiation threat

A contract will only be renegotiated if the gains to trade from renegotiation are sufficient to cover bank renegotiation costs κ. This is the case whether the bank has an exclusive (or monopoly) position in period 1 or whether the market for period 1 contracts is competitive. In the monopoly case the bank captures all the gains to trade in the form of profits but will only renegotiate if these exceed renegotiation costs κ. In the competitive case the consumer's One self is in a position to capture the gains but they too can only entice a bank to renegotiate it if they can cover its renegotiation costs. Hence in both cases the 'no-renegotiation' will be the same as formalized below.

To study this, we first consider the set of contracts the parties would renegotiate to. Consider first the situation where the market for period 1 contracts is competitive. Period 1 banks compete to renegotiate or exchange the existing continuation contract C_1^0 for a new contract $C_1^1(C_1^0)$. Competition insures that the new or existing bank just break even after covering any renegotiation costs, so the contract design problem can be written:

$$C_1^1(C_1^0) = \underset{C_1}{argmax}\ U_1(C_1) \tag{12}$$

$$\text{s.t. } \Pi_1(C_1; C_1^0) \geq \kappa \tag{13}$$

This last constraint can be written out $c_1 + c_2 + \kappa \leq\ c_1^0 + c_2^0$. In a renegotiation the bank can be thought of as replacing a contract that promised the consumer continuation (c_1^0, c_2^0) in exchange for a new contract (c_1, c_2) preferred by One-self. To be willing to accept this the cost of the new contract plus renegotiation cost to the bank must not exceed the cost of the existing contract. With competition this constraint exactly binds.

As long as U_1 is well behaved this can be solved for an interior $C_1^1(C_1^0)$ using the first-order condition $u'(c_1^1) = \beta u'(c_2^1)$ and binding condition 13. [CUT?:As drawn for the CRRA case in figure 2, the contract C_1^0 at P_κ would be renegotiated to point R_κ where the ray $c_2^1 = \beta^{\frac{1}{\rho}} c_1^1$ (along which the FOA are met) intersects the period 1 zero profit line 13. One-self makes a utility gain. Note that had $\kappa = 0$ the contract would have been renegotiated to P_0).]

If the bank instead finds itself in a monopoly position in period 1 then it will renegotiate existing contract C_1^0 to a new contract $C_1^{m1}(C_1^0)$ to increase profits by offering the smallest enticement necessary for One-self to accept the renegotiated contract:

$$C_1^{1m}(C_1^0) = \arg\max_{C_1}\ \Pi_1(C_1; C_1^0) \tag{14}$$

$$U(C_1) \geq U(C_1^0) \tag{15}$$

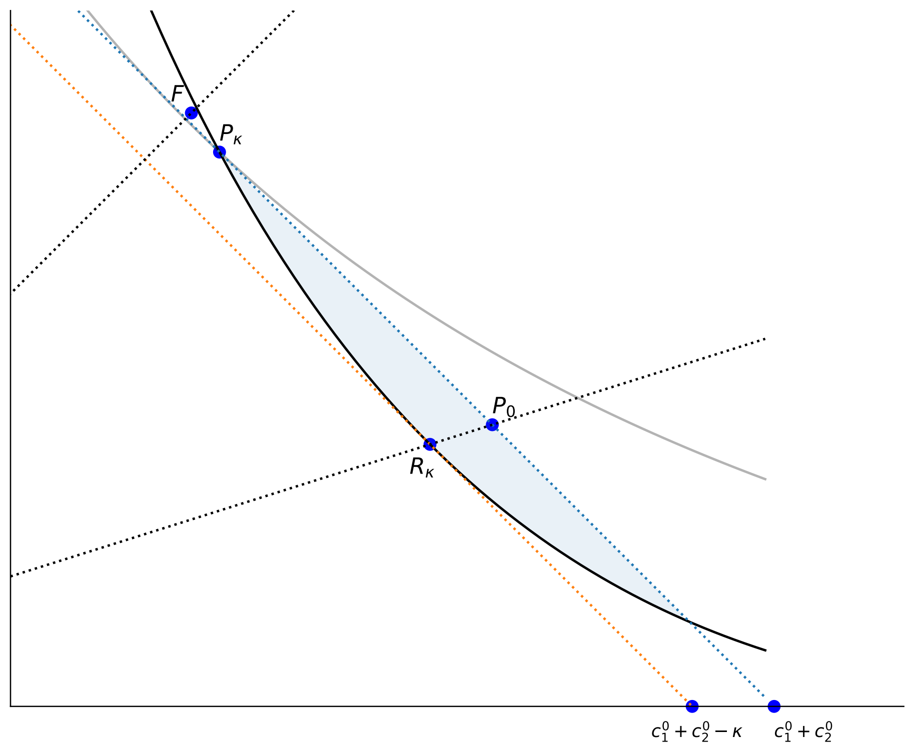

Figure 2: Monopoly commitment contract with $\kappa < \bar{\kappa}$

Solving for an interior solution using first-order conditions and the binding condition 15, the CRRA case yields a closed form solution (40). [??CUT: In figure ?? contract C_1^0 at P would be renegotiated to point R^m where the ray $c_2^1 = \beta^{\frac{1}{\rho}} c_1^1$ intersects One-self's participation constraint 13. As drawn the bank gains.]

3.2 The 'no-renegotiation' condition

Under what conditions is a contract *not* renegotiated in period 1? Assuming a tie-breaking rule in favor of Zero-self's preferences, the no-renegotiation condition under period 1 competition is:

$$U_1\left(C_1^0\right) \geq U_1\left(C_1^1(C_1^0)\right) \tag{16}$$

and the no-renegotiation condition under period 1 monopoly is:

$$\Pi_1(C_1^{1m}\left(C_1^0\right); C_1^0) \leq \kappa \tag{17}$$

These two conditions are in fact identical: a period 0 contract is credible if and only if there is no way for a bank to offer One-self a new contract that simultaneously (a) leaves One-self with at least as much discounted utility as in the original contract, and (b) generates additional profits of at least κ to the bank. In short the contract is renegotiation-proof so long as renegotiation costs are large enough to make sure no Pareto-gain is possible between One-self and the bank. A single no-renegotiation condition is applied to any continuation contract C_1^0 and renegotiation cost κ (a closed-form solution representation is given in Equation 42).

The condition is illustrated in Figure 1. Let F denote *any* continuation contract in period 1. The horizontal distance between the isoprofit lines through P_0 and R_0 denotes the maximum profit a bank could gain through renegotiation (equal to the cost savings from renegotiating the contract, or $c_1^0 + c_2^0 - c_1^1 - c_2^1$. If this gain is less than or equal to κ the consumer and bank will not find it worthwhile to renegotiate.

3.3 When are full-consumption commitment contracts credible?

What is the minimum renegotiation cost sufficient to deter the renegotiation of full-smoothing commitment contracts? This is found by setting $c_1^0 = c_1^F = c_2^0$ in the no-renegotiation condition (42) and solving for κ. A competitive full-smoothing commitment contract will survive if and only if

$$\kappa \geq \bar{\kappa} \equiv c_1^F \cdot \Upsilon \tag{18}$$

while a monopolistic full-smoothing commitment contract will survive if and only if:

$$\kappa \geq \bar{\kappa}^m \equiv c_1^{mF} \cdot \Upsilon \tag{19}$$

where Υ is a constant (44).

Here $\bar{\kappa}$ and $\bar{\kappa}^m$ are the threshold minimum renegotiation costs required to deter the renegotiation of full-smoothing commitment contracts. From (44) it is clear that the greater the consumption levels in a full-smoothing commitment contract (the greater the scope for profitably rearranging consumption in period 1), the more costly it becomes to deter renegotiation.

Under competition we know that c_1^F is independent of autarky utility (given a fixed value of y). So $\bar{\kappa}$ does not depend on how close or far from optimal consumption smoothing the consumer is in autarky. Under period 0 monopoly we have a threshold $\bar{\kappa}^m$ that rises linearly with c_1^{mF} which in turn is non-decreasing in autarky utility U_0^A (see 38). Since $c_1^F > c_1^{mF}$ for any initial Y_0 we must also always have $\bar{\kappa}^m < \bar{\kappa}$. Proposition 1 summarizes:

Proposition 1. *Given threshold renegotiation costs $\bar{\kappa}$ and $\bar{\kappa}^m$ as defined in Conditions 18 and 19.*

(a) *The competitive full-smoothing commitment contract survives if and only if* $\kappa \geq \bar{\kappa}$.

(b) *The monopolistic full-smoothing commitment contract survives if and only if* $\kappa \geq \bar{\kappa}^m$ *with* $\bar{k}^m$ *strictly rising in the consumer's autarky utility.*

(c) $\bar{\kappa}^m < \bar{\kappa}$.

Notice that monopoly is better at delivering full-smoothing commitment contracts than under competition ($\bar{\kappa}^m < \bar{\kappa}$), but this is not because monopolists are inherently better at committing; rather, this follows from the fact that having at the outset extracted surplus by offering the consumer a contract with the lowest possible consumption, there is relatively less surplus left to be captured via renegotiation in period 1.[17]

A further implication, of statement (b) in the proposition, is that under monopoly, consumers with better autarky options are less likely to get full-smoothing commitment contracts that could be sustained. A consumer with a higher autarky utility must be offered higher consumption by the monopolist, and the no-renegotiation condition is harder to satisfy at higher levels of consumption. This serves to dampen the advantages of improved outside options for sophisticated hyperbolic discounters contracting with monopoly banks.

4 Imperfect-Smoothing Commitment Contracts

Consider now the contract design problem where bank renegotiation costs are not high enough to sustain full-smoothing commitment contracts. Since One-self prefers different tradeoffs between period 1 and period 2 consumption compared to Zero-self, any period 1 renegotiation between One-self and a bank can only harm – or at best not improve – Zero-self's inter-temporal utility. A bank that contracts with naifs will capitalize on the consumer's failure to anticipate such harmful renegotiations (Section 4.3). A sophisticated consumer however will be wise to the problem and will only agree to renegotiation-proof contracts (Sections 4.2 and 4.3). Such contracts will have a binding renegotiation-proof constraint (17) and therefore will offer Zero-self less consumption smoothing than a full-smoothing commitment contract would. The absence of sufficiently high credibly enforced external renegotiation costs forces the parties to either (a) distort the terms of the period 1 continuation contract closer to One-self's preferred choice or (b) limit consumption in periods 1 and 2, as a costly endogenous strategy to reduce the scope for renegotiation. We label these 'imperfect-smoothing commitment' contracts. Technically these are still 'full commitment' contracts in the sense that renegotiation is in fact avoided in equilibrium but they provide

[17]Indeed, in reality monopolists may also be better at committing (i.e. having a higher κ). Our point is that this is not necessary for monopolists to offer better smoothing than competitive firms.

less than perfect or efficient consumption smoothing from Zero-self's perspective. They therefore also offer lower Zero-self's inter-temporal utility or bank profits.

For expositional convenience, we first discuss the monopoly case.

4.1 Monopoly

4.1.1 Constructing the contract

When the market for period 0 contracts is monopolized the bank will want to maximize multi-period profits subject to Zero-self's participation and the no-renegotiation constraint

$$\max_{C_0} \Pi_0\left(C_0; Y_0\right) \tag{20}$$

$$s.t. U_0\left(C_0\right) \geq U_0^A \tag{21}$$

$$\Pi_1\left(C_1^1\left(C_1\right); C_1\right) \leq \kappa \tag{22}$$

A sophisticated consumer can rationally anticipate how her later self may be tempted to renegotiate. Zero-self would agree to a contract that will be renegotiated but only if the bank adjusts the terms of the offered period 0 contract to compensate for the reduced consumption smoothing that would result. Anticipated renegotiation however can only harm bank profits as this would trigger renegotiation costs. Hence the monopoly bank will itself insist on renegotiation-proof contracts.

The bank will be looking for the most profitable renegotiation-proof contract that lies on Zero's participation constraint 11. Consider a candidate contract C_0^0. The associated continuation contract C_1^0 must lie along Zero-self's autarky utility surface which can be projected as indifference curve $\beta\left[u(c_1^0) + u(c_2^0)\right] = U_0^A - u(c_0^0)$ in $c_1 - c_2$ space. The optimal contract will be the most profitable renegotiation proof contract along this surface. The contract will be renegotiation proof when $c_1^1 + c_2^1 + \kappa \geq c_1^0 + c_2^0$ and $u(c_1^1) + \beta u(c_2^1) \leq u(c_1^0) + \beta u(c_2^0)$. Many points are renegotiation proof but the one that is most profitable amongst these will satisfy the two conditions exactly depicted in the figure by point P_κ in 2.

The profit-maximizing choice of C_0 is then determined by backward induction.

4.1.2 Properties of the contract

The renegotiation-proof contract can be explicitly derived for the CRRA case of $\kappa = 0$ (Equation 64). For, $\kappa > 0$, the contract cannot be explicitly derived in closed form, but its key properties can be established.

Proposition 2. *Suppose $\kappa < \bar{\kappa}^m$ and the consumer is sophisticated. Under monopoly, the profit-maximizing renegotiation-proof contract (C_0^{mP}) has the following properties:*

(i) $\Pi_0\left(C_0^{mP}; Y_0\right) < \Pi_0\left(C_0^{mF}; Y_0\right)$

(ii) $c_0^{mP} > c_0^{mF}$

Proposition 2 compares the renegotiation-proof contract to the full-smoothing commitment contract when the renegotiation-proofness constraint binds. First, bank profits will be lower than under full-smoothing commitment. The bank wishes it could promise to not renegotiate but it cannot make such a promise credible without giving up some profits. As explained in the introduction, the problem here is not one of cheating or contract failure, it is the possibility of a legitimate renegotiation between the consumer and the firm. The monopolist would have gained from having higher renegotiation costs since in equilibrium renegotiation does not take place.

An associated observation is that the bank will now prefer not to contract with individuals who have minimal smoothing needs. If the bank were able to provide full-smoothing commitment, it could offer a profit-making contract to any such individual. Now however, for individuals whose autarky utility is close enough to U_0^F, the bank would make negative profits under the best renegotiation-proof contract.

The second statement of the proposition is about the terms of the contract – when full-smoothing commitment is not feasible, the renegotiation-proof contract will involve higher consumption in period 0 (i.e. either a smaller loan or less savings) compared to full-smoothing commitment. The following is a sketch of the argument (the proof in the appendix uses some additional notation for logical clarity which we describe intuitively here).[18]

Any contract C_0 can be fully described in terms of three variables, c_0, s, and α. Here, c_0 is period 0 consumption and s is the total consumption allocated to periods 1 and 2. α determines the share of s that is consumed in period 1. So, $C_0 = (c_0, \alpha s, (1-\alpha)s)$. This notation serves two purposes.

First, α captures renegotiation concerns. Under full-smoothing, $\alpha = \frac{1}{2}$, as this is optimal from Zero-self's perspective. When the no-renegotiation constraint binds, we get a function $\alpha(s)$ which tells us how much larger c_1 must be relative to c_2 so that further renegotiation would be unprofitable. While the function cannot be explicitly stated, we show that α must rise as s rises (as total consumption in periods 1 and 2 gets bigger, period 1 must get a bigger share).

Second, we can succinctly state the first-order condition. Define the continuation utility from Zero-self's perspective as $V(s,\alpha) \equiv \beta\left[u(\alpha s) + u((1-\alpha)s)\right]$. At any contract that

[18] If the reader prefers to skip this, we present a purely intuitive explanation of the results near the end of Section 4.2.2.

constitutes an optimum, the following must be true:

$$\frac{du\left(c_0\right)}{dc_0} = \frac{dV}{ds} \tag{23}$$

Otherwise, the bank could raise profits by reallocating consumption from period 0 to the future or vice versa.

Now suppose the optimal renegotiation-proof contract specified the same level of period 0 consumption as the full-smoothing contract, so $c_0^{mP} = c_0^{mF}$. Since any future consumption must be split unevenly, in order to continue to satisfy the consumer's period 0 participation constraint, it must be true that $s^{mP} > s^{mF}$. We show in the appendix that s^{mP} would have to be large enough that, at these values,

$$\frac{du\left(c_0^{mP}\right)}{dc_0} > \frac{dV}{ds} \tag{24}$$

so this contract could not be profit-maximizing. In other words, a switch from full-smoothing commitment to renegotiation-proofness while maintaining the same c_0 would require such a large jump in future total consumption (to continue satisfying Zero-self's participation constraint) that the marginal utility of future consumption would be low. So the bank could do better by raising period 0 consumption at the expense of future consumption.

The bank limits renegotiation possibilities by transferring consumption away from the future (when renegotiation is a temptation) to the present. Relative to full-smoothing commitment, consumers get contracts with larger loans or less savings.

4.2 Competition

4.2.1 Constructing the contract

If the market for period 0 contracts is competitive the optimal contract will solve the problem:

$$\max_{C_0} \; U_0\left(C_0\right) \tag{5}$$

$$\Pi_0\left(C_0; Y_0\right) \geq 0 \tag{6}$$

$$\Pi_1\left(C_1^1\left(C_1\right); C_1\right) \leq \kappa \tag{17}$$

As noted in section 3.2, the no-renegotiation constraint 17 assures that the gains-to-trade from renegotiation fall short of bank renegotiation costs (see also 42). Even if new banks could enter in period 1 to offer part or or all of the surplus from renegotiation to One-self in

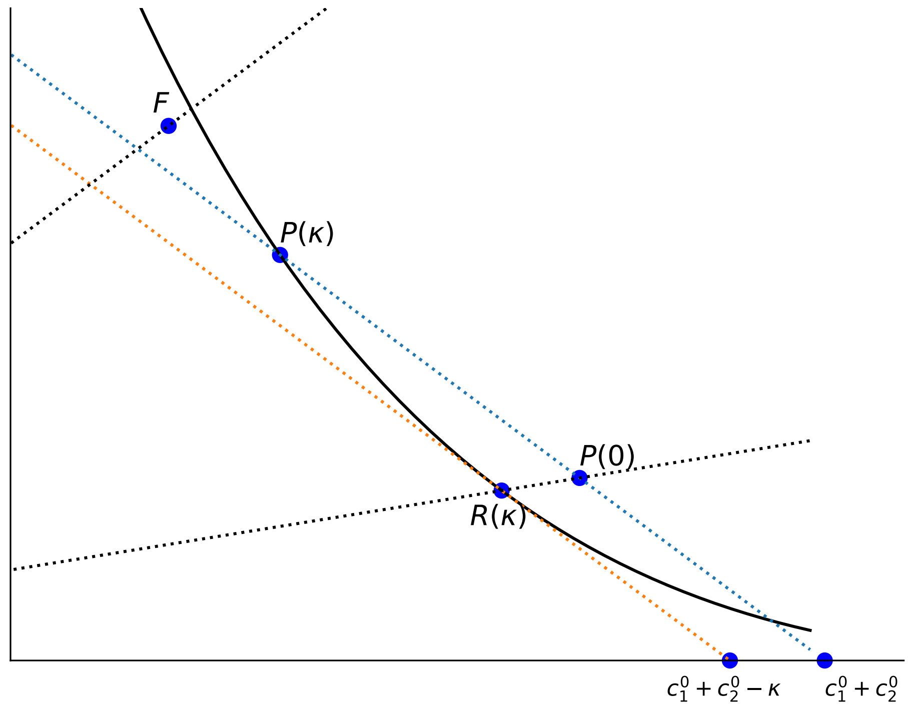

Figure 3: Imperfect smoothing commitment contract with $\kappa < \bar{\kappa}$

period 1 the constraint deters renegotiation as long as those banks also face renegotiation cost κ.[19]

Like a Stackelberg leader, Zero-self will want to choose the contract C_0 that achieves the highest welfare considering the best responses of One-self and the bank in period 1 subgames.

Figure 3 offers a (zoomed-in) view of the contract space of interest. Suppose Zero-self has chosen a candidate period 0 level of consumption c_0^0. If this to be part of an optimum renegotiation-proof contract Zero must ensure that the continuation contract represented by point $P(\kappa)$ in the figure lies on the bank's binding period 0 zero profit condition (otherwise Zero-self could raise her welfare and still meet the constraints). In other words the continuation contract will lie along the period 1 budget line $y - c_0^0 = c_1^0 + c_2^0$ drawn running through point $P(0)$ in the figure.

A bank will only renegotiate away from a contract along this budget line if the renego-

[19]Later in our discussion of non-exclusive contracts we discuss the case where competing banks can enter in period 1 and offer to renegotiate at lower or zero renegotiation cost).

tiated contract (c_1, c_2) lies on or below iso-cost line $c_1 + c_2 = y - c_0^0 - \kappa$. That is because, by design, any contract above this line will not offer sufficient cost savings (i.e. profit gain) to cover renegotiation cost κ. Note also that candidate renegotiation contracts must satisfy One-self's first order condition $u'(c_1) = \beta u'(c_2)$ – otherwise the gains to trade from renegotiation could be increased to make these renegotiation more attractive. The contract that just satisfies these two conditions is represented by point $R(\kappa)$.[20]

We have drawn an indifference curve for One-self's preferences through this point. All points along the period 1 budget line $c_1^0 + c_2^0 = y - c_0^0$ that also lie above this indifference curve will be renegotiation-proof contracts. To see this consider any contract P' along this segment (or indeed any point in the half-eye). One-self will only accept renegotiation away from this contract if it moves One-self to an indifference curve higher than the one running through P'. By construction however any such contracts must lie above the bank's no-renegotiation line and hence would be rejected. By similar reasoning any contract along the budget line outside of this top-segment of the half-eye would be renegotiated. Since Zero-self's welfare increases as as we move toward a more balanced consumption bundles, of all possible renegotiation-proof contracts Zero prefers the contract labeled $P(\kappa)$ that offers the highest intertemporal utility. This preferred renegotiation-proof contract offers less consumption smoothing compared to the full-smoothing commitment contract (reached at $\kappa \geq \bar{\kappa}$ where the no-renegotiation constraint ceases to bind).

Except for the special case where $\kappa = 0$, there is no simple closed form solution for the optimal contract even in the CRRA case. This can be seen from the fact that there are two points where the no-renegotiation condition indifference curve crosses the period 1 zero-profit line. As described in the appendix the c_1^0 coordinates of these two roots are given by a non-linear equation (42).

In the special case of perfect competition with costless renegotiation ($\kappa = 0$) there will be a unique solution and a closed form. In figure 3 think of how $P(\kappa)$ slides down the budget line as κ shrinks until we get to a point where One's indifference curve is tangent to the period 1 budget line. This continuation contract is 'renegotiation-proof' only in the very narrow sense that it won't be renegotiated because it already delivers One-self's preferred consumption choice. This contract is explicitly solved in expression (65).

Consider the practical interpretation of a simple example: with $\beta = 0.5$ and $\rho = 1$ and $\kappa = 0$ the best available competitive contract $C_0^P = (150, 100, 50)$ offers considerably less consumption smoothing in later periods compared to the benchmark full-smoothing $C_0^F = (150, 75, 75)$. If the consumer's initial income stream were arranged as $Y_0 = (100, 100, 100)$ we would interpret the absence of commitment case ($\kappa = 0$) as rolling over period one debt

[20]With period 0 competitive we'll have $c_1^0 + c_2^0 = y - c_0^0$ and can therefore identify this point from $u'(c_1) = \beta u'(y - c_0^0 - \kappa - c_1)$. For the CRRA case $c_1 = (y - c_0^0 - \kappa)/(1 + \beta^{\frac{1}{\rho}})$.

that Zero would have preferred to have seen repaid. The entire burden of the debt that Zero took out in period 0 but would prefer to have been shared equally between periods 1 and 2 is 'rolled over' and placing the entire burden now on period 2. Had the income stream instead been $Y_0 = (200, 50, 50)$ then we might interpret the consumer in period one as 'raiding savings' that, with commitment, One self would have protected for period 2 consumption.

In this example, consumers that can obtain full-smoothing commitment contracts will save/repay more or borrow less in period 1 and consume more in period 2. The inability to commit leads to lower welfare for Zero in this competitive setting. However, this is not generally true in the monopoly case, as we show below. Credible division rules between periods 1 and 2 depend on the no-renegotiation constraint in some subtle ways.

4.2.2 Properties of the contract

Suppose contract C_0^P is the solution to the maximization problem described by 5, 6 and 17.

Proposition 3. *Suppose $\kappa < \bar{\kappa}$ and the consumer is sophisticated. Under competition, the competitive renegotiation-proof contract that maximizes Zero-self's discounted utility (C_0^P) has the following properties:*

(i) $U_0\left(C_0^P\right) < U_0\left(C_0^F\right)$

(ii) The relationship between c_0^P and c_0^F is ambiguous. There is some $\hat{\rho}$ such that: if $\rho \leq \hat{\rho}$, then $c_0^P > c_0^F$; if $\rho > \hat{\rho}$, then there are parameter values under which $c_0^P < c_0^F$.

The first statement is straightforward: Since $\kappa < \bar{\kappa}$ means the new renegotiation-proofness constraint (17) binds full-smoothing smoothing cannot be achieved and the consumer's welfare must be lower than under the first-best contract.

Now, will period 0 consumption be higher or lower than under full-smoothing commitment? The proposition is that this depends on parameter values, in particular the intertemporal elasticity of substitution $\frac{1}{\rho}$. Consider the competitive full-smoothing commitment contract C_0^F. Following the modified notation of section 4.1.2 and first-order condition (8), it must be true that:

$$\frac{du\left(c_0^F\right)}{dc_0} = \frac{\partial V\left(s^F, \frac{1}{2}\right)}{\partial s}$$

Now suppose the competitive renegotiation-proof contract C_0^P involves the same period 0 consumption as under full-smoothing commitment, so that $c_0^P = c_0^F$. By the bank's zero-profit constraint, the contract will also have $s^P = s^F$, but consumption will be split in period 1's favor. If the utility function is relatively linear (low ρ), then an imbalanced split of s

results in a lower marginal utility than from a balanced split. So:

$$\frac{du\left(c_0^F\right)}{dc_0} > \frac{dV\left(s^F, \alpha\left(s^F\right)\right)}{ds}$$

In such a case, the renegotiation-proof contract must involve higher period 0 consumption than the full-smoothing commitment contract.

If, on the other hand, the utility function is highly convex (high ρ), then an imbalanced split results in higher marginal utility relative to full-smoothing. In such cases, the renegotiation-proof contract will have lower period 0 consumption than under full-smoothing commitment under certain parameter values.[21] This can be seen more explicitly in the case of $\kappa = 0$ (Equation 65).

So, under competition, the renegotiation-proofness constraint could change the contract in either direction: a larger loan (less saved) or a smaller loan (more saved). Period 2 consumption however always falls relative to the full-smoothing commitment case, even in the cases when Zero saves more/borrows less. In fact for CRRA utility the adjustment of period 0 consumption (in the absence of commitment compared to with commitment) is always relatively small while the adjustment to period 1 and period 2 consumption is relatively much larger.[22] In other words despite having a first-mover advantage, Zero can do little other than to partially accommodate to the consumption pattern that One-self wants to impose.

The contrast between monopoly and competition can be explained using the intuition of income and substitution effects. In either case, a move from full-smoothing commitment can be viewed as a rise in the "price" of future utility from Zero-self's perspective. As a result, substitution effects will lead to an increase in period 0 consumption and a drop in future consumption. Under monopoly, since the consumer is always left at her autarky utility, there are no income effects. When the renegotiation-proofness constraint binds, the price of future utility effectively rises, as a result of which substitution effects lead to greater period 0 consumption. Under competition, income and substitution effects work against each other; the net result depends on the shape of the consumer's utility function.

[21] The precise construction of the cutoff value $\hat{\rho}$ is somewhat complicated, as $\frac{dV}{ds}$ depends not just on $u'(c_1)$ and $u'(c_2)$, but also on how the sharing rule, $\alpha(s)$, changes with s.

[22] To illustrate, with $\kappa = 0$ at no point does period 0 consumption rise or fall by more than six percent for any value $\rho \in (0, \infty)$ and $\beta \in (0, 1)$ but at reasonable parameter values such as $\rho = 0.5$ and $\beta = 0.5$ in the absence of commitment period 1 consumption rises to 149 percent of the level it would be with commitment, and period 2 consumption falls to just 37 percent of what it would be.

4.3 Contracting with Naive Hyperbolic Discounters

For naive agents, the problem of renegotiation does not generally lead to a renegotiation-proof contract. The naif believes she will not be tempted to renegotiate. Banks therefore offer contracts that take into account the potential renegotiation. Under monopoly, the bank adds to its profits by engaging in renegotiation that was not anticipated by the consumer in period 0. Under competition, banks return the potential surplus from renegotiation to the Zero-self.[23]

4.3.1 Monopoly

Relative to a sophisticated consumer, with a naive consumer the monopolist bank can make additional profits on two margins. First, since there is no perceived renegotiation problem, the consumer is willing to accept a contract that is more profitable for the bank up-front; subsequently, possible renegotiation generates additional profits for the bank.[24]

The bank must choose between a renegotiation-proof contract and one that will be renegotiated upon. If κ is sufficiently large there is little to gain from renegotiation and the consumer will be offered the full-smoothing commitment contract. But when κ is relatively small, the bank might prefer to offer a contract that will subsequently be renegotiated. In such cases, the bank solves the following problem:[25]

$$\begin{aligned} &\max_{C_0} \quad \Pi_0 \left(C_0; Y_0\right) + \Pi_1 \left(C_1^{m1} \left(C_1\right); C_1\right) - \kappa \\ &s.t. \qquad\qquad U_0 \left(C_0\right) \geq U_0^A \end{aligned} \tag{25}$$

Let the solution be denoted C_0^{mN}. This is explicitly derived in the appendix (71, 72). As under competition, the bank maximizes profits by offering a contract that divides future consumption as much in favor of period 2 as possible. The greater the imbalance between the contracted c_1 and c_2, the greater the bank's profits from renegotiation. We show that if $\rho < 1$, the contract is at a corner solution where $c_1 = 0$. If $\rho > 1$, an explicit solution does not exist, but maximization pushes the contract to a point where c_2 approaches infinity.[26] This contract can be compared to the full-smoothing commitment contract and to the renegotiation-proof contract for sophisticates. In particular, it will involve lower perio d

[23] A similar analysis could be carried out if consumers were misinformed not about their own preferences but about κ.

[24] There is an additional consideration – that naive hyperbolic discounters might be inaccurately optimistic about autarky outcomes because of a failure to anticipate commitment problems. This would have the interesting effect of tightening the participation constraint and reducing surplus available to the monopolist

[25] We do not need to worry about a renegotiation-proofness constraint here. Since period 0 believes her period 1 preferences are consistent with her own, she expects any renegotiation of the period 0 contract to yield the same discounted utility as the contract itself.

[26] This can be dealt with by a reasonable assumption of an upper bound on contract terms.

0 consumption than under both full-smoothing commitment and renegotiation-proofness. This result appears counter-intuitive. In the case of lending, it does not reinforce the narrative of banks preying on naive consumers by offering them relatively large loans with steep repayments. Indeed, there are other considerations beyond the scope of this model, such as the possibility of collateral seizure, that could generate large loans. But our limited model helps to highlight a particular aspect of contracting with naive hyperbolic discounters: here, the bank offers them relatively *small* loans because its gains from renegotiation depend on the surplus that the initial contract delivers to periods 1 and 2. In order to fully take advantage of the consumer's naivete, the consumer must start out with sufficiently small repayments that the bank could profit from rearranging them.

The next proposition summarizes the above discussion.

Proposition 4. *Suppose the consumer is naive. Under monopoly:*

(i) If κ is sufficiently higher than $\bar{\kappa}^m$, the firm will offer the agent the full-smoothing commitment contract (C_0^{mF}) and it will not be renegotiated.

(ii) Otherwise, the contract C_0^{mN} will satisfy $c_0^{mN} < c_0^{mF} < c_0^{mP}$ (either explicitly or in the limit), and it will be renegotiated in period 1.

4.3.2 Competition

Under competition, with naive consumers contracts must account for renegotiation to have firms continue earning zero profits. First, note that if contracts are not exclusive, the equilibrium contract must be identical to the full-smoothing commitment contract. This is because the firm offering the contract in period 0 does not expect to benefit from renegotiation, so the contract gets competed down to the one that maximizes the naive Zero-self's perceived utility while delivering zero profits to the bank.

Under exclusive contracts, anticipated profits from future renegotiation will be returned to the consumer through more favorable initial contracts. If κ is sufficiently small, the equilibrium contract involves renegotiation and satisfies:

$$\begin{aligned}&\underset{C_0}{max} U_0\left(C_0\right)\\&s.t. \Pi_0\left(C_0;Y_0\right)+\Pi_1\left(C_1^{m1}\left(C_1\right);C_1\right)\geq\kappa\end{aligned}\tag{26}$$

Let the solution be denoted C_0^N. This is explicitly derived in the appendix (76 and 77). Contracts divide future consumption as much in favor of period 2 as possible. This maximizes the potential gains from renegotiation. In the context of loans, this suggests contracts where the debt burden is heaviest in the intermediate stages, resulting in renegotiation to postpone payments.

Unlike under monopoly, competition returns anticipated renegotiation gains to the consumer. Some of these gains are returned to the Zero-self, so there is no clear prediction about whether period 0 consumption will be lower or higher than under full-smoothing commitment.

Proposition 5. *Suppose the consumer is naive. Under competition:*

(a) If contracts are not exclusive: The consumer will accept the full-smoothing commitment contract, C_0^F. The contract will be renegotiated in period 1 if and only if $\kappa < \bar{\kappa}$.

(b) If contracts are exclusive:

(i) If κ is sufficiently higher than $\bar{\kappa}$, the consumer will accept the full-smoothing commitment contract (C_0^F) and it will not be renegotiated.

(ii) Otherwise, the consumer will accept a contract C_0^N with the following properties: if $\rho < 1$, $c_0^N < c_0^F$. If $\rho > 1$, then there are parameter values under which $c_0^N > c_0^F$.

5 Not for profit and hybrid ownership forms

Consider next the case of a firm that, in a pre-contract stage, has the possibility of choosing its ownership structure say by incorporating as a legal non-profit or, more broadly, by choosing a degree of 'hybrid' ownership, for example by retaining for-profit status but allowing social investors to establish considerable ownership stakes and managerial control. In the spirit of Hansmann () and the discussion in the introduction, we model this as a restriction on the firm's ability to distribute raw profits to managers and shareholders:

Definition. Given 'raw profits' Π_0, a 'nonprofit' firm retains 'captured profits' $f(\Pi_0)$, where $f(0) = 0$, $f'(\Pi_0) \in (0,1)$, and $f''(\Pi_0) \leq 0$.

This formulation follows Glaeser & Shleifer (2001) who argued that though the principals of a non-profit may be technically legally barred from tying compensation to cash profits, they can in practice capture a fraction of those profits in costly and imperfect ways via the consumption of perquisites or 'dividends in kind' (e.g. the lavish expense account). The ability of perquisites to substitute for unrestricted consumption falls as profits get larger.

Setting aside welfare concerns that might drive firms to adopt nonprofit or hybrid status, we examine when purely profit-minded firms might make such governance choices; i.e. when can a voluntary restriction on the ability to enjoy profits make a self-interested firm better off?[27] This has parallels to the explanation for commercial nonprofits due to Hansmann

[27] Indeed, welfare concerns could directly improve consumer outcomes by either allowing Zero-self's participation constraint to be slack or by raising the costs of renegotiation κ. We consider the latter point in an example below.

(1996) and modeled by Glaeser & Shleifer (2001) but established on quite different behavioral grounds.[28]

At the outset, it should be noted that profit-oriented principals have no incentive to switch to hybrid/nonprofit status when consumers are naive. Since the consumer does not perceive a need for commitment, any promise of superior commitment is of no value to her. The analysis with sophisticated consumers follows.

5.1 Monopoly

In a pre-contract phase the firm now first establishes its type via the adoption of legal non-profit status and/or by choosing credible and stable ownership and governance structures that commit it to those limitations. If the monopoly firm were to operate as a nonprofit or a hybrid, when facing a sophisticated hyperbolic discounter it would design a renegotiation-proof contract to solve:

$$\underset{C_0}{max}\ f\left(\Pi_0\left(C_0;Y_0\right)\right) \tag{27}$$

$$U_0\left(C_0\right) \geq U_0^A \tag{28}$$

$$f\left(\Pi\left(C_0;Y_0\right)+\Pi_1\left(C_1^{m1}\left(C_1\right);C_1\right)\right)-f\left(\Pi\left(C_0;Y_0\right)\right) \leq \kappa \tag{29}$$

Why might a profit-maximizing firm choose to operate as a nonprofit when that reduces its ability to capture profits? The answer lies in the loosening of the no-renegotiation constraint (29). Any gains from renegotiation are worth less than they would be to the for-profit firm. Clearly, the for-profit monopolist's contract (C_0^{mP}) would now leave the no-renegotiation constraint slack. Because the non-profit can more credibly commit to not renegotiate contracts that offer greater consumption smoothing across periods 1 and 2, Zero-self becomes more willing to pay for this consumption stream.

The captured-profits maximizing solution gives a contract that we denote C_0^{mNP}. If $\kappa < \bar{\kappa}^m$, with a relaxed renegotiation-proof constraint $\Pi_0(C_0^{mNP};Y_0) > \Pi_0(C_0^{mP};Y_0)$ but whether or not it will be in the bank principals' best interest to strategically convert to non-profit status depends on whether the captured profits under non-profit status exceed the profits they could earn as a pure for-profit, in other words on whether $f\left(\Pi_0(C_0^{mNP};Y_0)\right) > f\left(\Pi_0(C_0^{mP};Y_0)\right)$. The monopolist faces a tradeoff in considering non-profit status: higher raw profits (as the commitment problem is partly solved) but a diminished capture of those raw profits.

[28] In those accounts a firm delivers less than a promised quantity or quality of a good or service, unambiguously harming the time-consistent client. The client discovers this after the fact but cannot challenge the contract breach only because it is too difficult or costly. In contrast in our model the firm and the One-self customer both gain from voluntarily breaking existing contract commitments and Zero-self is no longer around to mount a challenge.

Does the rise in extracted surplus outweigh the fact that all profits are now discounted? Proposition 6 (in Section 5.2) establishes the existence of captured profit functions that would be strictly preferred to for-profit status for monopoly firms. This is easy to see: the possible concavity of f could leave the enjoyment of profits relatively unaffected while significantly loosening the no-renegotiation constraint (since renegotiation would raise profits further, and since f is concave, these additional profits would count for little).

Given particular captured profit functions, we can also ask which consumers are more likely to be served by nonprofit monopolists. If consumers are far from optimal in autarky, then the for-profit firm would anyway be making substantial profits. In this case, the non-profit's credibility advantages are not enough to outweigh the fact that it loses a significant amount of enjoyment of its profits due to legal restrictions.

However, for consumers with higher autarky utility, the gains that can be captured from nonprofit status are large relative to the profits that a for-profit would have made, so the firm prefers to operate as a nonprofit. As an example, consider an autarky consumption bundle at which the for-profit firm would earn zero profits. Now, the nonprofit firm can earn positive profits, so regardless of f nonprofit status dominates.

5.1.1 An example

Let us consider a situation where a firm may choose it's degree of hybrid-ness or for-profit orientation, indexed by a parameter $\alpha \in [0, 1]$. For a chosen α, let the captured profits function be linear:

$$f(\Pi_0) = \alpha \Pi_0 \tag{30}$$

We can interpret α as the maximum fraction of raw profits that can be distributed to managers and shareholders. An $\alpha = 1$ would represent a pure for-profit investor-led firm, $\alpha = 0$ a strictly regulated non-profit.

We can also allow α to directly affect the non-pecuniary renegotiation cost the firm's principals incur when they opportunistically break contractual promises to customers. A more hybrid or non-profit firm dominated by social investors is more likely to hire staff and managers that internalize client welfare and social investor motivations and therefore are more likely to feel non-pecuniary costs associated with guilt, shame or loss of reputation from breaking promises. If we now label the cost of renegotiation $\eta(\alpha)$ – replacing our earlier κ – this idea is captured by assuming that function η falls weakly in α. Putting both mechanisms together gives us modified no-renegotiation constraint (31) which states that the fraction of raw profits Π_1 that can be captured from renegotiating a contract must not exceed renegotiation costs:

$$\alpha \Pi_1(C_1^{m1}(C_1); C_1) \leq \eta(\alpha) \tag{31}$$

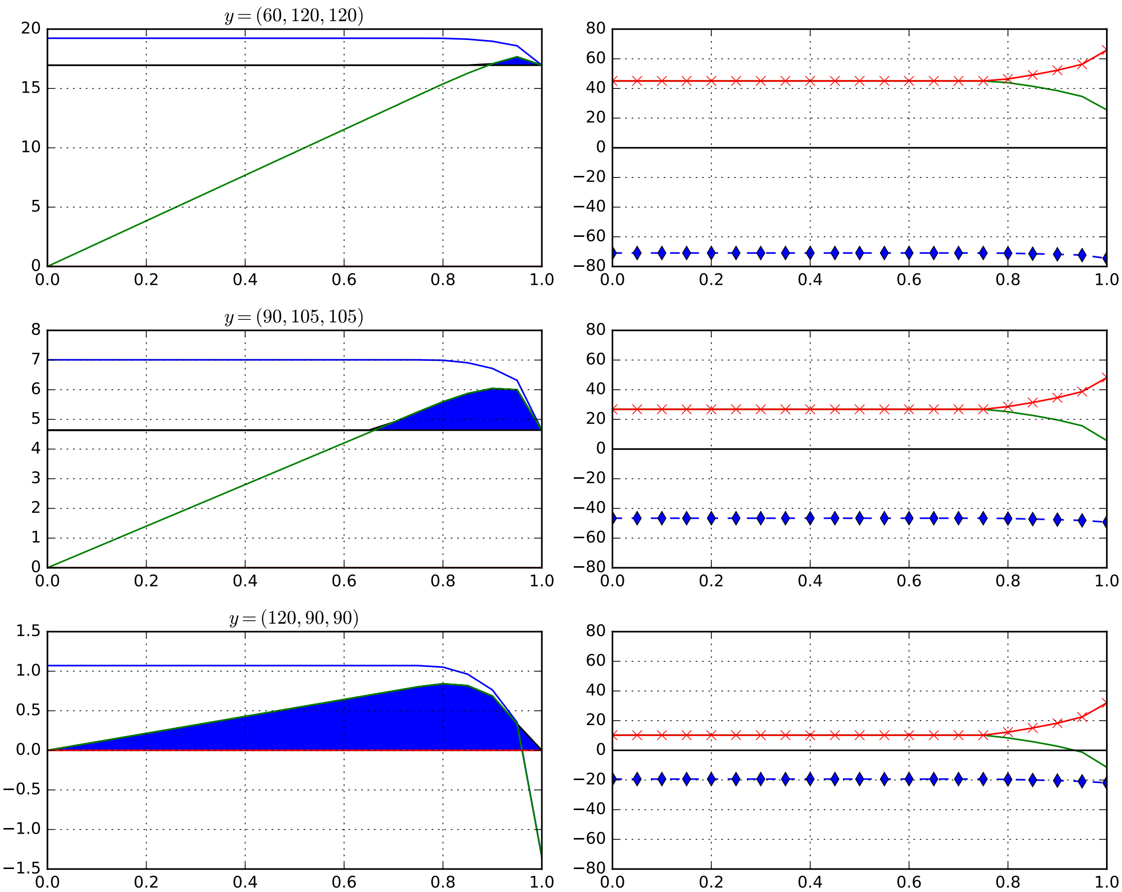

Figure 4: Captured rent by ownership status and endowment income

If we define $\kappa(\alpha) \equiv \frac{\eta(\alpha)}{\alpha}$, this no-renegotiation constraint can be written as

$$\Pi_1(C_1^{m1}(C_1); C_1) \leq \kappa(\alpha) \tag{32}$$

which looks like the earlier constraint (22) except κ is now a function of α. The earlier renegotiation problems were for the special case of a pure for-profit firm with $\alpha = 1$ but we can now analyze contracting, captured profits, and client welfare at any level of α and ownership choices in a strategic equilibrium.

To the extent that the loosening of the no-renegotiation constraint happens through the right-hand side (i.e. via term $\eta(\alpha)$, which represents the firm's motivation to honor the initial agreement), the firm benefits unambiguously–it is able to offer better commitment *and* fully retain the added profits.

In Figure 4 we illustrate the case where non-pecuniary costs to breaking a promise not to renegotiate fall with α according to $\eta(\alpha) = 10(1 - \alpha)$ and hence that the overall cost to renegotiation varies with α according to $\kappa(\alpha) = 10(1-\alpha)/\alpha$. The plots depict captured profits that would be achieved at different levels of α starting from three different initial endowment streams. These three streams - (60, 120, 120), (90, 105, 105) and (120, 90, 90) – are equal in their present value of 300 but differ in terms of period 0 income (with remaining income allocated equally across period 1 and 2). The higher of the two curved lines represents 'raw' profits $\Pi_0(C_0^{m\alpha}; Y_0)$ and the lower curve captured profits $\alpha\Pi_0(C_0^{m\alpha}; Y_0)$. A horizontal line has been drawn in to indicate the level of profits $\Pi_0(C_0^{mP}; Y_0)$ captured by a pure for-profit ($\alpha = 1$). Consider the top panel where the customer has initial income $(60, 120, 120)$. As this type of customer wants to borrow heavily in period 0, profits to the bank are large, even in the case of renegotiation-proof contracts. Adopting non-profit status by lowering α confers limited profit gain however: the cost of lowering alpha (giving up a share of already high profits) is not compensated for by the gains from being able to credibly commit to a smoother contract. However at $(90, 105, 105)$ the tradeoff is different and profits can be increased. In the picture any non-profit with an α between approximately 0.7 and less than one captures more profits than a pure for-profit. Finally for customers with an endowment $(120, 90, 90)$ are already fairly close to their preferred consumption stream so the profits to be captured even under full commitment are not that large. Indeed in this case a pure for-profit cannot earn positive profits. Here the cost of adopting non-profit status is low compared to the gains, and we the simulation reveal that any non-profit status firm captures more profits than a pure for-profit, and maximum captured profits are achieved at around $\alpha = 0.7$.

5.2 Competition

5.2.1 Exclusive contracts

Consider what would happen in the competitive market situation now if contracts can be assumed to remain exclusive, so that any new surplus in the event of a renegotiation between the bank and the One-self goes to the bank (this grants the bank monopoly power in period 1). In this setting, a nonprofit/hybrid firm will be led to offer contract terms to solve:

$$\underset{C_0}{max} U_0\left(C_0\right) \tag{33}$$

$$s.t. f\left(\Pi_0(C_0; Y_0)\right) \geq 0 \tag{34}$$

$$f\left(\Pi\left(C_0; Y_0\right) + \Pi_1\left(C_1^{m1}\left(C_1\right); C_1\right)\right) - f\left(\Pi\left(C_0; Y_0\right)\right) \leq \kappa \tag{35}$$

Let the contract that solves this program be denoted C_0^{eNP} . Consider first a field where all firms start as pure for-profits and earn zero profits. If the no-renegotiation constraint binds, Zero-self's utility must be lower than optimal. Starting from this situation consider now one firm's strategic choice of whether to adopt non-profit status. One firm deviating into nonprofit status in this way can make positive profits while offering Zero-self a contract with a higher discounted utility because of the loosened no-renegotiation constraint (35). So, if the borrowers are sophisticated hyperbolics, in equilibrium all firms become nonprofit and earn zero profits.

5.2.2 Non-Exclusive Contracts

Now, assume that exclusivity and period 1 monopoly power disappears. Firms can compete to renegotiate each other's contracts in period 1.

If there were only nonprofits in equilibrium, any one firm could make positive profits by switching to for-profit status and undoing a rival bank's contract in period 1. The advantages of undercutting other firms' contracts outweigh the benefits of promising one's own clients it will not renegotiate. As a result, equilibrium contracts will be determined by for-profit firms, and consumers will be offered lower commitment than from non-profit firms alone.[29]

The above discussion is summarized in the following proposition.

Proposition 6. *(a) Suppose $\kappa < \bar{\kappa}^m$. Under monopoly, there exist captured profit functions such that the firm will operate as a nonprofit.*

(b) Suppose $\kappa < \bar{\kappa}$. Under competition: (i) If contracts are exclusive, firms will operate as nonprofits for any captured profit discount function. (ii) If contracts are not exclusive, there is no captured profit discount function under which firms will operate as nonprofits.

6 Additional considerations

Our preceding analysis made the simplifying assumption that contracts between consumers and banks could only be initiated in period 0. The alternative to a period 0 contract was autarky for the consumer and zero profits for the bank. This served to streamline the analysis. We now discuss the interesting problem of how the contract space is enriched by allowing unbanked consumers to sign two-period contracts in period 1, possibly without contracting in period 0.[30] The main change will relate to the formulation of reservation values and their implications for the shape and feasibility of the period 0 contracts. This does not change most qualitative results of the paper but the discussion raises interesting questions about circumstances where consumers could be better off under an autarky economy compared to one with a financial intermediary.

Consider the monopolist bank facing a sophisticated hyperbolic discounter. If a contract were not signed in period 0, they would meet again in period 1. In period 1, the contract must

[29] The same argument applies if banks can costlessly renegotiate other bank's contracts.
[30] We thank Abhijit Banerjee for helpful discussions on this point.

satisfy One-self's participation constraint, which would be determined by some unbanked consumption path $C_1^{A'}$. This can be stated formally. Given some consumption path $C_1^{A'}$, the bank solves:

$$\max_{C_1} \Pi_1 \left(C_1; C_1^{A'}\right)$$
$$\text{s.t. } U_1 \left(C_1\right) \geq U_1 \left(C_1^{A'}\right)$$

Let the solution be denoted $C_1^{m'}$. Two observations can be made. First, the bank can always offer a period 1 contract that delivers nonnegative profits. This is because any contract will satisfy One-self's optimality condition, $u'\left(c_1^{m'}\right) = \beta u'\left(c_2^{m'}\right)$. So, except in the special case where the autarky consumption path satisfies this condition, the bank can make positive profits in period 1. Second, the autarky consumption path $C_1^{A'}$ might differ from C_1^A, the consumer's autarky utility in the absence of banking. In other words, C_1^A maximizes $U_0\left(C_0^A\right)$ while $C_1^{A'}$ maximizes $U_0\left(c_0^{A'}, c_1^{m'}, c_2^{m'}\right)$. In the latter case, period 0 anticipates that consumption across periods 1 and 2 is guaranteed to satisfy period 1's optimality condition. We can denote $C_0^B \equiv \left(c_0^{A'}, c_1^{m'}, c_2^{m'}\right)$, which corresponds to a Zero-self utility of U_0^B.

In period 0, any contract must meet the Zero-self's reservation utility, U_0^B:

$$\underset{C_0}{max} \Pi_0 \left(C_0; Y_0\right)$$
$$\text{s.t.} U_0 \left(C_0\right) \geq U_0^B$$

The maximization problem looks familiar, apart from the modified reservation utility. The Zero-self's discounted utility from such a contract is no longer monotonic in her Zero-self's full-autarky utility, U_0^A. For example, consider two hypothetical consumers who in autarky must consume their income streams, which deliver the same autarky utility but through different consumption paths: consumer X has $c_1^A = c_2^A$ while consumer Y has $c_1^A > c_2^A$ in a way that satisfies period 1's optimality condition. Then, for consumer X, $U_0^B < U_0^A$ while for consumer Y, $U_0^B = U_0^A$. It follows that, since period 0 contracts depend on the distribution of future consumption, a consumer who fares relatively better in the absence of a bank may fare relatively worse under a banking contract.

Given this benchmark full-commitment contract, the renegotiation-proof contract can be solved for by adding a no-renegotiation constraint to the above maximization problem. The constraint is the same as used previously, and again narrows the set of contracts that can be offered in period 0. As in Proposition 2, the renegotiation-proof constraint results in lower profits and greater period 0 consumption relative to full-commitment. These results are independent of the period 0 reservation utility and therefore remain unchanged.

A key difference here, however, is that a renegotiation-proof contract will be offered to all consumers (unlike before, where the bank was better off not contracting with consumers whose autarky utility left them close enough to the first-best). Intuitively, this is because the alternative to a period 0 contract is not autarky; rather, it is a period 1 contract that tilts consumption in period 1's favor. Since, in period 0, the bank can at least offer the consumer a consumption path of C_0^B, it ensures that a contract will be accepted.

By opening up the possibility of period 1 contracts, we introduce an additional consideration–the same bank that offers commitment itself creates a need for commitment. By threatening to fully indulge the One-self's preferences, the bank is always able to induce the Zero-self to accept an offer of partial commitment, no matter how weak.

Finally, observe that the bank's decision about whether to operate as a nonprofit is subject to the same tradeoff between improved commitment and reduced enjoyment of profits. However, under monopoly the attractiveness of nonprofit status drops (relative to the case where period 1 contracts are disallowed) due to the fact that even the for-profit bank finds it profitable to offer contracts to consumers at all levels of autarky utility.

7 Conclusion

The starting point for this paper is the observation that the solution to any commitment problem must also address a renegotiation problem. We show how the renegotiation problem depends on costs of renegotiation and how it changes contract terms in sometimes unexpected ways. In this context, we also provide a rationalization of commercial nonprofits in the absence of asymmetric information.

We argue that the model sheds some light on trends in microfinance, payday lending, and mortgage lending. We hope this paper also offers a framework that can be built upon. The incorporation of additional 'real-world' factors could improve our understanding of particular institutions and generate empirically relevant comparative statics. Examples of these include nondeterministic incomes, private and heterogenous types, collateral and strategic default, and longer time horizons.

Furthermore, the analysis could be expanded to heterogeneous populations. For instance, how might a monopoly's governance choices be affected when it serves a market that comprises both naive and sophisticated hyperbolic discounters? With sophisticates, the firm would prefer high renegotiation costs while with sophisticates, it would prefer that the same costs be low.

Finally, the differences between monopoly and competition open up some new, potentially interesting questions. How does market structure evolve and what are the implications for commitment? And through this evolution might there emerge third parties to contracts between consumers and banks that can more effectively enforce the commitment that is sought after on both sides of the market?

8 Appendix: CRRA Derivations and Proofs

8.1 Full-commitment

8.1.1 Competition

Combining the first-order conditions (8) and the budget constraint (6) of the utility maximization problem, the competitive full-smoothing commitment contract C_0^F is:

$$C_0^F = \left(\frac{y}{1+2\beta^{\frac{1}{\rho}}}\right) \cdot \left(1, \beta^{\frac{1}{\rho}}, \beta^{\frac{1}{\rho}}\right) \tag{36}$$

8.1.2 Monopoly

For the monopolist bank that offers full-commitment, the solution is determined by the first-order condition and the consumer's participation constraint:

$$C_0^{mF} = \left(\frac{U_0^A (1-\rho)}{1+2\beta^{\frac{1}{\rho}}}\right)^{\frac{1}{1-\rho}} \cdot \left(1, \beta^{\frac{1}{\rho}}, \beta^{\frac{1}{\rho}}\right) \tag{37}$$

$$\Pi_0\left(C_0^{mF}; Y_0\right) = y - \left(U_0^A (1-\rho)\right)^{\frac{1}{1-\rho}} \left(1+2\beta^{\frac{1}{\rho}}\right)^{\frac{-\rho}{1-\rho}} \tag{38}$$

It can easily be verified that $C_0^F > C_0^{mF}$.

8.2 Renegotiation

8.2.1 Renegotiated contracts

Given an existing continuation contract C_1^0 , assuming the contract is renegotiated, the competitively renegotiated contract will be:

$$C_1^1\left(C_1^0\right) = \left(\frac{c_1^0 + c_2^0 - \kappa}{1+\beta^{\frac{1}{\rho}}}\right) \cdot \left(1, \beta^{\frac{1}{\rho}}\right) \tag{39}$$

And under monopoly, the renegotiated contract will be:

$$C_1^{m1}\left(C_1^0\right) = \left(\frac{(c_1^0)^{1-\rho} + \beta(c_2^0)^{1-\rho}}{1+\beta^{\frac{1}{\rho}}}\right)^{\frac{1}{1-\rho}} \cdot \left(1, \beta^{\frac{1}{\rho}}\right) \tag{40}$$

The corresponding profit gains from renegotiation under monopoly are:

$$\Pi_1\left(C_1^{m1}\left(C_1^0\right);C_1^0\right)=\left(c_1^0+c_2^0\right)-\left((c_1^0)^{1-\rho}+\beta(c_2^0)^{1-\rho}\right)^{\frac{1}{1-\rho}}\left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{-\rho}{1-\rho}} \tag{41}$$

8.2.2 No-renegotiation condition

Substituting from 41 in the no-renegotiation condition (17), we get the following explicit no-renegotiation condition:

$$\begin{aligned} \Pi_1\left(C_1^{m1}\left(C_1^0\right);C_1^0\right) &\leq \kappa \\ \Longleftrightarrow \left(c_1^0+c_2^0\right)-\left((c_1^0)^{1-\rho}+\beta(c_2^0)^{1-\rho}\right)^{\frac{1}{1-\rho}}\left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{-\rho}{1-\rho}} &\leq \kappa \end{aligned} \tag{42}$$

This condition applies identically whether contract renegotiation happens under competition or monopoly.

8.2.3 No-renegotiation condition for full-smoothing contracts

Setting $c_1^0 = c_2^0$ in the no-renegotiation constraint (42) above we can re-arrange to the constraint as:

$$\kappa \geq c_1^0 \cdot \Upsilon \tag{43}$$

where

$$\Upsilon=\left[2-\left[\frac{(1+\beta)}{\left(1+\beta^{\frac{1}{\rho}}\right)^{\rho}}\right]^{\frac{1}{1-\rho}}\right] \tag{44}$$

8.3 Imperfect-Smoothing Commitment Contracts

Redefine any consumption stream in the following manner:

$$C_0=(c_0,c_1,c_2)\equiv(c_0,\alpha s,(1-\alpha)\,s) \tag{45}$$

so that c_1 and c_2 are expressed as shares of total future consumption s. Since the no-renegotiation constraint places restrictions on the relative values of c_1 and c_2, we can rewrite the constraint (42 using the new notation to get a continuous function $\alpha(s)$, which determines the mimimum fraction of any s that must be offered to One-self to prevent renegotiation:

$$(s)\left(1-\left(\alpha^{1-\rho}+\beta\,(1-\alpha)^{1-\rho}\right)^{\frac{1}{1-\rho}}\left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{-\rho}{1-\rho}}\right)\leq\kappa \tag{46}$$

Observe that at One-self's optimal division of s, $\left(c_2=\beta^{\frac{1}{\rho}}c_1 \Longleftrightarrow \alpha=\frac{1}{1+\beta^{\frac{1}{\rho}}}\right)$, there cannot be profit gains from renegotiation so the constraint will be slack. For any s, there may be two values of α that satisfy the constraint with equality–one with α smaller than One-self would like (lower boundary), and another with α larger than One-self would like (upper boundary). Assuming the full-smoothing contract does not satisfy the constraint, the second-best contract must lie on the lower boundary. This defines a continuous function $\alpha(s)$, which determines the mimimum fraction of any s that must be offered to One-self to prevent renegotiation.

$$\alpha(s) = min\left\{\alpha : (s)\left(1 - \left(\alpha^{1-\rho} + \beta(1-\alpha)^{1-\rho}\right)^{\frac{1}{1-\rho}}\left(1 + \beta^{\frac{1}{\rho}}\right)^{\frac{-\rho}{1-\rho}}\right) = \kappa\right\} \tag{47}$$

It can easily be verified that $\alpha'(s) > 0$ (profits from renegotiation rise in s, so if s rises there must be an increase in the share allocated to 1-self to compensate). Implicitly differentiating the binding no-renegotiation constraint by s, we have:

$$\frac{d\alpha}{ds} = \left(\frac{k}{s^2}\right)\left(\frac{1+\beta^{\frac{1}{\rho}}}{\alpha^{1-\rho} + \beta(1-\alpha)^{1-\rho}}\right)^{\frac{\rho}{1-\rho}}\left(\frac{1}{\alpha^{-\rho} - \beta(1-\alpha)^{-\rho}}\right) \tag{48}$$

The terms in the first two sets of parentheses are always positive. The last term is positive when the no-renegotiation constraint is binding (One-self would ideally like $\alpha^{-\rho} = \beta(1-\alpha)^{-\rho}$ but if $\kappa > 0$ she has to settle for $\alpha^{-\rho} > \beta(1-\alpha)^{-\rho}$.

Finally, for any s and α, let

$$V(s,\alpha) \equiv \beta\left[u(\alpha s) + u((1-\alpha)s)\right] \tag{49}$$

This is the discounted utility over periods 1 and 2, from period 0's perspective. It will be useful to note that the first-order conditions of the full-smoothing contract problems (competition and monopoly) can be written as:

$$\frac{du(c_0)}{dc_0} = \frac{dV\left(s,\frac{1}{2}\right)}{ds} \tag{50}$$

8.3.1 Sophisticated Hyperbolic Discounters

Proof of Proposition 2: (i) Since the full-commitment profit-maximizing contract was uniquely determined, and since it does not satisfy the renegotiation-proofness constraint, the renegotiation-proof contract must yield lower profits than the full-commitment contract does.

(ii) Using the modified notation, the full-smoothing contract terms are c_0^{mF} and s^{mF}, with $\alpha^{mF} = \frac{1}{2}$. The imperfect-smoothing contract terms are c_0^{mP} and s^{mP}, with $\alpha^{mP} =$

$\alpha\left(s^{mP}\right)$. Suppose $c_0^{mP} \leq c_0^{mF}$. Then, to satisfy Zero-self's participation constraint,

$$V\left(s^{mP}, \alpha\left(s^{mP}\right)\right) \geq V\left(s^{mF}, \frac{1}{2}\right) \tag{51}$$

$$\Rightarrow s^{mP} \geq s^{mF}\left[\frac{\left(\frac{1}{2}\right)^{1-\rho}+\left(\frac{1}{2}\right)^{1-\rho}}{\left(\alpha^{mP}\right)^{1-\rho}+\left(1-\alpha^{mP}\right)^{1-\rho}}\right]^{\frac{1}{1-\rho}} \tag{52}$$

Differentiating $V\left(s^{mP}, \alpha^{mP}\right)$, we get the following inequalities:[31]

$$\begin{aligned}
\frac{dV\left(s^{mP}, \alpha^{mP}\right)}{ds} &= \frac{\partial V\left(s^{mP}, \alpha^{mP}\right)}{\partial s} + \frac{\partial V\left(s^{mP}, \alpha^{mP}\right)}{\partial \alpha}\frac{d\alpha^{mP}}{ds} && (53)\\
&< \frac{\partial V\left(s^{mP}, \alpha^{mP}\right)}{\partial s} && (54)\\
&= \beta\left(s^{mP}\right)^{-\rho}\left[\left(\alpha^{mP}\right)^{1-\rho}+\left(1-\alpha^{mP}\right)^{1-\rho}\right] && (55)\\
&\leq \beta\left(s^{mF}\right)^{-\rho}\left[\frac{\left(\frac{1}{2}\right)^{1-\rho}+\left(\frac{1}{2}\right)^{1-\rho}}{\left(\alpha^{mP}\right)^{1-\rho}+\left(1-\alpha^{mP}\right)^{1-\rho}}\right]^{\frac{-\rho}{1-\rho}}\left[\left(\alpha^{mP}\right)^{1-\rho}+\left(1-\alpha^{mP}\right)^{1-\rho}\right] && (56)\\
&= \beta\left(s^{mF}\right)^{-\rho}\left[\left(\frac{1}{2}\right)^{1-\rho}+\left(\frac{1}{2}\right)^{1-\rho}\right]\left[\frac{\left(\alpha^{mP}\right)^{1-\rho}+\left(1-\alpha^{mP}\right)^{1-\rho}}{\left(\frac{1}{2}\right)^{1-\rho}+\left(\frac{1}{2}\right)^{1-\rho}}\right]^{\frac{1}{1-\rho}} && (57)\\
&< \beta\left(s^{mF}\right)^{-\rho}\left[\left(\frac{1}{2}\right)^{1-\rho}+\left(\frac{1}{2}\right)^{1-\rho}\right] && (58)\\
&= \frac{dV\left(s^{mF}, \alpha^{mF}\right)}{ds} && (59)\\
&= \frac{du\left(c_0^{mF}\right)}{dc_0^{mF}} && (60)\\
&\leq \frac{du\left(c_0^{mP}\right)}{dc_0^{mP}} && (61)
\end{aligned}$$

Since $\frac{dV\left(s^{mP}, \alpha^{mP}\right)}{ds} < \frac{du\left(c_0^{mP}\right)}{dc_0^{mP}}$, this contract cannot be profit maximizing for the monopolist (it could do better by reallocating consumption away towards Zero-self). This contradiction implies that our assumption is incorrect. It must be true that at the profit-maximizing imperfect-smoothing contract, $c_0^{mP} > c_0^{mF}$. $\square$

Proof of Proposition 3: (i) We know that $U_0\left(C_0^F\right) = U_0^F$. By assumption, since the

[31] An explanation of the steps: Line 54 follows from the fact that $\alpha(s)$ rises in s (derived from Equation 47) and V falls as α rises, making the allocation worse from Zero-self's perspective. Line 56 follows from Inequality 52. Line 60 follows from the FOC of the monopolist's profit-maximization problem with full-smoothing contracts.

renegotiation-proofness constraint is binding, the renegotiation-proof contract cannot offer the optimal consumption path. Therefore $U_0\left(C_0^P\right) < U_0\left(C_0^F\right)$.

(ii) At the full-commitment contract:

$$\frac{du\left(c_0^F\right)}{dc_0} = \frac{dV\left(s^F, \frac{1}{2}\right)}{ds} = \left(s^F\right)^{-\rho}\left(2\left(\frac{1}{2}\right)^{1-\rho}\right) \tag{62}$$

Consider a renegotiation-proof contract with $c_0 = c_0^F$. To keep bank profits zero, this contract would also have $s = s^F$. But in the renegotiation-proof contract, s must be divided according to $\alpha\left(s^F\right)$. So:

$$\begin{aligned}\frac{dV\left(s^F, \alpha\left(s^F\right)\right)}{ds} &= \left(s^F\right)^{-\rho}\left(\alpha\left(s^F\right)^{1-\rho} + \left(1-\alpha\left(s^F\right)\right)^{1-\rho}\right) \\ &+ \frac{d\alpha\left(s^F\right)}{ds}\left(s^F\right)^{1-\rho}\left(\alpha\left(s^F\right)^{-\rho} - \left(1-\alpha\left(s^F\right)\right)^{-\rho}\right)\end{aligned} \tag{63}$$

The first term–the direct effect of a change in s–is weakly less than $\frac{dV\left(s^F,\frac{1}{2}\right)}{ds}$ if $\rho \leq 1$ and strictly greater if $\rho > 1$. The second term–the component of $\frac{dV}{ds}$ that is driven by the change in α–is strictly negative. Therefore, if $\rho < 1$, $\frac{dV\left(s^F,\alpha\left(s^F\right)\right)}{ds} < \frac{dV\left(s^F,\frac{1}{2}\right)}{ds} = \frac{du\left(c_0^F\right)}{dc}$, so the renegotiation-proof contract must satisfy $c_0^P > c_0^F$.

Next, we consider the case when $\rho > 1$. We can make the following observations about $\alpha(s)$. First, $\underset{\kappa\to 0}{lim}\alpha(s) = \frac{\beta^{\frac{-1}{\rho}}}{1+\beta^{\frac{-1}{\rho}}}$. Second, implicitly differentiating equation 46 with respect to s, and combining it with the previous limit result, we get $\underset{\kappa\to 0}{lim}\frac{d\alpha(s)}{ds} = 0$. Therefore, if $\rho > 1$ and κ is small enough, the second term in Equation 63 will be sufficiently small in magnitude that $\frac{dV\left(s^F,\alpha\left(s^F\right)\right)}{ds} > \frac{dV\left(s^F,\frac{1}{2}\right)}{ds} = \frac{du\left(c_0^F\right)}{dc}$. In this case, the renegotiation-proof contract must satisfy $c_0^P < c_0^F$. $\square$

If $\kappa = 0$, the renegotiation-proof contracts can be explicitly derived since in any contract it must be true that $c_2 = \beta^{\frac{1}{\rho}} c_1$. Solving the respective maximization problems, we get the following equilibrium contracts for monopoly and competition, respectively:

$$C_0^{mP} = \left(\left(\frac{U_0^A (1-\rho)}{1+\beta^{\frac{1}{\rho}} \left(\frac{\left(1+\beta^{\frac{1-\rho}{\rho}}\right)^{\frac{1}{\rho}}}{\left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{1-\rho}{\rho}}} \right)} \right)^{\frac{1}{1-\rho}}, \left(\frac{\beta+\beta^{\frac{1}{\rho}}}{1+\beta^{\frac{1}{\rho}}} \right)^{\frac{1}{\rho}} c_0^{mP}, \beta^{\frac{1}{\rho}} \left(\frac{\beta+\beta^{\frac{1}{\rho}}}{1+\beta^{\frac{1}{\rho}}} \right)^{\frac{1}{\rho}} c_0^{mP} \right) \tag{64}$$

$$C_0^P = \left(\frac{y}{1+\beta+\beta^{\frac{1}{\rho}}}, \left(\frac{\beta+\beta^{\frac{1}{\rho}}}{1+\beta^{\frac{1}{\rho}}} \right) c_0^P, \beta^{\frac{1}{\rho}} \left(\frac{\beta+\beta^{\frac{1}{\rho}}}{1+\beta^{\frac{1}{\rho}}} \right) c_0^P \right) \tag{65}$$

It can easily be established that $c_0^{mP} > c_0^{mF}$, $c_0^P > c_0^{mF}$ if $\rho > 1$, and $c_0^P < c_0^{mF}$ if $\rho < 1$.

8.3.2 Naive Hyperbolic Discounters

Suppose the monopolist intends to renegotiate the contract. The maximization problem, combined with the expression for $C_1^{m1}(C_1)$ (40), simplifies to:

$$\max_{c_0, c_1, c_2} y - c_0 - \frac{\left(c_1^{1-\rho} + \beta c_2^{1-\rho}\right)^{\frac{1}{1-\rho}}}{\left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{\rho}{1-\rho}}} - \kappa \tag{66}$$

$$s.t. \frac{c_0^{1-\rho}}{1-\rho} + \beta \frac{c_1^{1-\rho}}{1-\rho} + \beta \frac{c_2^{1-\rho}}{1-\rho} \geq U_0^A \tag{67}$$

The partial derivatives of the resulting Lagrangian are:

$$\frac{\partial \mathcal{L}}{\partial c_0} = -1 - \lambda c_0^{-\rho} \tag{68}$$

$$\frac{\partial \mathcal{L}}{\partial c_1} = c_1^{-\rho} \left[-\left(\frac{c_1^{1-\rho} + \beta c_2^{1-\rho}}{1+\beta^{\frac{1}{\rho}}} \right)^{\frac{\rho}{1-\rho}} - \lambda \beta \right] \tag{69}$$

$$\frac{\partial \mathcal{L}}{\partial c_2} = c_2^{-\rho} \left[-\beta \left(\frac{c_1^{1-\rho} + \beta c_2^{1-\rho}}{1+\beta^{\frac{1}{\rho}}} \right)^{\frac{\rho}{1-\rho}} - \lambda \beta \right] \tag{70}$$

An interior solution, with $\frac{\partial \mathcal{L}}{\partial c_1} = 0$ and $\frac{\partial \mathcal{L}}{\partial c_2} = 0$ does not exist (on a $c_1 - c_2$ plot, the two first-order conditions do not intersect). If $\rho < 1$, the Lagrangian is maximized at a corner solution with $c_1 = 0$. If $\rho > 1$, the Lagrangian is maximized at the limit as c_2 approaches infinity. Using this, the maximization problem can be re-solved. If $\rho < 1$:

$$C_0^{mN} = \left(\left(\frac{U_0^A (1-\rho)}{2+\beta^{\frac{1}{\rho}}} \right)^{\frac{1}{1-\rho}}, 0, \left(\frac{1+\beta^{\frac{1}{\rho}}}{\beta} \right)^{\frac{1}{1-\rho}} \left(\frac{U_0^A (1-\rho)}{2+\beta^{\frac{1}{\rho}}} \right)^{\frac{1}{1-\rho}} \right) \tag{71}$$

If $\rho > 1$, the solution is undefined, but in the limit is given by:

$$C_0^{mN} = \left(\left(\frac{U_0^A (1-\rho)}{1+\left(1+\beta^{\frac{1}{\rho}}\right)\beta^{\frac{1}{\rho}}} \right)^{\frac{1}{1-\rho}}, \beta^{\frac{1}{\rho}} \left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{1}{1-\rho}} \left(\frac{U_0^A (1-\rho)}{1+\left(1+\beta^{\frac{1}{\rho}}\right)\beta^{\frac{1}{\rho}}} \right)^{\frac{1}{1-\rho}}, \infty \right) \tag{72}$$

Let us define profits from such a contract as:

$$\Pi_0^{mN} \equiv \Pi\left(C_0^{mN}; Y_0\right) + \Pi_1\left(C_1^{m1}\left(C_1^{mN}\right); C_1^{mN}\right) - \kappa$$

Proof of Proposition 4: (i) and (ii) are simultaneously established through the following observations. First, Π_0^{mN} is strictly falling in κ while $\Pi_0\left(C_0^{mF}; Y_0\right)$ is invariant in κ. Second, at $\kappa = \bar{\kappa}^m$,

$$\Pi_0\left(C_0^{mF}; Y_0\right) = \Pi_0\left(C_0^{mF}; Y_0\right) + \Pi_1\left(C_1^{m1}\left(C_1^{mF}\right); C_1^{mF}\right) - \kappa < \Pi_0^{mN} \tag{73}$$

Third, if κ gets indefinitely large, $\Pi_0\left(C_0^{mF}; Y_0\right) > \Pi_0^{mN}$. Finally, it can be verified from the explicit derivations that $c_0^{mN} < c_0^{mF}$. $\square$

We now derive equilibrium contracts for naive consumers under perfect competition. Suppose contracts are exclusive. Then, a contract that is renegotiated satisfies:

$$\max_{c_0, c_1, c_2} \frac{c_0^{1-\rho}}{1-\rho} + \beta \frac{c_1^{1-\rho}}{1-\rho} + \beta \frac{c_2^{1-\rho}}{1-\rho} \tag{74}$$

$$s.t. y - c_0 - \frac{\left(c_1^{1-\rho} + \beta c_2^{1-\rho}\right)^{\frac{1}{1-\rho}}}{\left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{\rho}{1-\rho}}} - \kappa \geq 0 \tag{75}$$

The first-order conditions are the same as under monopoly (68, 69, 70). Combining these with the zero-profit constraint, we get the following solution. If $\rho < 1$:

$$C_0^N = \left(\frac{y-\kappa}{2+\beta^{\frac{1}{\rho}}}, 0, \left(\frac{1+\beta^{\frac{1}{\rho}}}{\beta} \right)^{\frac{1}{1-\rho}} \left(\frac{y-\kappa}{2+\beta^{\frac{1}{\rho}}} \right) \right) \tag{76}$$

If $\rho > 1$, the solution is undefined, but in the limit is given by:

$$C_0^N = \left(\frac{y-\kappa}{1+\beta^{\frac{1}{\rho}}\left(1+\beta^{\frac{1}{\rho}}\right)}, \beta^{\frac{1}{\rho}}\left(1+\beta^{\frac{1}{\rho}}\right)^{\frac{1}{1-\rho}}\left(\frac{y-\kappa}{1+\beta^{\frac{1}{\rho}}\left(1+\beta^{\frac{1}{\rho}}\right)}\right), \infty \right) \tag{77}$$

Proof of Proposition 5:

(a) Under non-exclusive contracts, firms offering period 0 contracts do not benefit from renegotiation (profits from renegotiation will equal κ). So the equilibrium contract is the one that is arrived at without taking renegotiation into account–i.e. the full-commitment contract. If $\kappa < \bar{\kappa}$, the gains from renegotiation exceed the transaction costs, so the contract will be renegotiated.

(b) The following observations establish part (b). First, $U_0\left(C_0^N\right)$ is strictly falling in κ while $U_0\left(C_0^F\right)$ is invariant in κ. Second, at $\kappa = \bar{\kappa}$, $U_0\left(C_0^N\right) > U_0\left(C_0^F\right)$ (this must be true by construction of C_0^N). Third, if κ gets indefinitely large, $U_0\left(C_0^N\right) < U_0\left(C_0^F\right)$, so Zero-self will prefer the full-smoothing commitment contract over the renegotiable contract.

Suppose $\rho < 1$. Comparing C_0^F (36) to C_0^N (76), it is clear that $c_0^N < c_0^F$. Suppose $\rho > 1$. If κ is small enough, $c_0^N > c_0^F$. □

8.4 Nonprofits

Proof of Proposition 6: (a) A non-profit will earn higher raw profits Π than a for-profit. If $f\left(\Pi\left(C_0^{mNP}; Y_0\right)\right) \geq \Pi\left(C_0^{mP}; Y_0\right)$ (i.e. if the captured profit function has a slope sufficiently close to 1 up to $\Pi\left(C_0^{mNP}; Y_0\right)$), the firm will choose to operate as a nonprofit.

(b) (i) Suppose all firms are for-profit and offer the renegotiation-proof contract C_0^P. There is some ε_1 and ε_2 satisfying $0 < \varepsilon_2 < \varepsilon_1$ and a corresponding $\hat{C}_0 = \left(c_0^P, c_1^P - \varepsilon_1, c_2^P + \varepsilon_2\right)$ such that $U_0\left(\hat{C}_0\right) = U_0\left(C_0^P\right)$ and

$$f\left(\Pi_0\left(\left(\hat{C}_0\right); Y_0\right) + \Pi_1\left(C_1^{m1}\left(\hat{C}_1\right); \hat{C}_1\right)\right) < \kappa$$

So, any firm can make positive profits by operating as a non-profit. Therefore, in equilibrium, consumers will borrow only from non-profit firms.

(ii) If all firms are nonprofit, an individual firm has a strict incentive to switch to for-profit status, and make profits in period 1. Therefore, there must be for-profits in equilibrium, and equilibrium contracts will be constrained by their presence. □

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