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ABSTRACT

Banking and Trading*

We study the effects of a bank's engagement in trading. Traditional banking is relationship-based: not scalable, long-term oriented, with high implicit capital, and low risk (thanks to the law of large numbers). Trading is transactions-based: scalable, short-term, capital constrained, and with the ability to generate risk from concentrated positions. When a bank engages in trading, it can use its 'spare' capital to profitably expand the scale of trading. However there are two inefficiencies. A bank may allocate too much capital to trading ex-post, compromising the incentives to build relationships ex-ante. And a bank may use trading for risk-shifting. Financial development augments the scalability of trading, which initially benefits conglomeration, but beyond some point inefficiencies dominate. The deepening of financial markets in recent decades leads trading in banks to become increasingly risky, so that problems in managing and regulating trading in banks will persist for the foreseeable future. The analysis has implications for capital regulation, subsidiarization, and scope and scale restrictions in banking.

JEL Classification:
Keywords: banking, capital regulation, scale restrictions and trading

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1 Introduction

We study the effects of a bank's engagement in trading. We use the term "banking" to describe business with repeated, long-term clients (also called relationship banking), and "trading" for operations that do not rely on repeated interactions. This definition of trading thus includes not just taking positions for a bank's own account – proprietary trading – but also other short-term activities that do not rely on private and soft information, e.g. originating and selling standardized loans. Both commercial and investment banks over the last decade have increasingly engaged in short-term trading. We need to understand the rationale for that, and the challenges that it poses.[1]

Such challenges clearly exist. They are perhaps most vivid in Europe, where some large universal banks seem to have over-allocated resources to trading prior to the crisis, with consequent losses affecting their stability (e.g., UBS, see UBS, 2008; an earlier example is the failure of the Barings Bank due to trading in Singapore in 1995). In the United States, the development of universal banks was until recently restricted by the Glass-Steagall Act. Yet there are many examples of a shift of institutions into short-term activities, with similar negative consequences. Since early 1980-s, many New York investment banks have turned the focus from traditional underwriting to short-term market-making and proprietary investments; these have often backfired during the crisis (Bear Stearns, Lehman Brothers, Merrill Lynch). Also, in 2000-s, commercial banks have used their franchise to expand into short-term activities, such as wholesale loan origination and funding (Washington Mutual, Wachovia), exposing themselves to risk. And post-Glass-Steagall, there is evidence of trading being a drain on commercial bank activities in newly created universal banks, such as Bank of America-Merrill Lynch. A 2012 loss related to the market activities in JP Morgan is another example. The banks' short-term activities, especially proprietary trading, have received significant regulatory attention: the Volcker Rule in the Dodd-Frank Act in the U.S., and the Report of the Independent Commission on Banking (the so-called Vickers report) in the UK.

[1] More recently several banks have abandoned (or claim to have abandoned) trading activities in order to focus on client-related business only. We are somewhat skeptical whether this is truly a long term trend.

The interaction between banking and trading is a novel topic. The existing literature on universal banks focuses primarily on the interaction between lending and underwriting. Such interaction is relatively well-understood, and also was not at the forefront during the recent crisis. Our paper downplays the distinction between lending and underwriting: for us both could possibly represent examples of long-term, relationship-based banking.[2] We contrast them to short-term, individual transactions-based activities. We see a shift of relative emphasis towards such "trading" as one of the major developments in the financial sector (for sure prior to the crisis).

The focus on trading as a possibly detrimental activity in banks, and its difference from underwriting in this regard, is supported by emerging empirical evidence. Brunnermeier et al. (2012) show that trading can lead to a persistent loss of bank income following a negative shock. In contrast, underwriting, while more volatile than commercial banking, is not associated with persistent losses of profitability.

The key to our analysis is the observation that the relationship business is usually profitable and hence generates implicit capital, yet is not readily scalable. The trading activity on the other hand can be capital constrained and benefit from the spare capital available in the bank. Accordingly, relationship banks might expand into trading in order to use 'spare' capital. This funding (liability-side) synergy is akin to the assertions of practitioners that one can "take advantage of the balance sheet of the bank".

Opening up banking to trading, however, creates frictions. We highlight two of them. One friction is *time inconsistency* in the allocation of capital between the long-term relationship banking business and the short-term trading activity. Banks may be tempted to shift too much resources to trading in a way that undermines the relationship franchise. Another friction is *risk-shifting*: the incentives to use trading to boost risk and benefit shareholders as residual claimants. As a result of these two factors, a bank can overexpose itself to trading, compared to what is socially optimal, or *ex ante* optimal for its shareholders.

[2]Underwriting, insofar as it requires hard and codified information that is to be transmitted to the markets, may have a lower relationship intensity that commercial bank lending based on soft information. Nevertheless, at its core, underwriting remains a relationship-based activity.

Both problems become more acute when financial markets are deeper, allowing larger trading positions. This increases the misallocation of capital and enables the gambles of scale necessary for risk-shifting. The problems also become more acute when bank returns are lower. Both factors have been in play in the last 10-20 years. Consequently, the costs of trading in banks may have started to outweight its benefits. These frictions are likely to persist for the foreseeable future, so a regulatory response might be necessary.

The paper is organized as follows. Section 2 discusses the literature. Section 3 outlines the features of banking and trading, and sets up the model. Section 4 demonstrates the benefits of conglomeration. Section 5 identifies the first cost of conglomeration – the time-inconsistency problem. Section 6 deals with the other cost of conglomeration – the risk-shifting problem, and the interaction between the two costs. Section 7 discusses modeling features and policy implications. Section 8 concludes.

2 Relationship to the Literature

Our paper complements a number of strands in the banking and internal capital markets literature. There is a vast literature on the costs and benefits of combining commercial and investment banking, in particular whether underwriting that follows prior lending relationships has biased standards (see Puri, 1996, and Krosner and Rajan, 1994, Fang et al., 2010) or benefits from synergies (Schenone, 2004). While this literature focuses on how borrower specific information is used across lending and underwriting activities, our analysis focuses on combining banking (either lending or underwriting) with trading activities that do not depend on borrower specific information.

In studying the problems of conglomeration, we focus on shareholder incentives. An alternative approach would have been to consider the incentive problems of managers (e.g. as in Acharya et al., 2011). While incentive issues in banks are undoubtedly important, banks are subject to pressures from financial markets to maximize shareholder returns. So understanding the distortions that can be caused by shareholder value maximization alone remains important, particularly when such distortions may have worsened in recent past because of external factors, such as increases in financial market depth. Some papers have linked the distortions in bank trading activities to the abuse of the safety net, including deposit insurance (Hoenig and Morris, 2011). Our results are not driven by government guarantees, offering more general implications.

There is also a literature that studies how the expansion of markets affects bank relationships (Boot and Thakor, 2000), and how financial market exuberance might make banking highly procyclical (Shleifer and Vishny, 2010). We do not consider such aspects. Instead we study how the core relationship business might be deprived of resources and put at risk due to the presence of another activity – short-term trading – in the same organization.

More generally, our paper relates to the literature on internal capital markets (Williamson, 1975, Danielson, 1984). Conglomeration may help relax the firm's overall credit constraint (Stein, 1997) but also impose costs, primarily related to divisional rent-seeking (Rajan et. al., 2000). Our model is similar in describing the benefits of conglomeration as relaxing credit constraints, but points to a different set of costs: headquarters may misallocate capital due to time inconsistency and risk shifting problems, which arise in combining banking and trading. By analyzing a particular case of the misallocation of resources, we can analyze the evolution of bank business models and draw implications for the future.

3 Model

3.1 Approach

We describe a relationships-based business that we call "banking" and a transactions-based business that we call "trading". The banking activity relies on a fixed endowment of information about existing customers; trading does not. We argue that this distinction alone suffices to highlight a range of synergies and conflicts between the two businesses.

The fixed endowment of information makes the banking activity profitable (and, we assume, not credit constrained), relatively safe, yet not scalable. Securing the value of information requires non-contractible ex-ante investments that pay off over time; thus banking becomes long-term in nature. In contrast, since it does not rely on any endowment, trading is scalable, less profitable (and hence, we assume, credit constrained), short-term oriented, and possibly risky.[3]

The fact that the banking activity has capacity for extra leverage ("spare capital"), while trading is credit-constrained, drives the synergy between the two: conglomeration can be used to expand the scale of trading. The potential conflicts between banking and trading come from the differences in horizon and risk. Universal banks may choose to over-allocate capital to trading because of the time inconsistency between long-term returns of banking and short-term returns of trading, and because the risky trading allows shareholders to engage in risk-shifting, unlike the safe banking activity. The *ex post* over-allocation of capital to trading can compromise *ex ante* investments in relationships, destroying the relationship oriented banking franchise.

The analysis proceeds in steps. We first set up a benchmark model of synergies abstracting from the sources of conflicts. So, at the start, the time-consistency problem and the possibility of risk shifting in trading are not present. We then introduce time-inconsistency by making returns on banking dependent on *ex ante* decisions of customers and distributed over time. This introduces the long-term nature of banking in contrast to trading. After this we introduce risk-shifting by considering risky trading. We also demonstrate the potential for mutual amplification between the time inconsistency and risk-shifting problems.

3.2 Credit Constraints

A key feature of our model are credit constraints. We build on Holmstrom and Tirole's (1998, 2011) formulation that limits leverage based on the incentives of owner-managers

[3] One could characterize the banking activity as a high-margin-low-volume operation while trading as a low-margin-high-volume operation.

to engage in moral hazard. We let the form of the credit constraint be identical for standalone banking, trading, and the conglomerated activity. Assume that shareholders can choose to run the bank normally, or engage in moral hazard (to obtain private benefits). They will run the bank normally when:

$$\Pi \geq bA \tag{1}$$

where Π is the shareholder return when assets are employed for normal business, and the right hand side bA is the shareholder return to moral hazard: a measure of bank assets A multiplied by the conversion factor $b > 0$ of assets into private benefits.[4]

There are many ways to interpret the payoff to moral hazard bA. They can represent savings on exerting the manager-shareholder's effort (without which the relationship banking projects do not repay, and trading strategies lose money), the possibility of absconding (Calomiris and Kahn, 2001), or limits on the pledgability of revenues (Farhi and Tirole, 2011). When the incentive compatibility (IC) constraint (1) is not satisfied, shareholders engage in moral hazard and a bank becomes worthless for creditors; anticipating this, creditors will not provide funding. This way, the IC constraint (1) also describes the maximum leverage and, assuming decreasing returns to scale, the maximum size of a bank.

We will now describe the banking and trading businesses.

3.3 Banking

Background We model relationship banking as based on a fixed endowment of information about customers, which allows the bank to obtain profits from serving them. We do not distinguish between commercial banking (lending) and a client-oriented investment (underwriting) activity. Both share the key properties that we are interested in:

[4] We do not consider the possibility of outside equity (assuming that it is very costly). See Section 7.2 for more discussion.

- *Not scalable.* It is prohibitively costly to expand the customer base at short notice.

- *A valuable franchise (high charter value).* A bank derives high returns from relationships, i.e. rents on its fixed endowment of information. It has therefore high implicit capital. We thus assume that its leverage constraint is not binding: it has spare borrowing capacity.[5]

- *Low risk (certain return), due to the law of large numbers.* A bank's portfolio contains multiple loans (or underwriting commitments) with independently distributed returns, making overall performance low risk (risk free in the model). The certainty of returns combined with the high charter value implies limited risk-shifting opportunities (in our model, non-existent). For example, shareholders of a bank with high franchise value and certain returns will fully internalize the losses associated with choosing a low monitoring effort.[6]

- *A long-term franchise.* The return to relationship banking is distributed over time and depends on customers' *ex-ante* investment in relationships. We capture this by assuming that part of the return on the banking activity is obtained in the form of *ex ante* credit line fees paid by customers. If there are doubts about the bank's ability to make good on credit line commitments, the fees that customers are willing to pay (their investment in relationships) decline. This intertemporal feature (i.e. the long-term nature of banking) is introduced as a source of conflict between banking and trading in Section 5. In the benchmark model of Section 4 we abstract from it.

Setup The bank operates in a risk-neutral economy with no discounting. It has no explicit equity and has to borrow in order to invest; the risk-free rate on bank borrowing is normalized to zero. There are three dates: 0, 1, 2.

[5] The rents imply some informational monopoly on the part of the bank; it may be related to past investments by the bank and its customers into their relationships, and/or to advantages of proximity or specialization in local markets. Note that the time and proximity elements involved in building relationships provide a natural explanation for the lack of scalability.

[6] In the model, we abstract from aggregate risk. With a sufficiently high charter value, the presence of aggregate risk would not affect the observation that risk-shifting opportunities are limited.

Franchise: informational rents. At date 0 the bank is endowed with private information on a mass $\bar{R}$ of customers. We let information produce a return for the bank in two ways.

- First, it gives the bank implicit equity (franchise value) R_0. An easy way to introduce franchise value into our model is to assume that at date 0 the bank has lent X to customers with a repayment of $X(1+b)+R_0$ at date 2 (hence obtaining profits $Xb+R_0$), while the measure of assets A relevant for the IC constraint (1) is the initial investment, X. Substituting this into (1) gives a "wedge" between profits and private benefits of R_0. Since R_0 plays a passive role in the model, we streamline the exposition by setting $X=0$: it can be produced from a minimal initial investment.

- Second, the bank has an opportunity to serve its customers' future funding needs. Each customer is expected to have a liquidity need of size 1 at date 1 (with certainty).[7] When covering it, the bank can collect informational rents r per customer, up to a total of $r\bar{R}$, from the repayment at date 2.

Spare borrowing capacity. We denote the amount that the bank borrows to cover the customers' liquidity needs at date 1 as $R \leq \bar{R}$. After borrowing, the bank can engage in moral hazard to immediately obtain bR. The IC (leverage) constraint (1) takes the form:

$$R_0 + rR \geq bR \tag{2}$$

where the left hand side is the bank's market value of equity in normal operations: the franchise value R_0 and the information rent on covering its customers' liquidity needs rR. We assume that this constraint is satisfied, including at $R=\bar{R}$, implying spare borrowing capacity in banking:

$$R_0 + r\bar{R} > b\bar{R} \tag{3}$$

[7] For simplicity, we set the probability that the credit line will be used equal to one. We could envision a probability less than one. For example, consider uncertainty about future market circumstances, with the credit line only being used when external circumstances make it optimal because spot markets have become 'too expensive' (cf. Boot et al., 1993).

3.4 Trading

Background The trading business is not based on an endowment of information. Consequently, it has different properties:

- *Scalable, with decreasing returns to scale.* We think of decreasing returns to scale in the context of a Kyle (1985) framework where the average return of an informed trader falls in the size of her trade because the price impact increases in size. The price impact is smaller when the mass of liquidity traders is larger. We can therefore relate the diseconomies of scale to the depth of financial markets and, in turn, to higher financial development, with lower diseconomies at higher depth.

- *Less profitable, credit constrained.* The return to trading is lower than the return to banking because trading does not benefit from an endowment of private information. As a result, trading, while scalable, can be credit constrained.

- *Short-term.* Unlike in banking, returns occur at one point in time and do not rely on *ex ante* investments.

- *A possibility of risky (probabilistic) returns.* A bank can choose between two trading strategies. One generates safe but low returns. Another generates somewhat higher returns most of the time, but can lead to catastrophic losses with a small probability.[8] We assume that the risky trading strategy has a lower NPV, yet a levered bank may choose it to engage in risk-shifting. We introduce risky trading in an extension of the model in Section 6.

Setup All trading activity is short-term. For T units invested at date 1, trading produces at date 2 net returns of tT for $T \leq S$ and 0 for $T > S$. The parameter S captures the scalability of trading; it is natural to relate it to the depth of financial markets, i.e. S is increasing in the depth of the market. Trading is less profitable than

[8] This is reminiscent of banks taking on "tail risk" to generate "fake alpha" (see e.g. Acharya et al., 2010).

banking since it does not benefit from the informational endowment:

$$t < r \tag{4}$$

And the low profitability of trading makes it credit constrained:

$$t < b \tag{5}$$

implying that the IC constraint (1) does not hold when trading is a standalone activity. We thus, for simplicity, assume that standalone trading is not possible due to credit constraints, despite the opportunity to profitably invest up to S units.[9]

The timeline for the benchmark model is summarized in Figure 1. It abstracts from the time inconsistency problem in banking (introduced in Section 5) and risk-shifting in trading (introduced in Section 6).

4 Benefits of Conglomeration

Our model implies a natural benefit to the conglomeration of banking and trading: it links a business with borrowing capacity but no investment opportunities (a relationship bank) with a business that has investment opportunities but is subject to credit constraints (trading).

Under conglomeration, at date 1, the bank maximizes profit:

$$\Pi_C = R_0 + rR + tT \tag{6}$$

subject to the joint leverage constraint (1):

$$R_0 + rR + tT \geq b(R + T) \tag{7}$$

[9] The fact that, in our analysis, trading cannot exist as a stand-alone business should not be taken literally. What is meant is that the viability of trading requires a substantial equity commitment. This what we observe in most cases. Many independent trading houses are partnerships with substantial recourse.

where $T \leq S$. Comparing this to (3) and (5) shows that conglomeration allows for a transfer of spare capital (borrowing capacity) from the relationship bank to the trading activity.

The bank chooses the allocation of date 1 borrowing capacity between relationship banking R and trading T to maximize profit. Since $r > t$, the bank will choose to serve all banking customers ($R = \bar{R}$) before allocating any remaining capacity to trading. The maximum amount of trading that a universal bank can support, $T_{\max}$ (assuming $T_{\max} \leq S$) is given by (7) set to equality, with $R = \bar{R}$:

$$T_{\max} = \frac{R_0 + \bar{R}(r - b)}{b - t} \tag{8}$$

Since it is never optimal to trade at a scale that exceeds S, $T = \min\{S, T_{\max}\}$. This means that when S is low – the scalability of trading is small – the bank covers all profitable opportunities in trading. When S is high – trading is more scalable – the bank covers trading opportunities $T_{\max} < S$ and abstains from the rest.

Proposition 1 (Conglomeration without frictions) *The conglomeration of banking and trading enables expanding the scale of trading, which is otherwise credit-constrained. In equilibrium, the bank serves all relationship banking customers, $R = \bar{R}$, and allocates the rest of its borrowing capacity to trading, as long as trading is profitable, $T = \min\{S, T_{\max}\}$.*

Proposition 1 is a benchmark that provides a rationale for why banks choose to engage in trading, and specifies the first-best allocation of borrowing capacity between the two activities. Next we study distortions that may arise in combining banking and trading.

5 Time Inconsistency of Capital Allocation

5.1 Setup: Long-term Banking

The previous section has outlined the benefit of combining banking and trading – the use of spare capital of the relationship bank to expand trading. We now turn to the costs of conglomeration. This section deals with the first distortion: the time inconsistency problem in capital allocation, induced by the different time horizon in banking (long-term) and trading (short-term).

Banking is long-term because it involves repeated interactions with customers with returns that are distributed over time and depend on *ex ante* investments in relationships. Put differently, in relationship banking, a bank has the opportunity to serve its customers' future funding needs. We capture the intertemporal effects by assuming that part of the returns come from *ex ante* credit line fees. By making these payments ex ante (at date 0), customers reduce the payments they have to the bank *ex post* (at date 1). As a result, returns to banking, although higher than returns to trading, might *ex post* be lower. This distorts capital allocation: once credit line fees have been collected, a bank may have incentives to allocate too much capital to trading, leaving itself with insufficient borrowing capacity to fully serve the credit lines. Anticipating that, customers reduce the credit line fees that they are willing to pay *ex ante*, lowering the bank's overall profit and borrowing capacity. Section 7 discusses why the credit line specification, capturing a front-loaded intertemporal allocation of returns and *ex ante* investments in relationships, reflects an important feature of relationship banking.

Assume that, while a bank can generate return r on covering customers' future funding needs, it can only capture $\rho \leq r$ through interest rates charged on the actual lending between dates 1 and 2. The value of ρ is limited by the potential for moral hazard at the borrower level (Boyd and De Nicolo, 2005, Acharya et al., 2007). When such moral hazard is severe, ρ may be low. The remaining $(r - \rho)$ can be captured at date 0 as a credit line fee. Importantly, in our setup, a bank cannot commit to cover the future liquidity needs of customers. That is, we let the bank have discretion to refuse lending in the future if it has no borrowing capacity left to lend under the credit line. The lack of enforceability implicit in this arrangement is similar to a real-life material adverse change clause used in credit lines.[10] The timeline incorporating the credit line arrangement is shown in Figure 2.

At date 1, the bank chooses R and T to maximize its profit:

$$\Pi_C = R_0 + (r - \rho) R_{ex-ante} + \rho R + tT \tag{9}$$

where $R_{ex-ante}$ is the borrowing that customers expect to get under a credit line and $(r - \rho) R_{ex-ante}$ is the total credit line fee. R is the actual borrowing under a credit line. The bank maximizes (9) subject to the IC constraint:

$$R_0 + (r - \rho) R_{ex-ante} + \rho R + tT \geq b\,(R + T) \tag{10}$$

Note that in equilibrium, $R_{ex-ante} = R$. This follows since customers correctly anticipate the bank's ability and willingness to lend under the commitment.[11]

Recall that in the benchmark case in Section 4, the bank always covered the customers' liquidity needs, because the return on the banking activity was higher than that on trading ($r > t$), and time inconsistency problems were not present (*ex post* return and total return were identical). Yet when a part of return to banking is obtained *ex ante* to deal with potential moral hazard at the borrower level, time inconsistency problems may interfere. As long as the *ex post* return to banking is sufficiently high, $\rho > t$, there is no diversion of borrowing capacity to trading. However when $\rho < t$, the bank has an incentive to divert borrowing capacity. In maximizing its *ex post* profit, the bank chooses to first allocate the borrowing capacity to trading up to its maximum profitable scale S, and only then give the remainder to banking.

[10] The material adverse change clauses are ususally quite generally formulated and give a bank leeway to refuse to lend under the credit line (claiming a general material adverse change on behalf of the borrower).

[11] As will become apparent, the bank will always charge the maximum possible amount, ρ, *ex-post*. That is, ρ is set at the highest level such that the moral hazard problem at the borrower level is not triggered. This minimizes the time inconsistency problem.

Whether the diversion of capital results in a misallocation away from banking depends on the scalability of trading. When the scalability is low, $S \leq T_{\max}$, the bank can cover all liquidity needs of customers even after allocating S to trading. That is, the allocation $\{\bar{R}; S|_{S \leq T_{\max}}\}$ satisfies the leverage constraint (7). Hence, $R = \bar{R}$ and relationship banking does not suffer. However when scalability is high, $S > T_{\max}$, banking is credit constrained *ex post*: the allocation $\{\bar{R}; S|_{S > T_{\max}}\}$ no longer satisfies (7). The borrowing capacity that remains after the bank has allocated S to trading is insufficient to cover all liquidity needs of customers, hence $R < \bar{R}$ and relationship banking suffers. Anticipating this, bank customers will pro-rate the credit line fee which they are willing to pay *ex ante* based on the expected lending that the bank will offer *ex post*: $(r - \rho)R_{ex-ante} < (r - \rho)\bar{R}$. The misallocation of borrowing capacity represents the time inconsistency problem, and undermines the ability of a bank to maintain its relationship banking franchise.

5.2 The Consequences of Time Inconsistency

Under time inconsistency ($\rho < t$ and $S > T_{\max}$), the bank chooses to allocate its borrowing capacity to trading even when this means that it cannot deliver on the more profitable banking activity. The severity of the consequences of the time inconsistency problem depends on the relationship between the profitability of banking r and the private benefits b. Observe that cutting back on banking conserves capital at a rate b (see IC constraint (1)) and undermines bank profitability at a rate r. We will show that only when the capital conservation b exceeds the loss in profits r some banking *might* be preserved. There are two cases.

Case 1: $r < b$. When r is small, such that $r < b$, cutting down on banking frees up more capital than is lost in profits (the leverage constraint becomes slack), hence trading can be expanded. This is the case when some banking may be preserved under time inconsistency. That is, when the scalability of trading is not very high:

$$T_{\max} < S \leq \frac{R_0}{b - t} \tag{11}$$

we solve (10) as equality:

$$R = \frac{R_0 - S(b-t)}{b-r} \qquad (12)$$
$$T = S$$

These results give rise to interesting comparative statics. In this region of the intermediate scalability of trading, a diversion of borrowing capacity from banking to trading is limited (the difference between S and $T_{\max}$). This misallocation is less severe at higher levels of banking profitability r: in (12) R is increasing in r, thus R is closer to the optimal allocation $\bar{R}$ for higher r. The reason is that a higher r increases the franchise value of the banking unit and allows it to offer more spare capital to trading. We can see this from (8); at higher r, more trading can be accommodated ($T_{\max}$ is higher), and this reduces the the ex post diversion to trading (i.e. the difference between S and $T_{\max}$).

A higher scalability of trading:

$$S > \frac{R_0}{b-t} \qquad (13)$$

leads to all resources being allocated to the trading activity, and relationship banking is wiped out. That is:

$$R = 0 \qquad (14)$$
$$T = \frac{R_0}{b-t}$$

Banking cannot be maintained now because the highly scalable trading can now accommodate all resources.

Case 2: $r \geq b$. When r is high, $r \geq b$, it follows immediately from (8) that $T_{\max} > R_0/(b-t)$. Given that – as is assumed – the time inconsistency problem is present ($S > T_{\max}$), we now, contrary to Case 1, only have the higher range of scalability in trading ($S > R_0/(b-t)$). From Case 1 we know that trading will wipe out all banking activity in that range.

An alternative way to see this is to note that for $r > b$ cutting down on banking leads to a loss in profits that is more than the capital freed up. This makes the leverage constraint (10) more instead of less binding, reducing the capital available to trading. No smooth reduction in the banking activity can help; in equilibrium, relationship banking totally disappears. The time inconsistency problem is so severe that only trading remains at a modest scale, based on the franchise value R_0:

$$\begin{aligned} R &= 0 \\ T &= \frac{R_0}{b-t} \end{aligned} \tag{15}$$

The lessons that can be drawn from both cases are however subtle. Highly profitable relationship banking ($r \geq b$) allows for a substantial trading activity (i.e. $T_{\max} > R_0/(b-t)$, see (8)) without a detrimental effect on the banking activity. If nevertheless the scalability of trading exceeds this elevated level ($S > T_{\max}$), time inconsistency problems in combining trading and banking will destroy the relationship banking franchise fully. Hence we have a bang-bang solution.

At low levels of bank profitability ($r < b$), the trading volume $T_{\max}$ that can be accommodated is smaller. Time inconsistency sets in earlier, and from this point on smoothly starts reducing the level of the banking activity. Not, however, that overall the banking activity suffers more from trading in the case $r < b$ than in the case $r \geq b$. Figure 3 summarizes the dynamics of relationship banking under time inconsistency as a function of trading opportunities.

Figure 3 can help interpret some fundamental changes in the financial sector. Over the last decades, the deepening of financial markets has expanded trading opportunities. With modest scalability of trading, banking did not suffer: time inconsistency was not binding since the implicit capital of relationship banks could accommodate all trading. Trading elevated overall bank profitability. Yet more recently two developments may have undermined banks that engage in trading. (*i*) The scalability S of trading may have become too high, and (*ii*) developments in information technology (possibly the same that have made trading more scalable) and deregulation may have reduced the profitability r of relationship banking. So trading has become more scalable, while banking became less profitable and less able to support even the same levels of trading without triggering detrimental time inconsistency. The former corresponds to the move to the right on the axes of Figure 3, while the latter points to a shift from case 2 to case 1 in the figure (with lower $T_{\max}$; note from (8) that $T_{\max}$ shrinks for lower values of r).

This migration provides some important lessons for the industry structure of banking. With limited trading opportunities and relatively profitable banking activities, there is substantial scope for combining banking and trading. However, more scalable trading coupled with less profitable banking can undermine banking severely. Combining the activities then becomes very costly.

The dynamics of R and T for cases $r < b$ and $r \geq b$, without (as in Section 4) and with time inconsistency (this section), are summarized in Figure 4, panels A and B.

Proposition 2 (Time inconsistency) *When a part of the return to banking is collected ex-ante, the profitability of banking is low (low R_0 and r leading to low ρ and $T_{\max}$) and/or trading is sufficiently scalable (high S), a bank may have incentives to allocate ex-post more borrowing capacity to trading than what is ex-ante optimal. Specifically, when $t > \rho$, then for $S > T_{\max}$, the bank will allocate insufficient capital to serving the future funding needs of its customers: $R < \bar{R}$. Anticipating this, ex-ante investments in banking suffer: customers pay lower credit line fees, compromising relationship banking.*

5.3 Costs of Conglomeration under Time Inconsistency

We can now derive bank profits. Recall that the cumulative profit of banking and trading as standalone activities is:

$$\Pi_S = R_0 + r\bar{R} + 0 = R_0 + r\bar{R} \tag{16}$$

where $R_0 + r\bar{R}$ is the profit of a standalone relationship bank (see (3)), and zero is the profit of standalone trading (which is not viable).

The profit of a bank that engages in trading depends on the scalability of trading, S. For $S \leq T_{\max}$, time inconsistency is not present, and the profit is increasing in S:

$$\Pi_C = R_0 + r\bar{R} + tS \tag{17}$$

For higher S, $S > T_{\max}$, Π_C is decreasing in S as time inconsistency distorts capital allocation. Following the two cases in Section 5.2: for $r < b$ a bank substitutes trading for banking, and its profit decreases smoothly (use (12)) until the maximum feasible scale of trading $S = R_0/(r-b)$ is reached:

$$\Pi_C = R_0 + \frac{rR_0 - Sb(r-t)}{b-r}, \text{ for } T_{\max} < S \leq R_0/(b-t) \tag{18}$$

$$\Pi_C = R_0 + t\frac{R_0}{(b-t)}, \text{ for } S > R_0/(b-t) \tag{19}$$

For $r \geq b$, cutting down on banking does not create borrowing capacity for trading. Hence, the banking activity collapses for $S > T_{\max}$, leading to a discrete drop in profit at $S = T_{\max}$, to the level given in (19). The profits of a conglomerated bank depending on the scalability of trading are summarized in Figure 4, panels C and D.

Overall, from (17-19), we observe that, in comparison to stand-alone banking, the engagement in trading increases profitability initially (for low S) but can lead to a loss of profitability for higher S. Specifically, when a bank fully substitutes trading for relationship banking ($R = 0$; $T = R_0/(b-t)$) its profit Π_C as given in (19) is less than the standalone profit Π_S (see (16)) when relationship banking rents $r\bar{R}$ are sufficiently high:

$$r\bar{R} > t\frac{R_0}{(b-t)} \tag{20}$$

The results can be summarized as follows:

Proposition 3 (Profits with time inconsistency) *The effect of conglomeration on* *bank profits is inverse U-shaped in trading opportunities S. For low opportunities ($S < T_{\max}$), time inconsistency is not present, and profits increase in trading opportunities as a bank can better use its spare capital. For large opportunities ($S > T_{\max}$), profits fall with additional trading as the time inconsistency problem intensifies. There exist parameter values such that beyond a certain scale of trading opportunities, banks that do not engage in trading generate higher profits than banks that combine relationship banking and trading.*

6 Trading as Risk-Shifting

6.1 Setup: Risky Trading

The previous section has identified an important distortion that may arise when banks engage in trading: a time inconsistency in capital allocation, which can damage the bank's relationship franchise. This section discusses a related distortion: the use trading for risk-shifting. We also study how the two problems interact.

Shareholders of a leveraged firm have incentives for risk-shifting when risk (funding) is not fully priced at the margin (Jensen and Meckling, 1978). The latter is a standard feature of corporate finance, and arises when funds are attracted before an investment decision, to which shareholders cannot commit. Risk not priced at the margin is certainly present in banks.[12]

Yet, generating risk-shifting in traditional relationship banking might be difficult. Risk-shifting requires probabilistic returns: an upside that accrues to shareholders and

[12] The pricing of risk might be more distorted in banks than in non-financial companies. One reason is the safety net (for insured deposits or "too big to fail" banks). Government bailouts of failing banks can subsidize risk taking. Another reason are the effects of seniority, when newly attracted funding is senior to existing debt due to the use of collateral (Gorton and Metrick, 2010), short maturities (Brunnermeier and Oehmke, 2011), or higher sophistication (Huang and Ratnovski, 2011). Then, new funding is effectively subsidized by existing creditors (although the latter may anticipate such risk transfer and charge higher interest rates *ex ante*). In addition to these, a possibly higher liquidity of bank assets compared to industrial firms may make it easier for banks to opportunistically change their risk profile (see Myers and Rajan, 1998). We do not need these additional effects in our model. But if present, they would strengthen our results. In particular, while we proceed to assume a positive NPV of risky trading, having risk subsidized may give the bank incentives to engage in risky trading even if it has a negative NPV.

a downside that exceeds the franchise value and imposes losses on creditors. But relationship banking is a rather stable activity with relatively predictable returns. For example, in commercial or investment banks that have multiple loans or underwriting operations with uncorrelated outcomes, the return is close to certain due to the law of large numbers (save for the exposure to the business cycle). With high franchise value, shareholders will internalize all consequences of their moral hazard, for example absorb losses associated with a somewhat higher share of non-performing loans that may arise because of insufficient monitoring. In contrast, trading allows the bank to generate highly skewed returns, for example, from large undiversified positions. Then, for a bank, trading becomes not just a profit opportunity, but a means to perform risk-shifting.

To model risk-shifting, we introduce risky trading. Assume that a bank can choose between a safe trading strategy considered before and a risky trading strategy, which for T units invested generates a gross return $(1+t+\alpha)T$ with probability p, and 0 with probability $1-p$, up to the maximum scale of trading S. The binary return is a simplification, representing a highly skewed trading strategy. The notion is that banks use trading to generate extra return "alpha" by taking bets that are safe in most states of the world, but occasionally lead to significant losses. Such behavior is supported by the accounts of the strategies employed in the run-up to the financial crisis (Acharya et al., 2010).

We assume that risky trading has a lower NPV than safe trading, yet positive:

$$0 < p(1+t+\alpha) - 1 < t \tag{21}$$

so that a bank would only choose risky trading for risk-shifting purposes, and, as long as there is spare borrowing capacity, will choose some some trading instead of leaving it unused.

At the same time, holding the cost of debt fixed, the risky trading has a higher return than safe trading, creating incentives for shareholders to use trading for risk-shifting. Yet, the return to risky trading is not as high as to make IC constraint (1) less binding in the larger volume of trading:

$$t < p(t+\alpha) < b \tag{22}$$

The choice of the trading strategy is not verifiable.

Under risky trading, a bank may be unable to repay its creditors in full. Shareholders then surrender available cash flows to creditors. Since the bank may choose to engage in risk-shifting, the interest rate charged by its creditors is no longer necessarily zero. Instead, creditors *ex ante* set the interest rate i based on their expectations of the bank's future trading strategy (achieving zero expected return). For simplicity, we assume that when multiple equilibria are possible, the creditors set the lower rate. The bank chooses safe trading when indifferent. We focus on the richest case that combines time inconsistency ($\rho < t$) and a smooth contraction of banking ($b > r$).

6.2 Risk-Shifting

We first derive conditions under which the bank would choose risky trading when charged a low interest rate $i = 0$. This allows us to define a threshold level of T beyond which a bank would shift to risky trading. We then characterize the risky trading equilibrium – interest rates, capital allocation, and profits.

Assume that $i = 0$ and consider the payoff to risky trading. When a bank invests R in relationship banking and T in risky trading, it obtains at date 2 from relationship banking $R_0+(1+r)R$; and from trading $(1+t+\alpha)\,T$ with probability p and 0 otherwise. The bank has to repay creditors $R+T$. It can do so in full when trading produces a positive return. Yet when trading produces a zero return, the bank has sufficient income to repay in full only if $R_0 + (1+r)R \geq R+T$, corresponding to an upper bound on the volume of trading:

$$T \leq R_0 + rR \tag{23}$$

When (23) holds, the bank's debt is safe, and shareholders internalize the losses from risky trading. Their payoff is:

$$\Pi_{Risky}|_{T\leq R_0+rR} = R_0 + rR + p\,(1+t+\alpha)\,T - T \tag{24}$$

This is lower than the payoff with safe trading: $\Pi_{Risky}|_{T\leq R_0+rR} < \Pi_C$, where Π_C is given in (6). By (21), risky trading has a lower NPV than safe trading. Hence, bank shareholders will never choose risky trading if they fully internalize possible losses.

We thus focus on the case $T > R_0 + rR$, where a bank cannot repay creditors in full when a risky trading strategy produces zero. Here, the shareholders' return when the bank engages in risky trading is:

$$\Pi_{Risky} = p\,(R_0 + rR + (t+\alpha)\,T) \tag{25}$$

We can now compute the threshold level of trading beyond which the bank chooses risky trading. This happens when $\Pi_{Risky} > \Pi_C$, giving (use (6) and (25)):

$$T > T_{Risky} = \frac{(R_0 + rR)\,(1-p)}{p(t+\alpha) - t} \tag{26}$$

From the inequality (26) it follows that the bank will choose risky trading when trading has a high scale ($T > T_{Risky}$), or when the value of the relationship banking franchise ($R_0 + rR$) is low. The reason is that risky trading effectively has a fixed cost, the loss of the relationship banking franchise value ($R_0 + rR$) with probability p, while its benefit, the additional return α, is proportional to the scale of trading. Hence the scale of trading has to be high enough to compensate for putting the relationship banking franchise at risk.

We can now complete the analysis by deriving the bank's choice of the trading strategy and the allocation of borrowing capacity as functions of the scalability of trading S. We start by endogenizing T_{Risky} as given in (26). When a bank allocates T to trading, the borrowing capacity left to banking (from (10) is:

$$R = \frac{R_0 - T(b-t)}{b-r} \tag{27}$$

Substituting this into (26) gives:

$$T_{Risky} = \frac{R_0(1-p)}{r\left(b(1-p) - p\alpha\right)/b + \left(p\alpha - t(1-p)\right)} \tag{28}$$

We can verify the following:

Lemma 1 *(i) $\partial T_{Risky}/\partial \alpha < 0$ and $\partial T_{Risky}/\partial p < 0$: when risky trading has a higher upside and a lower risk, the switch to risky trading occurs at a lower scale;*

(ii) $\partial T_{Risky}/\partial R_0 > 0$ and $\partial T_{Risky}/\partial r > 0$: when the relationship franchise value is higher, the switch to risky trading occurs at a higher scale.

Proof. All are obtained by differentiation and considering that:

(i) The denominator in (28) is positive:

$$r\left(b - p\left(\alpha + b\right)\right)/b + \left(p\alpha - t(1-p)\right) = \left[(b-r)p\alpha + (1-p)b(r-t)\right]/b > 0$$

since $b > r$ and $r > t$.

(ii) The expression $(b(1-p) - p\alpha)$ in the denominator of (28) is negative. Use (22) to see that:

$$b(1-p) - p\alpha < p(t+\alpha)(1-p) - p\alpha$$

and

$$p(t+\alpha)(1-p) - p\alpha = p\left(t - (t+\alpha)p\right) < 0$$

■

We can now derive the allocation of borrowing capacity, interest rates and profits under risky trading. To limit attention to the more insightful case, we focus on the case when $T_{Risky} > T_{\max}$. Risk-shifting is then only relevant when the time inconsistency problem is present.

Then, for $S \leq T_{Risky}$ the bank chooses the safe trading strategy with the allocation of the borrowing capacity given by (12). For $S > T_{Risky}$, the bank chooses risky trading. Note that when there is time inconsistency in the allocation of borrowing capacity in safe trading ($\rho < t$), it also exists in risky trading because $\rho < t < p(t+\alpha)$ (see (22)), where $p(t+\alpha)$ is the *ex post* return to risky trading. Therefore, under risky trading, the bank will also first allocate the maximum possible borrowing capacity to trading before using the remainder for banking. The interest rate i follows from the creditors' zero-profit condition:

$$(R+T) = p\,(R+T)\,(1+i) + (1-p)(R_0 + (1+r)R) \tag{29}$$

where $(R+T)$ is the amount borrowed by the bank, $p\,(R+T)\,(1+i)$ is the debt repayment when risky trading succeeds, and $(1-p)(R_0+(1+r)R)$ is the value of bank assets transferred to creditors in case of bankruptcy. The borrowing capacity R left for the banking activity follows from the IC condition (set to satisfy with equality):

$$p(R_0 + (r-i)R + (t+\alpha-i)T) \geq b(T+R) \tag{30}$$

where the left hand side is the expected payoff to bank shareholders in normal operations, and the right hand side is the moral hazard payoff.

As in (12) through (14), for $T_{Risky} < S \leq \frac{R_0}{b-(p(1+t+\alpha)-1)}$, we obtain:

$$\begin{aligned} R &= \frac{R_0 - S\,((1-p)+b-p(t+\alpha))}{b-r} \\ T &= S \end{aligned} \tag{31}$$

And for $S > \frac{R_0}{b-(p(1+t+\alpha)-1)}$:

$$\begin{aligned} R &= 0 \\ T &= \frac{R_0}{b-(p\,(1+t+\alpha)-1)} \end{aligned} \tag{32}$$

Similarly to (18) and (19), bank profits are:

$$\Pi_{Risky} = p\left(R_0 + \frac{rR_0 - Sb(r-(p(1+t+\alpha)-1))}{b-r}\right), \text{ for } T_{Risky} < S \leq \frac{R_0}{b-(p\,(1+t+\alpha)-1)} \tag{33}$$

$$\Pi_{Risky} = p\left(R_0 + \frac{(p(1+t+\alpha)-1)R_0}{b-(p\,(1+t+\alpha)-1)}\right), \text{ for } S > \frac{R_0}{b-(p\,(1+t+\alpha)-1)} \tag{34}$$

Note that the shift to risky trading has two negative effects. First, it has a direct negative effect on bank profits because the risky trading has a lower NPV than safe trading. Although shareholders do not internalize this *ex post*, they internalize it *ex ante* through higher interest rates on bank borrowing. Second, lower bank profits reduce bank borrowing capacity, and thus further undermine bank profitability. As a result, $\Pi_{Risky} < \Pi_C$ (compare (33) and (34) to (18) and (19)). The dynamics of R and T and the evolution of bank profit when the bank can use trading for risk-shifting are demonstrated in Figure 5.

Proposition 4 (Risk-shifting) *The bank may engage in risky trading as a form of risk-shifting, when the profitability of banking (r and R_0) is low and/or trading is sufficiently scalable ($S > T_{Risky}$). This is detrimental to bank profits, as the bank internalizes the costs of risk-shifting through higher borrowing costs.*

6.3 The Interaction of Time Inconsistency and Risk Shifting

Finally, we study the interaction between time inconsistency and risk shifting problems in banks that engage in trading. There are three effects, by which the two problems can amplify each other, so that the presence of one distortion makes the presence of another more likely.

Effect 1. *Risk-shifting makes time inconsistency more likely by increasing the ex post return on risky trading.* Recall that $t < p(t+\alpha)$. Thus the ex-post return from trading is higher with risky trading. This creates the region:

$$t < \rho < p(t+\alpha)$$

where the time inconsistency problem arises only under risk-shifting. That is, there was no time inconsistency in the absence of risky trading ($t < \rho$), but it is present under risky trading ($\rho < p(t+\alpha)$). To see this not that for such parameter value, a bank chooses safe trading and there is no time inconsistency for $T_{\max} < S < T_{Risky}$: when risk shifting is not present. Yet for $S > T_{Risky}$ a bank chooses risky trading, and that risky trading also triggers time inconsistency. See Figure 6.

Effect 2. *Time inconsistency makes risk-shifting more likely by increasing the equilibrium volume of trading.* Consider two cases. In case 1, $\rho > p(t+\alpha)$, so the time inconsistency problem is not present. The maximum volume of bank trading is $T_{\max}$ (8). Since $T_{Risky} \geq T_{\max}$, the bank will never engage in risk shifting since the equilibrium scale of trading is too low to make risk-shifting worthwhile. In case 2, $\rho < t$, and the time inconsistency problem is binding for $T > T_{\max}$. Then, time inconsistency can increase the equilibrium scale of trading beyond $T_{\max}$. When $T_{\max} < T_{Risky} < R_0/(b-(p(t+\alpha)-1))$, the bank will start engaging in risk shifting as a result of the higher scale of trading, driven by the time inconsistency problem. See Figure 7.

Effect 3. *Time inconsistency makes risk-shifting more likely by reducing the relationship bank's franchise value.* The risk to the bank's franchise value (its loss with a probability $(1-p)$) is the cost of risk shifting. To show the interaction between time inconsistency, franchise value and risk-shifting, we need to enrich the model. Assume that the presence of the time inconsistency problem is uncertain at date 0. Specifically, at date 0 there is a probability γ that at date 1 $t = t_{Low} < \rho$, and there is no time inconsistency; and with probability $1-\gamma$ $t = t_{High} > \rho$, and hence time inconsistency is present. This allows us to show the *ex post* consequences of different expectations of time inconsistency γ on the bank's franchise value, and through it on the threshold value T_{Risky} (28).

Consider the realization $t = t_{Low}$ at date 1, so that time inconsistency is present. Then, at date 1, the payoff to bank shareholders from the safe trading is:

$$\Pi_C^{\gamma} = R_0 + (r - \rho)\left(\gamma \bar{R} + (1-\gamma)R_{ex-ante}\right) + \rho R + tT \tag{35}$$

The expression Π_C^{γ} is similar to Π_C in (9), except for the second term – higher credit line fees that the customers are willing to pay the bank at date 0. Time inconsistency now arises not with probability 1, but with probability $1 - \gamma$; hence compared to (9) credit line fees (and bank franchise value) are higher by $(r - \rho)\,\gamma\left(\bar{R} - R_{ex-ante}\right)$.

Similarly, the payoff from risky trading is:

$$\Pi_R^{\gamma} = p\left(R_0 + (r - \rho)\left(\gamma \bar{R} + (1-\gamma)R_{ex-ante}\right) + \rho R + (t + \alpha)\,T\right) \tag{36}$$

Setting $R = R_{ex-ante}$ and equating Π_C^{γ} and Π_R^{γ} as given in (35) and (36) provides the threshold point for a switch to risk-shifting (similar to (26)):

$$T_{Risky}^{\gamma} = \frac{\left(R_0 + (r - \rho)\,\gamma\left(\bar{R} - R\right) + rR\right)(1 - p))}{p\,(t + \alpha) - t} \tag{37}$$

Observe that a higher γ elevates the bank's franchise value at date 2. First, it increases the credit line fees by $(r - \rho)\,\gamma\left(\bar{R} - R_{ex-ante}\right)$. Second, it increases the bank's borrowing capacity, increasing the value of R for any given S. Therefore, $\frac{dT_{Risky}^{\gamma}}{d\gamma} > 0$: risky shifting becomes less likely under less intensive time inconsistency, as the bank must have a higher scale of trading to compensate for a higher cost of compromising bank franchise value.

Proposition 5 (Interaction of time inconsistency and risk-shifting) *The problems of time inconsistency and risk shifting amplify each other. Time inconsistency increases the scale of trading and reduces franchise value of the relationship bank, in-*

creasing incentives for risk-shifting. Risk-shifting increases the bank shareholders' ex-post return from trading, which may trigger time inconsistency in capital allocation.

7 Discussion

At this stage it is useful to summarize the distortions in banks that engage in trading, and how they may have changed over time. There are two distortions: one is the time inconsistency of capital allocation where a bank may choose to trade on a scale that is too high at the expense of its relationship banking franchise. The second is the use of trading for risk-shifting. Both distortions are more likely when the profitability of banking is low and the scalability of trading is high. These factors may have come into play in recent decades due to developments in information technology, facilitating easier access to information benefiting trading (increasing S) and reducing the grip that banks have over their relationship borrowers. The latter would reduce the profitability of banking (reduce R_0 and r).

Moreover, our analysis points to several reinforcing effects. First, as we show in Propositions 2 and 4, the effects of higher scalability of trading and lower profitability of banking work in the same direction and reinforce each other. Second, time inconsistency and risk-shifting also arise simultaneously, and amplify each other as well (Proposition 5). Overall, this implies that trading and other transactional activities in banking, while possibly benign and beneficial historically, might recently have become destructive: i.e. undermining the viability of relationship banking and putting banks at risk. These implications appear consistent with the evidence from the recent crisis.

We now discuss some modeling features, in particular, the approach the modeling relationship banking, limits to external equity and commitment problems in capital allocation, and sum up key policy implications.

7.1 Front-loaded Income in Relationship Banking

This paper characterized relationship banking as a business requiring *ex ante* investments in relationships, which produce returns distributed over time. The intertemporal nature of commitments is indeed a key feature of relationship banking.

We have modeled the time dimension of relationship banking returns through a credit line contract with *ex ante* fees. Our formulation thus focuses on the "front-loaded income" from relationships, where a bank obtains profit early on, but needs to be able to honor future commitments. There is ample evidence that relationship banks indeed play a large role in providing liquidity insurance (or, more generally, funding insurance) to customers. Often, such role is played by local banks, which possess information on borrowers and local market conditions that is crucial to evaluate the borrower's state of affairs, especially in negative economic circumstances.

As we highlight in this paper, the "funding insurance" role brings potential time-inconsistency problems. Banks typically have discretion in deciding whether to honor lending commitments as most include "material adverse change" (MAC) clauses that give them an option to renege. In particular, we argue that shifting capital to the trading business *ex post* may undermine the bank's ability to expand relationship lending when requested, and render "insurance" relationships less valuable for borrowers and less profitable to the bank.

Observe that the credit line (with discretionary MAC clause) that we model is a particular way of structuring the relationship. The client is willing to get services/products from its relationship bank, possibly even pay a slight premium over market (transaction) prices, in return for knowing that the bank relationship might be valuable in stressful times. While we have in mind (and in the model) times of stress that the borrower faces, we do observe that a bank that faces stressful times typically prioritizes its limited (risk bearing) capacity to its relationship clients, and also in this way insures it relationship banking clientele.

Whether banks actually deliver when such need arises affects the reputation of the bank, and more generally the competitive position of the bank; e.g. the ease with which it can hold on to its customers. More reputable banks might be less opportunistic, and less susceptible to diversions of borrowing capacity to trading. In this context also a bank's credit rating is relevant. The rating may in part reflect the risk bearing (or, lending) capacity that is not filled up opportunistically. Hence, borrowers may anticipate that banks with higher rating are better able to deliver on (implicit) promises or guarantees about future funding availability. This could explain why ratings are of such importance in the financial services industry.

The way we have modeled relationship banking, i.e. via the credit line contracting feature, can be seen as capturing a variety of circumstances where banking is based on ex-ante investments and future funding commitments. One such example is syndicated lending, where banks that are part of the syndicate have a mutual understanding to try to accommodate requests to participate in each others' syndicated projects. Reputation, including having a good credit rating, may again be a key factor in convincing others that a bank might be able to deliver and play its part in the reciprocity based syndicated lending market. Another example are commitments to local markets based on the knowledge of customers which facilitates funding in times of economic stress.

Another feature of relationship banking commonly postulated in the literature is "back-loaded income", where borrowers are subsidized initially, while hold-up problems allow the bank to recoup the subsidies later (Petersen and Rajan, 1995; Boot and Thakor, 2000). This makes the relationship banking business more attractive *ex post* since the bank has already made investments *ex ante*. A bank with high future rents from relationships is less likely to be exposed to time inconsistency problems or to engage in risk-shifting. Yet, the *ex post* rents in banking have been reduced in the recent past due to higher competition and more easily available borrower information reducing the informational advantage of banks (Keeley, 1990). Hence, the "front-loaded" aspect of relationship banking that we analyze in the paper may have become more important.

7.2 External Equity and Internal Capital Allocation

Two important features of our analysis are frictions in the internal allocation of capital (the time inconsistency problem) and difficulties in accessing external equity. The latter could help explain why trading activities might have to be undertaken in conjunction with a relationship bank: if attracting external capital is costly, using the implicit capital of the relationship bank (its franchise value) could offer convenient access to capital. In our analysis, it is always optimal for banks to use their excess capital for trading. Suboptimality only comes in when too much is allocated to trading due to the time inconsistency problem. Costly outside equity also explains why the time inconsistency problem is really bad for the relationship banking franchise: the capital that is diverted to trading cannot be easily replaced.

A natural question is whether the bank could have preempted the diversion of capital to trading by returning it back to shareholders (e.g. via dividends or share buybacks). The answer is no. To understand this, note that besides excess capital (which the relationship bank cannot use due to a fixed customer base, and which indeed could be returned to shareholders), the relationship bank in the normal course of business maintains unused capital (spare borrowing capacity) in order to cover future funding needs of customers. The model highlights that such capital can be misallocated to trading, making the bank unable to fulfill its relationship commitments. But if this unused capital was returned to shareholders, the bank would still be unable to make good on its commitments. Hence, the relationship franchise would be destroyed in either case; returning capital to shareholders cannot resolve the problem of time inconsistency.

The problem of time inconsistency between short- and long-term activities that we focus on in this paper is reminiscent of the literature that shows how trading at an intermediate moment in dynamic models of financial intermediation might undermine commitment (see for example the Jacklin (1987) comment on the Diamond and Dybvig, 1983). Other, more general examples of the negative effects of short-term bank activities on commitment include a lack of shareholder discipline under unstable and diffused ownership (Bhide, 1993), increased ease of asset transformation moral hazard (Myers and Rajan, 1998), or the increased sensitivity of decisions to short term financial market pressures (Shleifer and Vishny, 2010).

7.3 Policy Implications

The paper offers two contributions to the policy debate. The first contribution is a set of stylized facts (predictions) that are useful for understanding the dynamics of banks that engage in trading. We suggest that:

- Relationship banks are tempted to 'use their balance sheet' (i.e. implicit capital) for scalable trading opportunities. While limited trading can enhance bank profitability and franchise value, excess trading can reduce profits and destroy the relationship banking franchise.

- Financial development has undermined trading in banks through two channels: more scalable trading and less profitable relationship banking (possibly due to higher competition and better available customer information). Both increase incentives to over-allocate capital to trading, and to use trading for risk-shifting.

- In the above, the activities that suffer most would be those that involve discretionary contracting: credit lines (with MAC clauses), syndicated lending (with reciprocity to syndicated banks), and in general commitments to customers to offer funding in periods of economic stress based on local knowledge (see Section 7.1). In the presence of time inconsistency such contracts become less valuable and may no longer be viable. Banking as a whole becomes more transactional.

- A broad implication from the increased intensity of the time inconsistency and risk shifting problems is that combining banking and trading (the traditional European universal bank model, shared by some U.S. conglomerates) might have become less sustainable. Universal banks have historically combined a sizable relationship banking activity with a much smaller transactions-based activity. Now banks might allocate too many resources to the transactional activity, leading to lower profit and higher risk.

The second contribution is to the debate on restricting the scope of banking. Broadly speaking, the policy debate has focused on two (possibly complementary) approaches: prohibiting trading in banks (specifically proprietary trading: the Volcker rule) or segregating trading and other market-based activities (including underwriting) into firewalled subsidiaries (the approach of the U.K. Independent Commission on Banking, "the Vickers Commission"). Our analysis, based on identifying two underlying market failures – the time inconsistency and risk-shifting problems – allows us to make the following observations:

Scope of restrictions. The market failures identified in our model are driven by banks engaging in trading: transactional (short-term, scalable) activities. Observe that Vickers separates from banks more than trading: not all market-based activities are transactional in nature; some – notably underwriting – are commonly relationship-based. The rationale for segregating them from banking is unclear. At the same time, Volcker might be too narrow in focusing solely on proprietary trading and not on other transactional bank activities (e.g. investing in structured assets).

Segregating vs. prohibiting. Segregating trading into a separate subsidiary (Vickers) might help alleviate the risk-shifting problem. It can reduce risk spillovers from trading to the relationship bank, and offer transparency and a more risk-sensitive pricing of the funding for trading. The limitation is that segregation may not be able to prevent reputation-based recourse, i.e. when the relationship bank voluntarily chooses to cover losses in trading (as was the case in the number of episodes in the recent crisis). However, segregating trading cannot resolve the time inconsistency problem. Similar to Section 7.2 above, even if some trading activities were segregated into a separate subsidiary, a bank would still have incentives to misallocate to trading the capital that it maintains for future funding needs of customers (maintaining lending capacity). Put differently, even with segregated trading a bank might trade too much; it might allocate too much capital to trading subsidiaries and too little to banking subsidiaries. A prohibition of proprietary trading (Volcker) – and more broadly of other transaction-based activities – in banks and banking groups might thus be essential to prevent time inconsistency.

Trading-like activities that are part of the lending process. A key implementation challenge to Volcker or Vickers is that a restriction on trading might affect market activities that are inherent to relationship lending, such as taking positions for hedging purposes. With caution, one could build on a "middle ground" suggested by our analysis. Banks could be allowed to undertake market operations but on a limited scale. Trading in low volumes (below $T_{\max}$ (20) and T_{Risky} (28)) does not trigger time inconsistency (capital misallocation is too small) or risk-shifting (bank shareholders sufficiently internalize the costs of risky trading). Trading on a limited scale would not create distortions but will give banks space to undertake market operations that are necessary to support the lending process.

Capital regulation. Our analysis highlights the importance of maintaining spare capital in a relationship bank for serving future funding needs of customers. Thus relationship banks, while inherently safe, need to operate at levels of capital sufficiently in excess of the regulatory minimums to have the flexibility necessary to fulfil their relationship commitments. This is consistent with the proposed role of procyclical and other capital surcharges (assuming that banks can draw upon those sources of capital relatively freely), as opposed to fixed high capital requirements, in supporting the supply of banking services over the business cycle.

8 Conclusion

The paper studies incentive problems in universal banks that combine relationship banking and trading operations. Banks have incentives to engage in trading since that allows them to use the borrowing capacity of the relationship bank to profitably expand the scale of trading. However it generates two inefficiencies. Universal banks may allocate too much capital to trading ex-post, compromising the incentives to build relationships ex-ante. And universal banks may use trading for risk-shifting, compromising bank stability.

Financial development augments the scalability of trading, which initially benefits conglomeration, but beyond some point inefficiencies dominate. The proliferation of financial markets and increased financial deepening in recent decades suggest that conglomeration faces severe head winds such that problems in managing and regulating universal banks will persist for the foreseeable future. Our results highlight the dynamic problems in universal banking and sheds light on the desirability of restricting bank activities of the type that were recently proposed by the Volcker rule in the U.S. and the Vickers report in the UK.

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Figure 1. The timeline.

Date 0

- Bank lends to customers (repaid at date 2), obtains implicit equity $\boldsymbol{R_0}$

Date 1

- Bank customers have liquidity needs $\overline{R}$
- A conglomerated bank chooses the allocation of borrowing capacity between banking (covering liquidity needs) $\boldsymbol{R}$ (earns $\boldsymbol{r}$) and trading $\boldsymbol{T}$ (earns $\boldsymbol{t}$)
- After borrowing, a bank has the ability to "abscond" with $\boldsymbol{b(R+T)}$
- Bank lends to customers and engages in trading

Date 2

- Returns realized, everyone repaid

Figure 2. The timeline with time inconsistency.

Date 0

- Bank lends to customers (repaid at date 2), obtains implicit equity $\boldsymbol{R_0}$
- Bank collects credit line fees $\boldsymbol{(r-\rho)\,R_{ex\text{-}ante}}$ for covering funding needs at date 1

Date 1

- Bank customers have liquidity needs $\overline{R}$
- A conglomerated bank chooses the allocation of borrowing capacity between banking (covering liquidity needs) $\boldsymbol{R}$ (earns $\boldsymbol{\rho}$) and trading $\boldsymbol{T}$ (earns $\boldsymbol{t}$)
- After borrowing, a bank has the ability to "abscond" with $\boldsymbol{b(R+T)}$
- Bank lends to customers and engages in trading

Date 2

- Returns realized, everyone repaid

Figure 3. Relationship banking allocation *R* as a function of trading opportunities *S*.

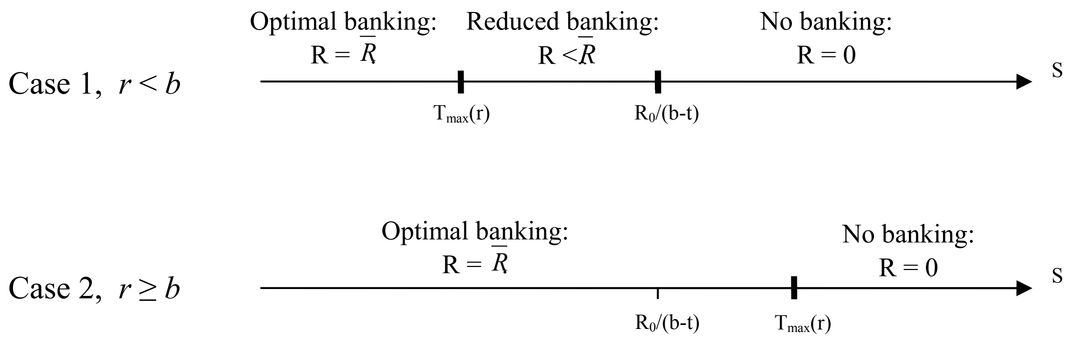
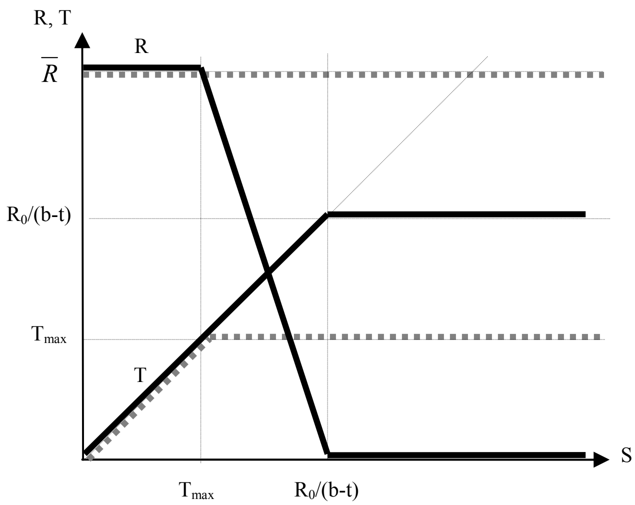
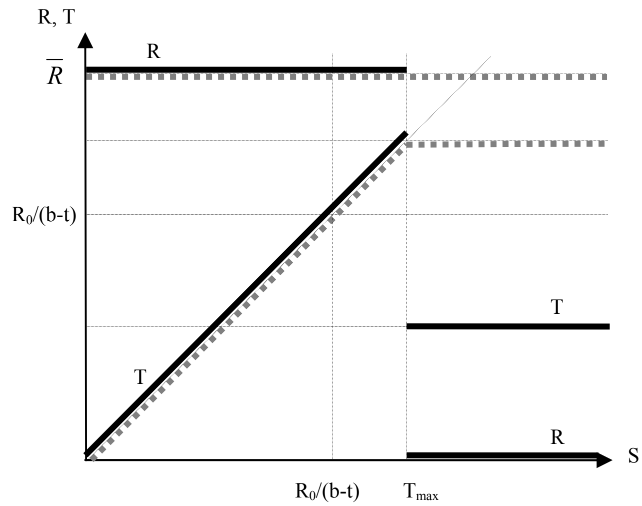


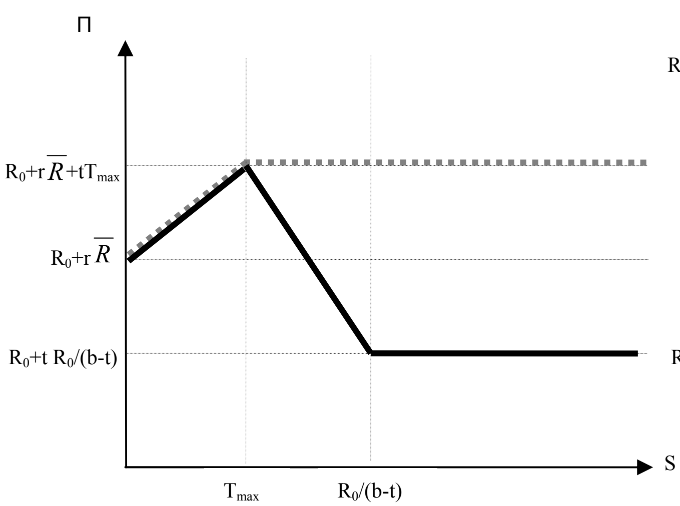
Figure 4. The volumes of banking (*R*) and trading (*T*), and profits (*Π*) under conglomerated banking.



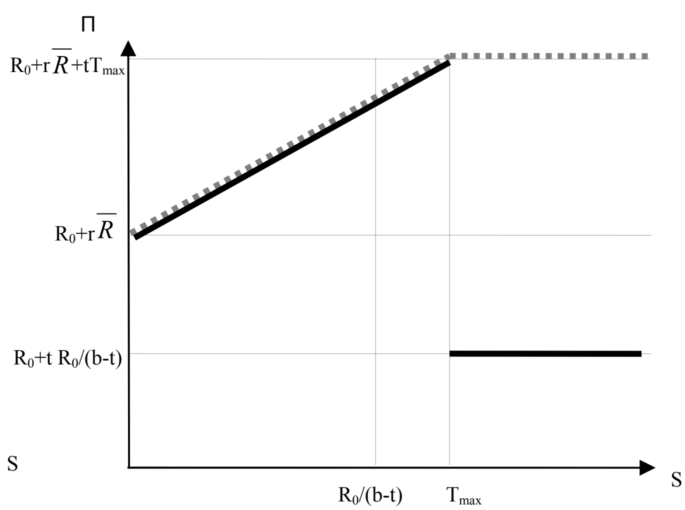
Panel A: *R* and *T* for *r<b*



Panel B: *R* and *T* for *r≥b*



Panel C: *Π* for *r<b*



Panel D: *Π* for *r≥b*

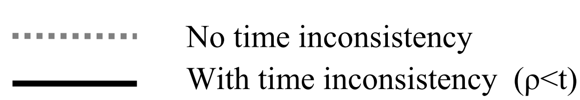
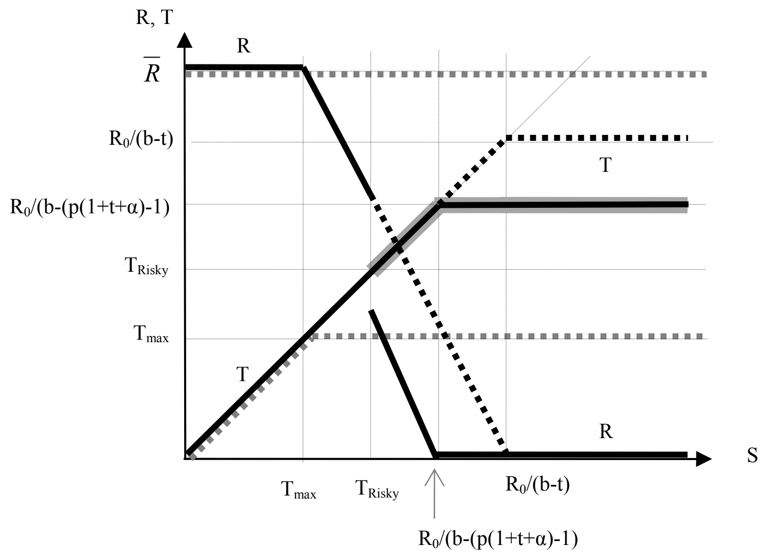
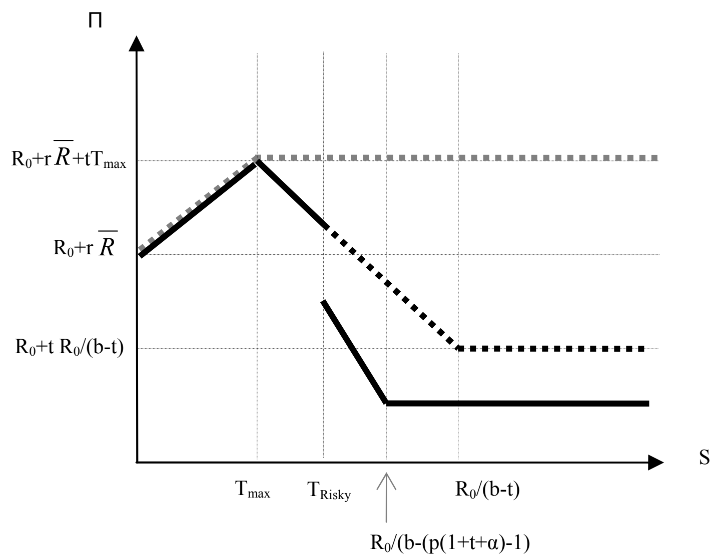


Figure 5. The volumes of banking (*R*) and trading (*T*), and profits (*Π*) with risk-shifting.



Panel A: *R* and *T*



Panel B: *Π*

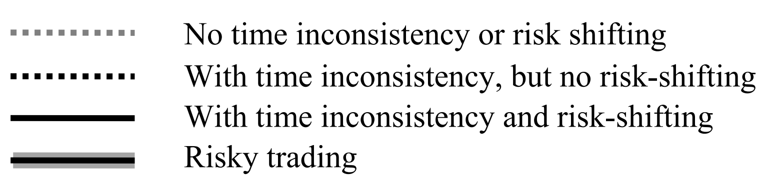
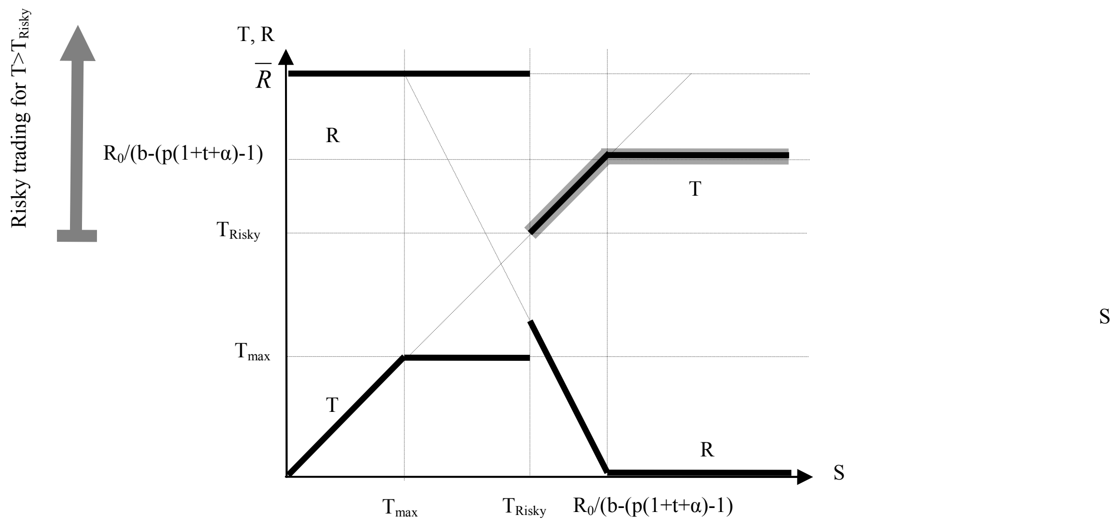


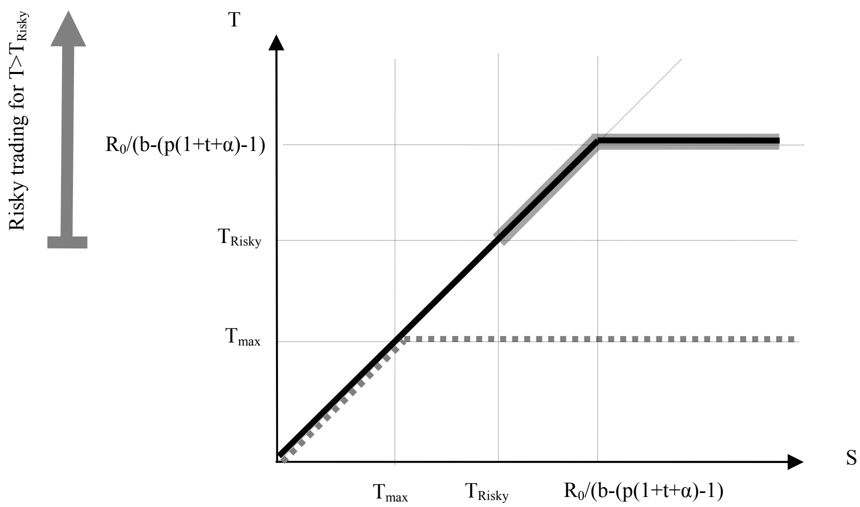
Figure 6. Time inconsistency arises due to a higher return to trading under risk-shifting ("Effect 1").



The case $t<\rho<p(t+\alpha)$): there is no time inconsistency when the bank chooses safe trading (for $T \leq T_{Risky}$); time inconsistency arises once the bank prefers risky trading ($T > T_{Risky}$)

Risky trading, for $T>T_{Risky}$

Figure 7. Risk-shifting arises due to a higher volume of trading, driven by time inconsistency ("Effect 2").



The volume of trading in the case $\rho > p(t+\alpha)$): there is no time inconsistency, T is bounded by $T \leq T_{max} < T_{Risky}$ and there is no risk-shifting

The volume of trading in the case $\rho < t$: time inconsistency arises for $S > T_{max}$; T can increase beyond T_{max} and exceed $T_{Risky.}$

Risky trading arises in the latter case, for $T > T_{Risky}$