

LENDER EXPECTATIONS ABOUT REPAYMENT QUALITY AND SLOW RECOVERIES FROM FINANCIAL CRISES

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Abstract

Recoveries from financial crises can remain slow even after credit spreads normalize and realized losses subside. This paper shows how forward-looking repayment expectations can generate persistent credit contractions. I develop a DSGE model with bank-firm lending relationships in which repayment quality is a persistent state about which lenders receive advance information. Negative news about future repayments induces pre-emptive credit tightening before losses are realized. Although lending spreads normalize relatively quickly, credit and output remain depressed because the continuation value of lending relationships recovers gradually. Anticipation extends the recovery to five-to-six years, compared with two-to-three years following an otherwise identical realized-loss shock. The paper thus presents a mechanism through which information can outlive the event it describes.

Keywords: Lenders' Outlook, Repayment Quality, Bank Loans, Financial Crises, Economic Recovery

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Small business owners feel that, despite being creditworthy, today banks remain either wary or entirely unwilling to lend to them, often times no matter how many banks they approach.

— *Mills and McCarthy (2014, p. 11)*^a

^aKaren G. Mills served as Administrator of the US Small Business Administration, 2009–2013.

1 INTRODUCTION

Credit need not deteriorate before credit supply does. [Mills and McCarthy \(2014\)](#)’s observation is not specific to small business lending; it points to a broader feature of credit markets: lenders need not wait for borrowers’ repayment capacity to deteriorate before adjusting the supply of credit. Expectations about *future* repayment can affect lending *today*. This forward-looking feature of credit supply matters for understanding why financial crises can leave such persistent scars. Analyzing 100 crises spread over one and a half centuries, [Reinhart and Rogoff \(2014, p. 51\)](#) document that recovery “following financial crises is often a five-to-ten-year process,” substantially longer than recoveries from typical recessions. This persistence is especially striking in economies where bank-firm lending relationships are pervasive ([Rajan, 1992](#); [Ongena and Smith, 2000](#); [Kosekova, Maddaloni, Papoutsis, and Schivardi, 2025](#)) — a sizable literature documents that such ties confer significant benefits on borrowers in normal times, including more stable credit access, lower borrowing costs, and insulation against transitory shocks ([Petersen and Rajan, 1994](#)). The natural prior therefore is that relationship-intensive systems should recover faster, because established ties provide continuity of credit access that cannot quickly be rebuilt. Yet the empirical record provides no such reassurance. The five-to-ten-year pattern documented by [Reinhart and Rogoff \(2014\)](#) holds across economies where relationship lending is extensive. This presents a well-defined challenge: what mechanism, operating within an economy in which relationship lending is pervasive, can account for recoveries extending five to ten years after a financial crisis, long after realized credit losses have subsided and credit spreads have normalized?¹

¹Relationship lending is important for aggregate credit conditions and business cycle dynamics. [Asker, Farre-Mensa, and Ljungqvist \(2015, p. 345\)](#) document that in 2010, only 0.06% of US firms were listed and even among larger firms with 500 or more employees, 86.4% of them were privately held. These firms account for approximately 53% of US nonresidential fixed investment, 69% of private-sector employment, and 59% of sales. [Ertan \(2025, p. 444\)](#) reports that in the European Union, small and medium enterprises (SMEs) represent more than 99% of companies in the nonfinancial sector, account for more than two-thirds of total nonfinancial employment and generate more than half of total gross value added.

This paper argues that the answer lies in what lenders expect about future loan performance. Adverse information about future repayment quality can reduce the current value of a lending relationship and induce banks to contract credit before any corresponding deterioration in realized loan performance occurs. The resulting contraction need not be reversed when the initial information shock passes, because the underlying repayment-quality state remains depressed and continues to reduce the value of maintaining the relationship. In this way, forward-looking repayment expectations provide a source of persistence that is distinct from the persistence generated by deterioration in intermediary balance sheets or by the subsequent repair of bank capital (Gerali, Neri, Sessa, and Signoretti, 2010; Gertler and Karadi, 2011). The mechanism connects two ideas that have largely been studied separately: the role of lending relationships as a source of endogenous persistence in credit markets, and the role of information about future financial conditions in generating anticipatory movements in credit.

The idea that financial disruption can impair the allocation of credit through information and lending relationships has a long history in macro-finance. In his analysis of the Great Depression, Bernanke (1983, p. 264) emphasizes that the banking problems of 1930–33 disrupted “the credit allocation process” and highlights the importance of banks’ accumulated “expertise, information, and customer relationships.” The historical evidence therefore points to an informational margin that is distinct from the contemporaneous realization of credit losses: disruption to financial intermediation can affect the availability and allocation of credit because banks possess information and relationships whose value extends beyond the current state of borrowers’ balance sheets. The question considered here is whether this informational margin can operate in a forward-looking direction: *can information about a future deterioration in repayment quality itself disrupt current credit allocation, before the deterioration is realized, and can it explain prolonged post-crisis recoveries, even in economies with extensive relationship lending?*

I study this question in a model of relationship-based bank lending with deep habits.² The model combines two ingredients. First, bank-firm lending relationships generate a continuation value for maintaining existing lending relationships, following the deep-habits approach to banking (Aliaga-Díaz and Olivero, 2010; Aksoy, Basso, and Coto-Martinez, 2013; Melina and Villa,

²I take the existence of lending relationships as given and do not model their endogenous formation. This follows the deep habits in banking literature, where the objective is to study how relationship persistence shapes credit dynamics, not why relationships arise. Endogenizing formation would introduce margins orthogonal to the mechanism studied here. Abstracting from endogenous emergence of credit relationships does not mean the model is silent on crisis-period relationship dynamics: when the continuation value turns negative, banks prefer exit, but deep habits generate gradual rather than instantaneous adjustment, consistent with the credit withdrawal documented by, among others, Bottero, Lenzu, and Mezzanotti (2020); Salvadè, Troege, and Taillet (2024); Berger, Bouwman, Norden, Roman, Udell, and Wang (2025) and Ertan (2025).

2014, 2018; Ravn, 2016; Airaudo and Olivero, 2019; Shapiro and Olivero, 2020; Sharma, 2025, 2026).³ Second, repayment quality is represented by a persistent economic state that affects the profitability of lending and therefore the value of continuing existing relationships. Lenders receive information about a future deterioration in repayment quality several periods before the deterioration is realized. The information is therefore a news shock to a well-defined economic state rather than a behavioral or extrapolative belief shock.⁴ Lenders revise their assessment of future loan performance, the continuation value of lending relationships falls, and banks respond by tightening credit before realized losses occur.

This paper connects relationship lending to the forward-looking assessment of loan repayment. Existing models of relationship lending emphasize that the value of maintaining a lending relationship affects current credit supply through the rents associated with future lending. I show that this value also depends on lenders' expectations about future repayment quality. A persistent repayment-quality state with forward-looking information about its future realization consequently links changes in lenders' repayment outlook to current credit supply, even before repayment losses occur. This interaction gives relationship lending a dual role in financial downturns: it can amplify pre-emptive tightening when repayment prospects deteriorate, while also supporting a faster recovery once those prospects improve. When the deterioration in repayment prospects is sufficiently persistent, however, credit and output can remain depressed for prolonged periods.

The distinction between the information shock and the subsequent realization of repayment losses is central to the mechanism. With advance information, the credit contraction begins immediately even though the underlying repayment-quality state has not yet deteriorated. Once the news arrives, the continuation value of lending relationships remains depressed because repayment quality itself evolves only gradually. Credit therefore remains below its steady state long after the initial information shock has passed. In the baseline relationship economy, the model generates a five-to-six-year recovery in credit and output following an anticipated deterioration in repayment quality. By contrast, when the identical deterioration in repayment quality arrives as a contemporaneous realized loss rather than as advance information, the recovery lasts only two-to-three years. The difference isolates the contribution of forward-looking repayment expec-

³See also Ravn, Schmitt-Grohé, and Uribe (2006).

⁴A growing literature emphasizes the need for macroeconomic models in which expectations are forward-looking yet disciplined by information and institutional structure rather than purely behavioral rules (Gennaioli, Ma, and Shleifer, 2016). The framework here follows this approach by modeling repayment quality as a persistent economic state and allowing information from monitoring — captured in reduced form in the model — to affect lenders' expectations about its future evolution, rather than from adaptive or extrapolative beliefs.

tations to post-crisis persistence: several additional years of depressed credit, investment, and output arise from the fact that lenders learn about the deterioration before it occurs.

This mechanism operates without an intermediary-net-worth shock, a deterioration in bank capital or nonlinear risk. The distinction is important because a central class of macro-finance models generates persistence through balance-sheet amplification — deterioration in borrower or intermediary net worth tightens financial constraints, reduces credit supply, and sets in motion feedback between financial conditions and economic activity (Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999; Gerali, Neri, Sessa, and Signoretti, 2010; Gertler and Karadi, 2011; Jermann and Quadrini, 2012; Brunnermeier and Sannikov, 2014; Bocola, 2016). In those models, persistence can arise from the gradual repair of balance sheets, leverage constraints, or nonlinear risk mechanisms. The mechanism here is deliberately different. Repayment-quality information affects lenders' expectations and the continuation value of lending relationships before realized losses impair intermediary balance sheets. Abstracting from bank net worth, leverage constraints, and precautionary motives (Gertler and Karadi, 2011; Brunnermeier and Sannikov, 2014; Bocola, 2016) therefore allows the model to isolate the slow recovery of the expected value of maintaining lending relationships as a separate source of persistence.

The relationship structure is essential for how the information shock propagates. Deep habits create a captive component of loan demand associated with existing lending relationships. When lenders revise the expected profitability of those relationships downward, they can tighten lending substantially without requiring an equally persistent movement in lending spreads. This generates a distinctive divergence between the dynamics of credit quantities and credit spreads. Following the information shock, spreads rise sharply but largely normalize within a few quarters, whereas lending remains depressed for several years as the continuation value of the relationship recovers only gradually. I refer to this divergence as the *spread-quantity dissociation*. It implies that the normalization of lending spreads need not signal a rapid normalization of credit conditions: when the adjustment operates through the continuation value of lending relationships, the quantity of credit can remain depressed even after the price of credit has largely returned to normal.

In a counterfactual exercise, I subject the relationship and arm's-length economies to the same anticipated deterioration in repayment quality. In the relationship economy, existing ties provide a degree of insulation: the captive component of credit demand limits the length of contraction relative to arm's-length lending. Yet the same relationship structure also provides the channel through which the adverse information affects current credit supply. Once the continuation value

of existing relationships falls, the economy does not return immediately to its pre-shock allocation. In the arm’s-length economy, the identical information shock instead produces a substantially more prolonged stagnation, approaching a decade. The comparison therefore reveals a dual role for relationship lending. Relationships moderate the persistence of contraction by somewhat supporting credit demand, but they do not eliminate it because the value of those relationships itself becomes sensitive to lenders’ expectations about future repayment quality. Relationship lending is thus neither simply a source of resilience nor simply a source of fragility: its effect depends on whether the value of maintaining the relationship remains high when lenders revise their assessment of future loan performance.

The interpretation of repayment quality as a forward-looking information state is grounded in how relationship lenders assess credit risk. Through repeated interactions, banks acquire both hard and soft information about borrowers and incorporate these assessments into internal credit grades and lending decisions (Diamond, 1984; Rajan, 1992, 1994; Berger and Udell, 1995; Boot, 2000; Hertzberg, Liberti, and Paravisini, 2010). Modern credit-risk and accounting practices likewise increasingly require lenders to assess expected, rather than exclusively realized, loan losses when evaluating credit quality and determining provisions (Kim and Kross, 1998; Keys, Mukherjee, Seru, and Vig, 2010; Vyas, 2011; Bushman and Williams, 2012; Dierkes, Erner, Langer, and Norden, 2013; Beatty and Liao, 2014; Qian, Strahan, and Yang, 2015; Khan and Ozel, 2016; Covas and Nelson, 2018; Harris, Khan, and Nissim, 2018; Becker, Bos, and Roszbach, 2020; Bushman, Gao, Martin, and Pacelli, 2021; Huber, 2022; Yang, 2022; Li, Ng, and Saffar, 2024; Kim, Kim, Kleymenova, and Li, 2026). These institutional features motivate modeling repayment quality as a state variable that can change when lenders receive information about future repayment, rather than beginning with realized losses on intermediary balance sheets.

This distinction is increasingly supported by empirical evidence that revisions in lenders’ expectations can themselves affect credit supply and economic activity (López-Salido, Stein, and Zakrajšek, 2017; Ma, Paligorova, and Peydro, 2021; Falato and Xiao, 2024; Farroni and Tozzo, 2024; Howes and Weitzner, 2025). Section 2 documents this evidence in detail.

The present paper’s position at the intersection of three strands of literature — relationship lending, forward-looking information, and expectations-driven credit contraction — allows it to generate pre-emptive tightening, the spread-quantity dissociation, and a five-to-six-year recovery simultaneously as features of a single mechanism. I discuss it in more detail in Section 1.1.

The mechanism has direct implications for financial stabilization policy. A standard balance-

sheet shock moves lending spreads and quantities together; when lenders instead receive information about future repayment quality, tightening begins before realized losses occur and the normalization of spreads can substantially precede the recovery of credit quantities. The mechanism therefore provides a structural interpretation of why the end of acute financial-market stress need not coincide with the end of a credit-driven recession, and why pass-through from balance-sheet policy interventions to credit supply can be weak during financial crises (Bocola, 2016). Restoring intermediary net worth may not restore the continuation value of lending relationships if lenders remain pessimistic about future repayment performance. Policies that directly address lenders’ forward-looking assessments may therefore complement rather than substitute for balance-sheet repair. These results also speak to Berger, Bouwman, Norden, Roman, Udell, and Wang (2025, p. 12)’s call for “more analysis of relationship lending” under different crisis types: the expectations mechanism studied here is distinct from net-worth transmission.

1.1 RELATIONSHIP WITH LITERATURE

The dominant approach in the macro-finance literature on the transmission of financial frictions to the real economy emphasizes borrower-side amplification through collateral constraints and balance-sheet feedbacks (Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999; Jermann and Quadrini, 2012) and agency problems and bank capital constraints on the intermediary side (Gerali, Neri, Sessa, and Signoretti, 2010; Gertler and Karadi, 2011; Brunnermeier and Sanik, 2014). These frameworks capture the amplification of *realized* financial shocks but abstract from the earlier informational stage at which lenders revise repayment assessments before any loss materializes. Cerra and Saxena (2008) document that financial crises produce permanent output losses substantially larger than these frameworks predict. The present paper offers a complementary persistence mechanism, the slow recovery of the continuation value of lending relationships following adverse revisions in repayment outlook, that operates independently of net-worth dynamics.

In an exercise, Christiano, Motto, and Rostagno (2014) show that news shocks to firm-level risk generate pre-emptive credit tightening in a Bernanke, Gertler, and Gilchrist (1999) framework. The present paper instead focuses on explaining the effects of forward-looking information gathered by banks (discussed in greater depth in the subsequent Section 2), its interaction with pervasive lending relationships and how it can account for slow post-crisis recoveries. It also adds the spread-quantity dissociation missing from the Christiano, Motto, and Rostagno (2014)

framework: without the captive demand structure of deep habits, credit adjustment operates symmetrically across spreads and quantities, and the persistent divergence between the two is absent. [Ferrante, Prestipino, and Schott \(2025\)](#) show that a net-worth shock is isomorphic to a credit supply shock in a [Gertler and Karadi \(2011\)](#) framework; the repayment quality shock here is not isomorphic because it enters through the profit function rather than a leverage constraint, is causally upstream of net worth, and admits a news shock structure with a coherent institutional interpretation that a net-worth news shock lacks since net worth can fall only after losses have accumulated.

The paper builds on the deep habits in banking literature ([Aliaga-Díaz and Olivero, 2010](#); [Aksoy, Basso, and Coto-Martinez, 2013](#); [Melina and Villa, 2014, 2018](#); [Ravn, 2016](#); [Airaudo and Olivero, 2019](#); [Shapiro and Olivero, 2020](#); [Sharma, 2025, 2026](#)), which models bank-firm lending relationships as a source of endogenous persistence in credit markets. Existing contributions study technology shocks, monetary and fiscal policy, credit standards, optimal monetary policy, labor market dynamics, realized credit loss shocks, and boom-bust cycles. The current work in this literature does not incorporate a forward-looking repayment-quality state, an information shock to future credit conditions, or the prolonged post-crisis recovery dynamics studied here. [Sharma \(2025\)](#) is the most directly adjacent: it shows that under realized credit loss shocks, output recovers within two to three years under relationship-based credit. The present paper differs in its driving force; the shock arrives as advance information rather than as a contemporaneous loss, generating three features absent from the deep habits literature: pre-emptive tightening, the spread-quantity dissociation, and a five-to-six-year recovery under relationship-based credit that is more than double the duration that realized losses alone produce, in line with the evidence in [Reinhart and Rogoff \(2014\)](#).

The paper connects to an emerging literature documenting that lenders' forward-looking beliefs about credit quality shape macroeconomic dynamics. [López-Salido, Stein, and Zakrajšek \(2017\)](#) identify fluctuations in credit-market sentiment as significant business cycle drivers and call for analysis of the primitive factors behind them and the role of intermediaries in their transmission;⁵ the repayment quality shock considered in this paper constitutes such a primitive. Most macro-finance models rely on shocks that arrive contemporaneously with credit deterioration, limiting

⁵[López-Salido, Stein, and Zakrajšek \(2017, pp. 1422–1423\)](#) underscore, "... there is clearly much more to do here. In particular, how significant of a role do ... financial intermediaries ... play in the transmission mechanism? ... we are at an early stage in our understanding of what primitive factors drive fluctuations in credit-market sentiment. ... one's view regarding the root source of credit-market sentiment clearly matters for how one thinks of policy implications."

their ability to generate pre-emptive tightening and the spread-quantity dissociation. The paper’s information-driven structure connects a structural general equilibrium mechanism to a growing empirical literature showing that lenders’ repayment beliefs, measured independently of balance-sheet conditions, are a significant driver of credit supply and output (Ma, Paligorova, and Peydro, 2021; Falato and Xiao, 2024; Farroni and Tozzo, 2024; Howes and Weitzner, 2025), surveyed in detail in [Section 2](#).

STRUCTURE

[Section 2](#) presents motivating evidence on lender expectations, credit dynamics, and post-crisis recovery. [Section 3](#) lays out the model. [Section 4](#) discusses solution and parameterization. [Section 5](#) presents the results. [Section 6](#) concludes.

2 MOTIVATING EVIDENCE ON LENDER EXPECTATIONS, CREDIT DYNAMICS, AND POST-CRISIS RECOVERY

Four empirical patterns motivate the paper’s design and correspond to its central predictions. First, banks adjust credit supply pre-emptively in response to forward-looking signals, before losses materialize. Second, recoveries from financial crises are remarkably persistent, extending five to ten years, and lenders’ expectations act as a sustained drag on credit independently of balance-sheet conditions. Third, lending relationships provide limited insulation when repayment outlooks deteriorate: banks adjust on the quantity margin as continuation values fall. Fourth, credit quantities remain depressed after spreads normalize, implying that spread-based measures understate post-crisis credit tightening. The subsections below document the empirical basis for each pattern.

2.1 PRE-EMPTIVE TIGHTENING BEFORE LOSSES MATERIALIZE

Relationship lenders continuously acquire hard and soft information through monitoring and repeated borrower interactions and embed these assessments in internal risk grades, expected credit loss provisions, and accounting measurements under forward-looking standards such as CECL and IFRS 9,⁶ where forward-looking expectations rather than realized defaults determine

⁶Current Expected Credit Losses (CECL) is the US accounting standard (Accounting Standards Codification (ASC) 326) issued by the Financial Accounting Standards Board (FASB) requiring banks to recognize expected

required provisions (Bushman and Williams, 2012; Beatty and Liao, 2014; Covas and Nelson, 2018; Harris, Khan, and Nissim, 2018; Li, Ng, and Saffar, 2024; Chen, Dou, Ryan, and Zou, 2025; Kim, Kim, Kleymenova, and Li, 2026). This formal accounting treatment creates the direct institutional channel from lenders’ repayment outlook to credit supply decisions that repayment quality shock formalizes in the model.

Micro evidence confirms that this channel is operative. Using data from a large German universal bank, Norden and Weber (2010) show that early warning indicators extracted from borrower account activity predict defaults up to twelve months in advance and serve as the basis for higher spreads, reduced credit limits, and increased provisioning, all while borrowers remain formally current. Bocola (2016) provides macroeconomic evidence: anticipation of impending sovereign default impairs financial intermediation before any realized default event, establishing that the expectational channel operates at the aggregate level. Krishnamurthy and Muir (2025) documents that financial crises involve sharp revisions in beliefs; the mechanism here is complementary, showing that the persistence of those beliefs once revised, not only their initial arrival, determines how long credit and output remain depressed.

Kim, Kim, Kleymenova, and Li (2026) exploit the staggered adoption of CECL across US banks and show that the formal requirement to provision for expected future losses improved information production: CECL-adopting banks recorded timelier loan-loss provisions that better reflected future economic conditions and experienced fewer subsequent loan defaults. Ertan (2025) shows that European banks adopting IFRS 9 immediately reduced SME lending by over ten percent before any actual defaults materialized, raising spreads, tightening collateral requirements, and shortening loan maturities. This is pre-emptive credit tightening driven by a formal requirement to assess future repayment quality, mirroring the model’s repayment quality shock mechanism. Chen, Dou, Ryan, and Zou (2025) also provide similar evidence.

2.2 PERSISTENT CREDIT CONTRACTION AND SLOW RECOVERY

Recoveries from financial crises are substantially longer than those from conventional recessions. Reinhart and Rogoff (2014) document a five-to-ten-year recovery process, and Hoshi and Kashyap (2015) examine Japan’s lost decade as a case study in protracted post-crisis stagnation. Cerra and

credit losses over the entire remaining life of a loan at origination, rather than only upon a loss event. International Financial Reporting Standards (IFRS) 9 is the analogous international standard issued by the International Accounting Standards Board (IASB), effective 2018. Both represent a departure from previously prevailing incurred-loss frameworks under which provisions were recognized only after a loss had already occurred.

Saxena (2008) document permanent output losses substantially larger than standard balance-sheet frameworks predict. Bocola (2016) shows that bank credit responds weakly to policy interventions during crises because precautionary behavior suppresses credit independently of net-worth repair. Bassett, Chosak, Driscoll, and Zakrajšek (2014) construct credit supply indicators from Senior Loan Officer Opinion Survey responses and find that changes in lending standards, interpreted as fundamental reassessments of credit riskiness, are associated with significant loan-volume and GDP declines. These findings motivate the paper’s emphasis on the persistence of lenders’ repayment outlook as the driver of recovery duration.

More recent evidence also suggests that the consequences of forward-looking credit assessment extend beyond bank lending. Chen, Dou, Ryan, and Zou (2025) find that banks adopting CECL before the COVID-19 recession reduced loan growth more during the subsequent stress period, and that counties with greater exposure to CECL-adopting banks experienced larger increases in unemployment and slower subsequent recoveries. These findings suggest that forward-looking assessments of credit losses can have persistent real effects during financial stress, but they do not identify the mechanism through which such expectations propagate through the lending relationship. Using loan- and firm-level data from China, Chen and Huang (2026) similarly find that banks adopting an expected-credit-loss model reduced credit supply relative to banks using an incurred-loss model following the onset of COVID-19, with the contraction persisting over the sample period and firms more exposed to ECL banks experiencing larger subsequent declines in economic activity.

2.3 LENDERS’ EXPECTATIONS AS INDEPENDENT DRIVERS OF CREDIT SUPPLY

Falato and Xiao (2024) document that persistent downward revisions in bank repayment expectations were a sustained drag on US lending after the 2008–09 crisis, operating over and above what balance-sheet conditions would predict and especially pronounced for commercial and industrial loans. Ma, Paligorova, and Peydro (2021) provide complementary evidence using direct measures of bank expectations across US metropolitan areas: lenders’ negative expectations are associated with lower loan growth, higher rates, and adverse real effects on firm-level borrowing and capital expenditure. Their COVID-19 analysis most cleanly isolates the channel: banks with more pessimistic pre-pandemic outlooks had stronger balance sheets ex post yet continued to lend less, confirming that “expectations can play a key role for credit supply, and balance sheet conditions

are not the only story” (p. 30).

Howes and Weitzner (2025) establish that the information banks produce drives lending decisions and macroeconomic outcomes, with information quality improving as conditions deteriorate, particularly for new and larger loans with higher expected losses. Farroni and Tozzo (2024), using Italian credit registry data, show that banks adjust both lending rates and loan quantities in response to signals about borrower quality prior to realized credit outcomes. Together, these findings establish that adjustment operates through a persistent suppression of credit supply that outlasts the initial spread response.

2.4 RELATIONSHIP EXIT AND ADJUSTMENT ALONG THE QUANTITY MARGIN

Despite extensive evidence of the benefits of bank-firm ties in normal times (Petersen and Rajan, 1994; Ongena and Smith, 2000; Kosekova, Maddaloni, Papoutsi, and Schivardi, 2025), those relationships provide limited insulation when lenders’ repayment expectations deteriorate sharply. Chodorow-Reich (2014) documents that during the 2008–09 crisis, firms with relationships with less healthy lenders had lower loan probabilities, higher rates, and significantly reduced employment. Bottero, Lenzu, and Mezzanotti (2020) show that during the Greek sovereign crisis, banks with greater exposure reduced credit supply substantially and were more likely to terminate relationships and cut credit line limits. Ricci, Soggia, and Trimarchi (2023) show, using Italian data, that adverse lending standard shocks reduce loans, tighten limits, and increase relationship termination, with firms unable to substitute credit from other banks. Salvadè, Troege, and Taillet (2024) find that banks exploit their information advantage to exit relationships before defaults, and Berger, Bouwman, Norden, Roman, Udell, and Wang (2025) find that relationship borrowers received worse terms during COVID-19 distress. Wilner (2000) builds a model showing that in trade credit, dependent creditors raise pricing more aggressively as the dependence increases, reflecting asymmetric extraction of relationship surplus. These findings are consistent with the model: when continuation values turn negative, banks prefer exit, but deep habits generate gradual adjustment, producing the persistent credit depression the paper documents.

Ertan (2025) provides the most direct evidence that relationship-dependent borrowers bear the adjustment when lenders formally revise repayment assessments. SMEs, who are bank-dependent and cannot easily switch lenders, bore disproportionate costs of IFRS 9 adoption: higher rejection rates, rising interest costs, declining loan amounts and maturities, and reduced capital investment,

with firms unable to substitute from alternative sources. In the model’s terms, the erosion of the continuation value converted the relationship structure’s stabilizing property into a conduit for adverse expectations.

2.5 SPREAD-QUANTITY DISSOCIATION DURING RECOVERY

The model shows that in case of relationship-based credit, despite spreads largely normalizing, credit remains persistently depressed. [Gilchrist and Zakrajšek \(2012, p. 1693\)](#) decompose credit spreads into a firm-specific default risk and a residual ‘excess bond premium (EBP)’ and find that increases in EBP appear to reflect “a reduction in the effective risk-bearing capacity of the financial sector and, as a result, a contraction in the supply of credit.” [Bassett, Chosak, Driscoll, and Zakrajšek \(2014, p. 39\)](#) construct credit supply indicators from adjusted lending standards and show these have substantial macroeconomic effects independent of spreads, reflecting what they term “fundamental reassessments of the riskiness of certain types of bank lending.” The framework in this paper highlights a distinct implication — following a financial crisis, credit quantities can remain persistently depressed even after spreads revert toward pre-crisis levels. In the model, this occurs because lending decisions depend not only on current risk premia but also on the continuation value of lending relationships which is impaired by persistent revisions in repayment outlook. As a result, spreads need not be sufficient statistics for credit conditions during recovery phases.

3 MODEL

I develop a DSGE model in which banks have lending relationships with borrowers and receive information about future repayment quality before that quality is realized. The model combines a standard collateral-based borrowing environment ([Kiyotaki and Moore, 1997](#); [Iacoviello, 2005](#); [Liu, Wang, and Zha, 2013](#); [Justiniano, Primiceri, and Tambalotti, 2015](#)) with deep habits in bank lending (see [Aliaga-Díaz and Olivero, 2010](#) and other references cited earlier in [Section 1](#)). The latter creates a continuation value of lending: today’s credit affects future borrower demand from the same bank. Advance information about repayment quality therefore affects current lending not only through expected repayment on current loans but also through the expected future profitability of existing lending relationships. This interaction is the central mechanism of the model. As I elaborate on in [Section 3.3.3](#), I abstract from bank net worth and bank capital

accumulation so that the model isolates this expectations channel. The real side of the economy follows a standard production environment common in the macro-finance literature. Relative to existing models of relationship banking, the key novelty is that lenders' outlook about repayment quality evolves as an independent state variable, altering banks' optimal credit supply even in the absence of realized losses and generating prolonged recovery despite spreads largely normalizing.

3.1 HOUSEHOLDS

Households have the utility function of the following form:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} (\beta^P)^t \left\{ \log (C_{i,t}^P - \gamma^P C_{i,t-1}^P) - \frac{N_{i,t}^\eta}{\eta} + \varsigma \log H_{i,t}^P \right\} \quad (1)$$

where $C_{i,t}^P$, $N_{i,t}$ and $H_{i,t}^P$ denote consumption, labor and housing respectively of the households, $\beta^P \in (0, 1)$ is a discount factor, γ^P measures the degree of habit formation in consumption, η is Frisch elasticity of labor supply and ς is a weight on housing. The superscript P denotes (patient) households. The household faces the following budget constraint

$$C_{i,t}^P + Q_t^H (H_{i,t}^P - H_{i,t-1}^P) + \int_0^1 D_{ik,t} dk \leq W_t N_{i,t} + \int_0^1 \Pi_{ik,t} dk + R_{t-1}^D \int_0^1 D_{ik,t-1} dk \quad (2)$$

where Q_t^H is the price of one unit of housing in terms of consumption goods, W_t is the real wage and R_{t-1}^D is the gross risk-free interest rate on the stock of deposits $D_{ik,t-1}$ of household i in bank k at the end of period $t-1$. I assume housing does not depreciate. Profits obtained by household i from bank k are denoted by $\Pi_{ik,t}$. After imposing symmetric equilibrium, FOCs of the households can be written as

$$\frac{1}{C_t^P - \gamma^P C_{t-1}^P} - \beta^P \mathbb{E}_t \frac{\gamma^P}{C_{t+1}^P - \gamma^P C_t^P} = \lambda_t^P \quad (3)$$

$$\beta^P \mathbb{E}_t \lambda_{t+1}^P = \frac{\lambda_t^P}{R_t^D} \quad (4)$$

$$\frac{\varsigma}{H_t^P} + \beta^P \mathbb{E}_t (\lambda_{t+1}^P Q_{t+1}^H) = \lambda_t^P Q_t^H \quad (5)$$

$$N_t^{\eta-1} = \lambda_t^P W_t \quad (6)$$

where λ_t^P is the Lagrange multiplier associated with household's budget constraint (2). One can combine household's first-order conditions with respect to consumption (3) and bank deposits (4) to obtain their Euler equation. Equation (5) describes household's Euler equation for housing and

links today's housing price to the utility it provides plus the expected capital gain. Equation (6) describes household's consumption-leisure tradeoff. First order conditions of the problem are derived in the Appendix C.

3.2 ENTREPRENEURS

Following Iacoviello (2005) and Liu, Wang, and Zha (2013), entrepreneur j maximizes the utility obtained from consuming the non-durable consumption goods

$$\mathbb{E}_0 \sum_{t=0}^{\infty} (\beta^E)^t \log (C_{j,t}^E - \gamma^E C_{j,t-1}^E) \quad (7)$$

where β^E and γ^E are as defined before. I assume that entrepreneurs are more impatient than the (patient) households, that is, $\beta^E < \beta^P$. Entrepreneurs face a collateral constraint as in Kiyotaki and Moore (1997) that limits the borrowing of each entrepreneur to a fraction of their assets

$$\int_0^1 R_{k,t}^L l_{jk,t} dk \leq \theta a_{j,t} \quad (8)$$

Here, $l_{jk,t}$ denotes entrepreneur j 's loan from bank k , $a_{j,t}$ denotes the expected value of entrepreneur j 's assets, θ is a loan-to-value (LTV) ratio and $R_{k,t}^L$ is the bank-specific lending rate.

Expected value of entrepreneur's assets $a_{j,t}$ is given by

$$a_{j,t} = \mathbb{E}_t (Q_{t+1}^H H_{j,t}^E + Q_{t+1}^K K_{j,t}) \quad (9)$$

In the above equation, Q_t^K denotes the value of installed capital in units of consumption goods, $K_{j,t}$ is stock of capital and $H_{j,t}^E$ stock of land or real estate.

A standard theoretical view holds that credit relationships and collateral-based borrowing constraints are substitutes: as a bank's informational advantage deepens through a relationship, its reliance on hard collateral should diminish in favor of soft-information lending (Boot and Thakor, 1994). This substitution view is a plausible intuition but is neither the unique nor dominant prediction of banking theory. Rajan and Winton (1995) demonstrate that collateral and monitoring — the informational basis of relationship lending — operate as theoretical complements under realistic conditions.⁷ Using the euro area credit registry AnaCredit, Degryse, De Jonghe, Laeven,

⁷In Rajan and Winton (1995) framework, by making a loan's effective priority contingent on private information obtained through monitoring, the selective ability to enforce collateral requirements gives banks an additional reason to invest in ongoing information acquisition. Their key prediction is that collateral enforcement is most

and Zhao (2025) document that over 70 percent of corporate credit amounts are collateralized across euro area countries where bank-firm relationships are the dominant form of credit intermediation (Kosekova, Maddaloni, Papoutsis, and Schivardi, 2025). Real estate is the empirically dominant collateral type, driving the aggregate collateral stock across most countries. The collateral constraint also plays a specific non-redundant mechanical role in the model: it links the entrepreneur’s borrowing capacity to the expected value of productive capital and commercial real estate, making credit supply sensitive to asset prices and investment conditions. See also Chaney, Sraer, and Thesmar (2012) and Liu, Wang, and Zha (2013).

Entrepreneurs have deep habits in banking relationships and I let $x_{j,t}$ denote entrepreneur j ’s effective or habit-adjusted borrowing. Given the continuum of banks in the economy who compete under monopolistic competition,⁸ this can be written as deep habit-adjusted Dixit and Stiglitz (1977) aggregator⁹

$$x_{j,t} = \left[\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right]^{\frac{\xi}{\xi-1}} \quad (10)$$

where stock of habits $s_{k,t-1}$ evolves according to¹⁰

$$s_{k,t-1} = \rho_s s_{k,t-2} + (1 - \rho_s) l_{k,t-1} \quad (11)$$

Here, $\gamma^L \in (0, 1)$ denotes the degree of habit formation in demand for loans and $\rho_s \in (0, 1)$ measures the persistence of these habits. The term $\gamma^L s_{k,t-1}$ is intended to capture the borrower hold-up effect. The parameter ξ denotes the elasticity of substitution between loans from different banks and is thus a measure of the market power of each individual bank, which is necessary for relationship-based credit and for forward-looking lending incentives to matter.¹¹

The deep habits framework is a parsimonious and deliberately reduced-form representation of

likely precisely when a lender’s monitoring-derived private information is adverse about the borrower’s condition. In the model, an adverse revision in the repayment-quality state, whether through the realized shock or through the advance information component (explained in Section 3.3), represents this type of adverse private information signal about future borrower repayment prospects. Consistent with their prediction that adverse monitoring information triggers collateral enforcement, Ertan (2025) shows that banks subject to ECL adoption, which formalizes adverse forward-looking credit quality assessment, increase collateral requirements for SME borrowers.

⁸Imperfect substitutability across bank loans is required for lending relationships and intertemporal incentives to arise. Significant empirical evidence exists for substantial product differentiation in banking, reflecting differences in monitoring, information production and borrower-specific services, see Kim, Kristiansen, and Vale (2005) and Aliaga-Díaz and Olivero (2010), among many others.

⁹Notice that when $\gamma^L = 0$, Equation (10) reduces to $x_{j,t} = \left[\int_0^1 (l_{jk,t})^{\frac{\xi-1}{\xi}} dk \right]^{\frac{\xi}{\xi-1}}$ in which case the model boils down to the benchmark case with no borrower hold-up.

¹⁰When $\rho_s = 0$, Equation (11) reduces to $s_{k,t-1} = l_{k,t-1}$, meaning that deep habit term entering Equation (10) reduces to the last period aggregate amount of loans from the bank k .

¹¹Empirical evidence showing market power in loan markets is extensive; see Fama (1985) and Claessens and Laeven (2004), among others.

credit relationships in a DSGE setting, and this paper uses it as such. The framework does not model the precise micro-foundations of information asymmetries, the sequential stages of relationship formation, or the explicit renegotiation of contract terms over time. For this paper’s specific question — how forward-looking revisions in repayment expectations interact with the continuation value and captive demand embedded in existing lending relationships — these features are not required. What the paper’s mechanism does require is: (i) a persistent captive component of loan demand that reduces the price sensitivity of credit and concentrates adjustment on quantities; (ii) a shadow value of maintaining lending relationships that responds to forward-looking expectations about future relationship rents; and (iii) endogenous market power that allows banks to raise spreads without proportionate loss of market share. Deep habits deliver all three in a tractable general equilibrium framework, making them the appropriate modeling tool for this specific question. A fully microfounded model of information asymmetries with explicit bank-borrower matching and endogenous relationship formation would introduce substantial additional complexity — requiring a heterogeneous-agent structure — without materially altering the paper’s core result, which depends on the properties of continuation values and captive demand rather than on the micro-foundation of how those properties arise. The deep habits approach follows the methodology of an established literature ([Aliaga-Díaz and Olivero, 2010](#); [Aksoy, Basso, and Coto-Martinez, 2013](#); [Melina and Villa, 2014, 2018](#); [Ravn, 2016](#); [Airaudo and Olivero, 2019](#); [Shapiro and Olivero, 2020](#); [Sharma, 2025, 2026](#)) precisely because it isolates the macroeconomic implications of persistent lending ties without requiring a fully structural model of relationship formation.

Given his total need for financing $x_{j,t}$, each entrepreneur chooses $l_{jk,t}$ to solve the following problem

$$\min_{l_{jk,t}} \int_0^1 R_{k,t}^L l_{jk,t} dk \quad (12)$$

subject to collateral constraint (8) and his effective borrowing (10). The first order condition associated with this problem gives entrepreneur j ’s optimal demand for loans from bank k

$$l_{jk,t} = \underbrace{\left(\frac{R_{k,t}^L}{R_t^L} \right)^{-\xi} x_t}_{\text{price-sensitive demand}} + \underbrace{\gamma^L s_{k,t-1}}_{\text{captive relationship demand}} \quad (13)$$

where $R_t^L \equiv \left[\int_0^1 (R_{k,t}^L)^{1-\xi} dk \right]^{\frac{1}{1-\xi}}$ is the aggregate lending rate. [Equation \(13\)](#) has an intuitive economic meaning and states that $l_{jk,t}$ is higher, the cheaper is borrowing from k th bank (i.e.,

lower $\frac{R_{k,t}^L}{R_t^L}$) and/or the stronger bank-firm relationship established with that bank (i.e., larger γ^L and/or $s_{k,t-1}$).

Production function of each entrepreneur is

$$Y_{j,t} = A_t (N_{j,t})^{1-\alpha} \left\{ (H_{j,t-1}^E)^\phi (K_{j,t-1})^{1-\phi} \right\}^\alpha \quad (14)$$

where $Y_{j,t}$ is output, $N_{j,t}$ is labor input, $\alpha, \phi \in (0, 1)$ are factor shares and A_t is a TFP shock. . The evolution of capital obeys the following law of motion

$$K_{j,t} = (1 - \delta) K_{j,t-1} + \left[1 - \frac{\Omega}{2} \left(\frac{I_{j,t}}{I_{j,t-1}} - 1 \right)^2 \right] I_{j,t} \quad (15)$$

where $I_{j,t}$ is firm j 's investment level, $\delta \in (0, 1)$ the rate of depreciation of capital stock and $\Omega > 0$ is a cost adjustment parameter. The entrepreneur faces the following budget constraint

$$C_{j,t}^E + \int_0^1 R_{k,t-1}^L l_{jk,t-1} dk \leq Y_{j,t} - W_t N_{j,t} - I_{j,t} - Q_t^H (H_{j,t}^E - H_{j,t-1}^E) + x_{j,t} \quad (16)$$

After imposing symmetric equilibrium, the FOCs of the entrepreneurs are

$$\lambda_t^E = \frac{1}{C_t^E - \gamma^E C_{t-1}^E} - \beta^E \mathbb{E}_t \frac{\gamma^E}{C_{t+1}^E - \gamma^E C_t^E} \quad (17)$$

$$\lambda_t^E = \beta^E \mathbb{E}_t \lambda_{t+1}^E R_t^L + \mu_t^E R_t^L \quad (18)$$

$$W_t = (1 - \alpha) \frac{Y_t}{N_t} \quad (19)$$

$$\lambda_t^E Q_t^H = \beta^E \mathbb{E}_t \left[\lambda_{t+1}^E \left(Q_{t+1}^H + \alpha \phi \frac{Y_{t+1}}{H_t^E} \right) \right] + \mu_t^E \theta \mathbb{E}_t Q_{t+1}^H \quad (20)$$

$$\kappa_t^E = \alpha (1 - \phi) \beta^E \mathbb{E}_t \left(\frac{\lambda_{t+1}^E Y_{t+1}}{K_t} \right) + \beta^E (1 - \delta) \mathbb{E}_t \kappa_{t+1}^E + \mu_t^E \theta \mathbb{E}_t Q_{t+1}^K \quad (21)$$

$$\lambda_t^E = \kappa_t^E \left[1 - \frac{\Omega}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 - \Omega \frac{I_t}{I_{t-1}} \left(\frac{I_t}{I_{t-1}} - 1 \right) \right] + \beta^E \Omega \mathbb{E}_t \left[\kappa_{t+1}^E \left(\frac{I_{t+1}}{I_t} \right)^2 \left(\frac{I_{t+1}}{I_t} - 1 \right) \right] \quad (22)$$

where μ_t^E , κ_t and λ_t^E are Lagrange multipliers associated with entrepreneur's collateral constraint (8), law of motion of capital (15) and entrepreneur's budget constraint (16). Entrepreneur's first order conditions with respect to consumption (17) and loans (18) may be combined to derive his Euler equation for consumption. Equation (19) describes entrepreneur's optimal demand for labor. Entrepreneur's Euler equation for land and capital are described by Equations (20)

and (21), respectively which relate their price today to their expected resale value tomorrow plus the payoff obtained by holding them for a period as given by their marginal productivity and their ability to serve as a collateral. Finally, entrepreneur's Euler equation for the investment is given by (22). All the derivations of first order conditions have been relegated to [Appendix C](#).

3.3 BANKING SECTOR

Banks in this model accept deposits from households and make loans to entrepreneurs. Banks operate in a monopolistically-competitive lending market and a perfectly-competitive deposit market. Each individual bank k chooses its lending rate $R_{k,t}^L$ and its demand for deposits $D_{k,t}$. Its profit function is given by

$$\Pi_{k,t} = \Psi_t R_{k,t-1}^L L_{k,t-1} + \int_0^1 D_{ik,t} di - L_{k,t} - R_{t-1}^D \int_0^1 D_{ik,t-1} di \quad (23)$$

where $L_{k,t}$ denotes total loans made by bank k to all entrepreneurs, that is, $L_{k,t} \equiv \int_0^1 l_{jk,t} dj$ and Ψ_t denotes loan repayment quality and scales the fraction of loans that are repaid.

3.3.1 REPAYMENT QUALITY AND LENDER OUTLOOK

I model loan repayment quality as a persistent state variable that directly enters banks' profit maximization problem. This variable summarizes the fraction of loans expected to be repaid and captures underlying borrower credit quality as assessed by the lender. Lending decisions depend on expected future repayments, so information about the future evolution of repayment quality affects current credit supply and pricing. Banks form rational expectations about its future evolution, and these expectations enter both the loan supply condition and the pricing condition ([Ma, Paligorova, and Peydro, 2021](#); [Falato and Xiao, 2024](#); [Farroni and Tozzo, 2024](#)). Because lending terms depend on expected repayments, shifts in lender expectations alter credit supply and pricing even in the absence of contemporaneous changes in realized loan performance ([Norden and Weber, 2010](#); [Bocola, 2016](#)).

The law of motion for repayment quality allows for informational shocks that affect lenders' outlook before realizations. Formally, repayment quality evolves as

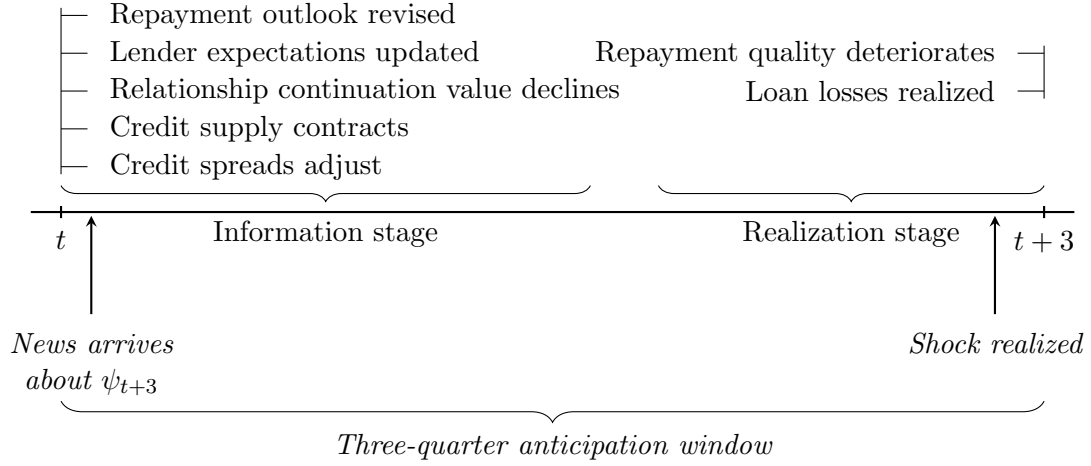
$$\log \Psi_t = (1 - \rho_\Psi) \log \Psi + \rho_\Psi \log \Psi_{t-1} + \sigma_\Psi \epsilon_{\Psi,t} + \sigma_{\text{info}} \epsilon_{\text{info},t-3} \quad (24)$$

which allows for the possibility that it may respond to information about future repayment quality with a lag between outlook revision and realization. The variable encompasses both a realized component (the contemporaneous shock $\epsilon_{\Psi,t}$) and the materialization of information shocks that arrived three periods earlier (the shock $\epsilon_{\text{info},t-3}$). Lenders' expectation of future repayment quality $\mathbb{E}_t \Psi_{t+h}$ are revised when new information $\epsilon_{\text{info},t}$ arrives. This specification captures the idea that lenders' outlook can deteriorate ahead of actual credit losses, thereby tightening lending conditions through anticipation alone. The three-period information horizon is consistent with [Norden and Weber \(2010\)](#), who show that early warning signals extracted from borrower account activity predict defaults up to twelve months in advance and serve as the basis for loan pricing, credit limit management, and loss provisioning decisions. [Appendix A](#) shows that the results are qualitatively unchanged under alternative information horizons.

3.3.2 REPAYMENT QUALITY AS THE PRIMITIVE STATE OF CREDIT SUPPLY

Banks' lending decisions are fundamentally forward-looking. Before extending or renewing credit, banks continually assess the likelihood that borrowers will repay their obligations and revise these assessments as new information becomes available. Lending decisions therefore begin not necessarily with the bank's own balance sheet but with information about borrowers' future repayment prospects. Existing macro-finance models such as [Gerali, Neri, Sessa, and Signoretti \(2010\)](#); [Gertler and Karadi \(2011\)](#) and related frameworks typically abstract from this informational stage and instead model shocks to bank capital or intermediary net worth. These frameworks have been successful in explaining how realized losses weaken intermediary balance sheets and subsequently restrict credit supply. However, they begin at a later stage of the financial transmission mechanism. The objective of this paper is different. Rather than asking how banks respond after their capital position has deteriorated, I ask how banks adjust lending once they receive adverse information about borrowers but before those losses materialize. The distinction is important because financial crises rarely begin with banks suddenly observing lower capital. Instead, banks first observe signals suggesting that repayment quality is likely to deteriorate, revise their expectations accordingly, and then alter lending behaviour ([Figure 1](#)). Repayment quality therefore represents the primitive informational object underlying subsequent credit decisions, while intermediary capital summarizes the cumulative consequences of those decisions once defaults have occurred. The choice of repayment quality as the primitive state is therefore dictated by the economic question addressed in this paper rather than by a claim that intermediary balance sheets are unimportant.

FIGURE 1: TIMELINE OF INFORMATION ARRIVAL AND SHOCK REALIZATION



Banks devote substantial resources to collecting precisely this type of information, and the contractual structure of institutional lending is specifically designed to incentivize them to do so. [Rajan and Winton \(1995\)](#) demonstrate that covenants and collateral are not merely risk-management devices but contractual instruments that increase a bank's incentive to monitor: by making a loan's effective maturity contingent on covenant-verifiable information and its effective priority contingent on monitoring-derived private information about the borrower's condition, loan contracts give banks a direct payoff from ongoing repayment quality assessment. The monitoring process that produces Ψ_t -type information is therefore contractually incentivized, not merely an institutional practice. Consistent with this, a large banking literature establishes that information production through monitoring and repeated interaction is a central economic function of financial intermediaries ([Diamond, 1984](#); [Rajan, 1992, 1994](#); [Berger and Udell, 1995](#); [Boot, 2000](#); [Keys, Mukherjee, Seru, and Vig, 2010](#); [Hertzberg, Liberti, and Paravisini, 2010](#); [Norden and Weber, 2010](#)). The information obtained is incorporated into internal borrower ratings, expected repayment forecasts, loan pricing, and monitoring decisions well before defaults occur, with [Norden and Weber \(2010\)](#) showing that monitoring-derived signals predict defaults up to twelve months in advance. The accounting literature emphasizes that banks also revise expected credit losses as new information arrives through formal provisioning systems: under IFRS 9 and CECL, forward-looking expected losses rather than realized defaults determine current provisions, giving institutional form to the forward-looking assessment that repayment quality represents ([Bushman and Williams, 2012](#); [Beatty and Liao, 2014](#)). [Kim, Kim, Kleymenova, and Li \(2026\)](#) provide causal evidence that this formal requirement improves banks' information production, and [Ertan \(2025\)](#) show that it generates pre-emptive credit tightening before defaults materialize; [Section 2](#)

discusses both in detail. These institutional features together imply that banks explicitly observe and continuously update information about future repayment quality — the natural primitive state — while their future net-worth position is itself an endogenous consequence of those repayment outcomes.

The framework studied here therefore addresses an earlier stage of transmission than intermediary capital models: it explains why banks curtail lending immediately after receiving negative information about future repayment quality, even when contemporaneous loan losses and balance-sheet deterioration remain limited. This distinction also clarifies why the repayment quality shock is not merely a relabeled credit supply shock in the sense of [Ferrante, Prestipino, and Schott \(2025\)](#), who show that in a [Gertler and Karadi \(2011\)](#) framework, a net-worth shock is isomorphic to a credit supply shock. The decline in repayment quality differs for three reasons. First, it enters through the bank’s profit function rather than a leverage or net-worth constraint. Second, it is causally upstream of net worth: repayment quality deteriorates before losses accumulate and reduce net worth, and monitoring-derived signals precede defaults by up to twelve months ([Norden and Weber, 2010](#)), a temporal gap that makes advance information about repayment quality institutionally grounded in a unique way. Third, and decisively, repayment quality admits an information shock structure precisely because banks receive forward-looking information about future repayment quality through the monitoring process that [Rajan and Winton \(1995\)](#) show their contracts are designed to incentivize; an information shock to net worth would represent information about a downstream balance-sheet outcome rather than the borrower-level repayment information that motivates the mechanism studied here. These three distinctions together imply that repayment quality and a net-worth shock are not observationally equivalent in their timing or in the mechanism through which they affect credit supply.

The second distinguishing feature of the paper is the presence of relationship lending. In a model without lending relationships, adverse information about repayment quality generates a relatively straightforward response: banks anticipate lower expected repayment, raise lending spreads, and reduce the quantity of credit supplied. Once relationship lending is introduced, the mechanism changes considerably. Banks now value not only current loan repayment but also the continuation value of long-term relationships embodied in future customer capital, future markups, habit stock, and expected relationship rents. Deterioration in repayment outlook therefore affects both expected loan repayment and the value of maintaining lending relationships. This interaction between forward-looking information and relationship continuation values gen-

erates a qualitatively different propagation mechanism from that present in standard financial accelerator models (Bernanke, Gertler, and Gilchrist, 1999; Gerali, Neri, Sessa, and Signoretti, 2010; Gertler and Karadi, 2011; Jermann and Quadrini, 2012; Christiano, Motto, and Rostagno, 2014): the captive demand structure concentrates credit adjustment on quantities while allowing spreads to largely normalize, producing the spread-quantity dissociation that is the paper’s central structural prediction and that does not arise without the relationship lending structure. The repayment quality state should therefore not be viewed as a reduced-form credit-supply disturbance: the informational component embedded in the same shock generates substantially more persistent contractions in credit and output when transmitted through relationship continuation values than when it affects the same otherwise identical relationship lending economy through realized losses alone, as shown in Section 5.1. This comparison demonstrates that the paper’s results arise from the interaction between forward-looking repayment information and the dynamic incentives created by long-term lending relationships. The mechanism provides a resolution to an apparent tension in the role of relationship lending by making the continuation value of relationships simultaneously the channel of transmission and the source of the moderating effect.

3.3.3 BANK BALANCE SHEET AND LOAN DEMAND

The balance sheet of bank k is

$$L_{k,t} = \int_0^1 D_{ik,t} di \quad (25)$$

where $L_{k,t}$ denotes total loans made by bank k to all entrepreneurs, that is, $L_{k,t} \equiv \int_0^1 l_{jk,t} dj$. Banks in this model accept deposits from households and make loans to entrepreneurs, intermediating deposits one-for-one into loans without accumulating net worth or equity.¹² Ertan (2025, p. 445) examines banks adjusting credit supply in response to formal forward-looking credit quality assessment and finds that post introduction of ECL model as a part of IFRS 9, “the main effects do not vary dramatically across banks with high and low capital adequacy” and interprets this as “evidence that regulatory capital adequacy is not a primary channel for (and objective of) banks’ lending decisions post ECL.” The absence of net worth dynamics is also an identifying restriction: by abstracting from the balance-sheet channel, the model isolates the expectations channel — the effect of forward-looking revisions in repayment quality on current credit supply — as the independent mechanism under study. If bank net worth were included alongside the repay-

¹²Beyond this simplifying abstraction, deposits account for approximately 93 percent of total bank liabilities in the US banking system (Doerr, Drechsel, and Lee, 2026), making them the dominant source of funding.

ment quality state, the credit dynamics of the model would reflect a mixture of the expectations channel and the balance-sheet channel, making it impossible to identify the contribution of each separately. The framework is therefore deliberately stripped to the elements necessary to answer the paper’s question: how lenders’ forward-looking repayment assessments, operating through the continuation value of lending relationships, generate persistent post-crisis credit contractions.

The abstraction also clarifies the paper’s relationship to intermediary balance-sheet models such as [Gertler and Karadi \(2011\)](#) and [Brunnermeier and Sannikov \(2014\)](#): those papers study credit dynamics after losses have already been realized and balance sheets impaired. The present paper studies an earlier stage — how adverse information about future repayment quality tightens credit before any loss materializes. These are complementary rather than competing questions, and abstracting from net worth is what permits the earlier stage to be studied in isolation. The paper does not aim to replicate the quantitative properties of realized-loss episodes or the nonlinear dynamics of severe financial crises, which are the domain of models with explicit net-worth dynamics. It aims to isolate a forward-looking channel that such models do not contain.

Each bank takes the demand for its loans as given

$$L_{k,t} = \int_0^1 l_{jk,t} dj = \int_0^1 \left[\left(\frac{R_{k,t}^L}{R_t^L} \right)^{-\xi} x_t + \gamma^L s_{k,t-1} \right] dj \quad (26)$$

where loan demand features external deep habits.¹³ Banks choose $D_{k,t}$ and $R_{k,t}^L$ to maximize their profits subject to (25) and (26). The derivations of banks’ FOCs are contained in [Appendix C](#).

3.3.4 SHADOW VALUE OF LENDING RELATIONSHIPS

A key object in this problem is the shadow value of extending an additional dollar of credit, denoted ϱ_t^E . This shadow value summarizes the expected profitability of a lending relationship, taking into account both current repayment conditions and the future demand for bank credit induced by relationship persistence. In a symmetric equilibrium, banks’ optimality conditions imply

$$\varrho_t^E = \mathbb{E}_t q_{t,t+1} \left[\underbrace{\left(\Psi_{t+1} R_t^L - R_t^D \right)}_{\text{current loan profitability}} + \underbrace{\gamma^L (1 - \rho_s) \mathbb{E}_t \varrho_{t+1}^E}_{\text{relationship continuation value}} \right] \quad (27)$$

¹³Lending relationships are modeled using external deep habits in banking, following [Aliaga-Díaz and Olivero \(2010\)](#) and the subsequent literature. With forward-looking agents, external habits preserve time consistency and generate a hold-up effect in equilibrium, as borrowers internalize neither the cross-sectional habit stock nor its impact on future lending terms. This formulation captures persistent lending relationships and intertemporal incentives in a tractable way, without requiring banks to commit to future pricing. See [Ravn, Schmitt-Grohé, and Uribe \(2006, pp. 213–214\)](#) for further discussion.

where $\mathbb{E}_t q_{t,t+1} = \beta^P \mathbb{E}_t \frac{\lambda_{t+1}^P}{\lambda_t^P}$ is the stochastic discount factor of bank owners. This condition shows that the value of lending today depends not only on the expected net repayment from current loans but also on how current lending affects future lending opportunities. Through the deep habits mechanism, extending additional credit today increases future loan demand from the same borrower, making the lending relationship itself an asset whose value evolves over time. Importantly, expected repayment quality $\mathbb{E}_t \Psi_{t+1}$ directly scales the payoff from lending, implying that shifts in lender outlook alters the shadow value of credit even in the absence of contemporaneous changes in realized defaults.

3.3.5 PRICING CHANNEL

Banks' pricing decision balances the expected gains from higher lending rates against the loss of market share induced by borrower substitution. The corresponding optimality condition is¹⁴

$$\xi \varrho_t^E x_t \frac{1}{R_t^L} = \mathbb{E}_t q_{t,t+1} \Psi_{t+1} L_{k,t} \quad (28)$$

This condition equates the marginal cost of raising lending rates, captured by the reduction in loan demand weighted by the value of a lending relationship, to the expected marginal benefit from higher repayments. Because expected repayment quality $\mathbb{E}_t \Psi_{t+1}$ enters directly into the benefit of higher rates, shifts in lender outlook affect both the quantity and pricing of credit through a common valuation channel.

Together, these conditions highlight how lender outlook propagate through lending relationships. A deterioration in expected repayment quality lowers the shadow value of lending, tightens credit supply, and raises lending spreads, even when fundamentals are unchanged. The persistence induced by lending relationships amplifies this effect by spreading the impact of outlook shifts over time.

¹⁴To see why Equation (28) features x_t , consider that, from Equation (13),

$$l_{jk,t} = \left(\frac{R_{k,t}^L}{R_t^L} \right)^{-\xi} x_t + \gamma^L s_{k,t-1}$$

Plugging this in bank's optimization problem and taking derivative with respect to $R_{k,t}^L$ gives the corresponding FOC.

3.4 MECHANISM: FORWARD-LOOKING REPAYMENT EXPECTATIONS AND RELATIONSHIP LENDING

The central mechanism operates through the continuation value of lending relationships. Banks value a loan not only for its current-period interest margin but also for the future rents generated by maintaining the relationship. Forward-looking information about future repayment quality can therefore affect current lending before repayment losses are realized.

To make this channel transparent, define

$$\mathcal{V}_t \equiv \frac{\mathbb{E}_t[q_{t,t+1}\varrho_{t+1}^E]}{\mathbb{E}_t[q_{t,t+1}]} \quad (29)$$

where ϱ_t^E is the bank's shadow value of lending to an entrepreneur and $q_{t,t+1}$ is the stochastic discount factor. The term $\mathcal{V}_t$ therefore summarizes the expected discounted value of the future lending relationship from the bank's perspective. The parameter γ^L governs the strength of relationship lending, while ρ_s governs the persistence of the relationship-specific lending stock.

Combining the bank's optimality conditions for loan supply and pricing, [Equations \(27\)](#) and [\(28\)](#), gives the lending-rate condition

$$R_t^L = \frac{\left[R_t^D - \gamma^L(1 - \rho_s) \frac{\mathbb{E}_t[q_{t,t+1}\varrho_{t+1}^E]}{\mathbb{E}_t[q_{t,t+1}]} \right] \left[\xi \left(1 - \gamma^L \rho_s \frac{s_{t-2}}{l_t} - \gamma^L(1 - \rho_s) \frac{l_{t-1}}{l_t} \right) \right]}{\Psi_{t+1} \left[\xi \left(1 - \gamma^L \rho_s \frac{s_{t-2}}{l_t} - \gamma^L(1 - \rho_s) \frac{l_{t-1}}{l_t} \right) - 1 \right]} \quad (30)$$

Define

$$\Theta_t \equiv 1 - \gamma^L \rho_s \frac{s_{t-2}}{l_t} - \gamma^L(1 - \rho_s) \frac{l_{t-1}}{l_t} \quad (31)$$

Using [Equation \(29\)](#), the lending-rate condition becomes

$$R_t^L = \frac{R_t^D - \gamma^L(1 - \rho_s)\mathcal{V}_t}{\Psi_{t+1}} \frac{\xi\Theta_t}{\xi\Theta_t - 1} \quad (32)$$

This condition gives the first step of the mechanism.

PROPOSITION 1 (Continuation value and the lending rate). *Holding R_t^D , Ψ_{t+1} , and Θ_t fixed, and under $\gamma^L > 0$, $\rho_s < 1$, $\Psi_{t+1} > 0$, and $\xi\Theta_t > 1$,¹⁵ the current lending rate is strictly decreasing in*

¹⁵In the neighborhood of steady state, $\Theta = 1 - \gamma^L \rho_s - \gamma^L(1 - \rho_s) = 1 - \gamma^L$, so $\xi\Theta = \xi(1 - \gamma^L) > 1$ is implied by the standard condition $\xi > 1/(1 - \gamma^L)$, which holds for all parameterizations in [Table 1](#) given the large value of ξ .

the continuation value of the lending relationship:

$$\frac{\partial R_t^L}{\partial \mathcal{V}_t} = -\gamma^L(1 - \rho_s) \frac{\xi \Theta_t}{\Psi_{t+1}(\xi \Theta_t - 1)} < 0 \quad (33)$$

Thus, holding the other arguments of the lending-rate condition fixed, a deterioration in the value of maintaining a lending relationship raises the current lending rate.

PROOF. See [Appendix B](#). ■

The second step is how forward-looking repayment information enters $\mathcal{V}_t$. The bank's shadow value of lending satisfies

$$\varrho_t^E = \mathbb{E}_t [q_{t,t+1} (\Psi_{t+1} R_t^L - R_t^D + \gamma^L(1 - \rho_s) \varrho_{t+1}^E)] \quad (34)$$

The first two terms capture the current-period return from lending, whereas the final term captures the value of maintaining the lending relationship into the future. Hence, repayment quality realized at $t + 1$ affects the current shadow value directly, while information about repayment quality farther in the future can reach today's lending decision only through the continuation-value term.

This distinction is central to the anticipated deterioration experiment. Suppose that at date t lenders receive information about Ψ_{t+h} , with $h \geq 2$. Iterating [Equation \(34\)](#) forward shows that the information must pass through $h - 2$ continuation-value links before reaching ϱ_{t+1}^E , which enters $\mathcal{V}_t$. Holding lending rates, discount factors, and all other equilibrium objects fixed, the direct effect is

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} = [\gamma^L(1 - \rho_s)]^{h-2} \frac{\mathbb{E}_t \left[q_{t,t+1} \left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} R_{t+h-1}^L \right]}{\mathbb{E}_t [q_{t,t+1}]} > 0 \quad (35)$$

The $h - 2$ exponent reflects the number of continuation-value links between the shadow value dated $t + 1$ and the current-period return generated by Ψ_{t+h} . For the baseline anticipation horizon $h = 3$, this gives

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+3}} \right|_{\text{direct}} = \gamma^L(1 - \rho_s) \frac{\mathbb{E}_t [q_{t,t+1} q_{t+1,t+2} q_{t+2,t+3} R_{t+2}^L]}{\mathbb{E}_t [q_{t,t+1}]} > 0 \quad (36)$$

PROPOSITION 2 (Advance information and the continuation value). *For an anticipation horizon $h \geq 2$, and holding lending rates, discount factors, and all other equilibrium objects fixed, the direct effect of expected repayment quality at $t + h$ on the continuation value is given by Equation (35) and is strictly positive:*

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} > 0 \quad (37)$$

Consequently, adverse information about future repayment quality lowers the continuation value of the lending relationship.

Combining Propositions 1 and 2 gives the central prediction of the mechanism: adverse information about sufficiently distant future repayment quality lowers the value of the lending relationship and thereby raises the current lending rate. The response occurs before the deterioration in repayment quality is realized. In this sense, the model generates *pre-emptive credit tightening*: current lending responds to the expected future profitability of maintaining the lending relationship rather than only to contemporaneous repayment losses.

PROOF. See Appendix B. ■

The role of relationship lending can be made explicit by combining the two derivatives. For $h \geq 2$, the direct effect of advance information on the current lending rate is

$$\left. \frac{\partial R_t^L}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} = - [\gamma^L (1 - \rho_s)]^{h-1} \frac{\xi \Theta_t}{\Psi_{t+1} (\xi \Theta_t - 1)} \frac{\mathbb{E}_t \left[q_{t,t+1} \left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} R_{t+h-1}^L \right]}{\mathbb{E}_t [q_{t,t+1}]} < 0 \quad (38)$$

PROPOSITION 3 (Relationship lending and the transmission of advance information). *For $h \geq 2$, holding the remaining equilibrium objects fixed, the direct response of the current lending rate to advance repayment information through the relationship-continuation channel is given by Equation (38). Its magnitude contains $h - 1$ factors of $\gamma^L (1 - \rho_s)$: $h - 2$ arise from transmission of the information into the continuation value and one arises from the sensitivity of the lending rate to that continuation value.*

The proposition identifies the transmission margin rather than a general comparative-static result for the equilibrium economy. In particular, it does not imply that relationship lending is destabilizing in general. The same continuation value that transmits advance information also makes lending relationships valuable: when future relationship rents are valuable, the bank has an incentive to preserve the relationship. An adverse revision in repayment prospects erodes that

value and induces tighter lending.

PROOF. See [Appendix B](#). ■

The arm's-length benchmark provides a clean counterfactual.

COROLLARY 3.1 (Arm's-length lending eliminates the advance-information continuation channel).

In the arm's-length benchmark $\gamma^L = 0$, advance information about Ψ_{t+h} for $h \geq 2$ has no direct effect on the current lending rate through the continuation-value channel:

$$\left. \frac{\partial R_t^L}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}, \gamma^L=0} = 0 \quad (39)$$

The corollary makes precise the role of relationship lending in the mechanism. Information about a sufficiently distant deterioration can affect current credit supply because it changes the value of an ongoing lending relationship. Eliminating that relationship-specific continuation value removes this particular channel of transmission.

PROOF. See [Appendix B](#). ■

3.5 AGGREGATION AND MARKET CLEARING

Aggregate resource constraint of the economy is

$$C_t^P + C_t^E + I_t = Y_t \quad (40)$$

The clearing condition for the housing market is

$$H_t^P + H_t^E = H \quad (41)$$

where H is the total fixed supply of housing.

4 MODEL SOLUTION AND PARAMETERIZATION

A period in the model corresponds to a quarter. [Appendices D, E and F](#) report the full set of equilibrium conditions, steady-state relationships, and the log-linearized system. Parameter values are summarized in [Table 1](#). Most parameters follow standard values in the macro literature,

allowing the analysis to isolate the role of information about future deterioration in repayment quality state and its persistence in shaping credit dynamics.

Households and entrepreneurs are assigned different discount factors, as is standard in borrowing models. Habit formation in consumption is set to 0.6, consistent with empirical estimates reported in [Smets and Wouters \(2007\)](#). The Frisch elasticity of labor supply η is set to 1.01, and the weight on housing services in utility ς is set to 0.1, following [Iacoviello \(2005\)](#). The labor income share implies a steady-state capital-output ratio of 1.15, consistent with U.S. data ([Liu, Wang, and Zha, 2013](#)). The land input share in production follows estimates in [Liu, Wang, and Zha \(2013\)](#) and [Iacoviello \(2005\)](#). The investment adjustment cost parameter lies well within the range reported in the literature, which spans values from zero ([Liu, Wang, and Zha, 2013](#)) to above 26 ([Christiano, Motto, and Rostagno, 2010](#)). The capital depreciation rate implies a steady-state non-residential investment-to-output ratio slightly above 0.13, in line with [Beaudry and Lahiri \(2014\)](#). The loan-to-value ratio is set to 0.95, close to the value used in [Iacoviello \(2015\)](#).

Banking-sector parameters follow the deep habits in banking literature. The habit parameter γ^L and the persistence of lending relationships ρ_s are chosen in line with [Aliaga-Díaz and Olivero \(2010\)](#), [Melina and Villa \(2014\)](#), [Melina and Villa \(2018\)](#), [Ravn \(2016\)](#), and [Shapiro and Olivero \(2020\)](#).¹⁶ The elasticity of substitution across loan varieties is set to 190, at the lower end of values used in the literature. Existing studies report values ranging from 190 ([Aliaga-Díaz and Olivero, 2010](#)) to 425 ([Melina and Villa, 2014](#)), with intermediate values used by [Ravn \(2016\)](#) and [Melina and Villa \(2018\)](#). As argued by [Aliaga-Díaz and Olivero \(2010\)](#), loans offered by different banks are likely to be closer substitutes than goods produced by different firms, consistent with the relatively small observed banking markups ([Ravn, 2016](#)). This motivates the use of a high elasticity.

The steady-state level of repayment quality, Ψ_t , is normalized to one. The scale of the information shock, σ_{info} , is set to 0.0019. It is chosen to generate an approximately 25 percent decline in bank lending on impact following a severe adverse revision in lenders' repayment-quality expectations. This target is intended to discipline the *severity* of the credit contraction and is motivated by evidence on the stock of business credit. The closest empirical counterpart to the model's lending variable L_t is commercial and industrial (C&I) loans at US banks which declined from 1.596 trillion in June 2008 to 1.19 trillion by October 2010 during the Global Financial Crisis

¹⁶In [Appendix A \(Figures A.1, A.2, A.3 and A.4\)](#), I vary both parameters and show that the dynamics documented in the paper are robust to these changes.

TABLE 1: PARAMETER VALUES

	Value	Description	Source/Target
β^P	0.995	Discount factor, households	Iacoviello (2005)
β^E	0.95	Discount factor, entrepreneurs	Iacoviello (2005)
$\gamma^i, i = \{P, E\}$	0.6	Habit formation in consumption	Smets and Wouters (2007)
η	1.01	Frisch elasticity of labor	Iacoviello (2005)
ς	0.1	Weight on utility from housing	Iacoviello (2005)
α	0.3	Non-labor share of production	Iacoviello (2005)
ϕ	0.1	Land share of non-labor input	Iacoviello (2005)
Ω	1.85	Investment adjustment cost parameter	Ravn (2016)
δ	0.0285	Capital depreciation rate	Ravn (2016)
θ	0.95	Loan-to-value ratio	Iacoviello (2015)
γ^L	0.72	Deep habit formation in lending	Aliaga-Díaz and Olivero (2010); Melina and Villa (2014, 2018); Ravn (2016); Shapiro and Olivero (2020)
ρ_s	0.85	Persistence of deep habit stock	Aliaga-Díaz and Olivero (2010); Melina and Villa (2014, 2018); Shapiro and Olivero (2020)
ξ	190	Elasticity of substitution between banks	Aliaga-Díaz and Olivero (2010)
Ψ	1	Steady-state repayment quality	Normalization
ρ_Ψ	0.90	Persistence of repayment quality state	Baseline – see text
σ_{info}	0.0019	Scale of repayment outlook revision	25% fall in C&I loans (Board of Governors of the Federal Reserve System (US), 2026, H.8)

(GFC), indicating a 25% drop in bank loans (Board of Governors of the Federal Reserve System (US), 2026, H.8). This decline is smaller than that observed during the Great Depression when the US commercial bank loans fell by roughly 39 percent between July 1929 and December 1932 (Mitchener and Richardson, 2025) and by 58.5 percent from their 1929 peak to the subsequent trough, with loans dropping by more than 20 percent in both 1932 and 1933. Flow measures provide complementary evidence of the severity of the disruption: new syndicated lending fell by 47 percent in 2008:Q4 relative to the preceding quarter and by nearly 80 percent relative to its pre-crisis peak (Ivashina and Scharfstein, 2010). Thus, the 25 percent target represents a severe but historically plausible contraction in business credit, rather than a calibration to any single episode. I distinguish this quantity-based calibration from evidence on loan performance. Non-performing loan (NPL) ratios measure the fraction of outstanding loans that have become

impaired and therefore do not provide a direct quantitative mapping into the stock of lending. I use the evidence that NPLs rise sharply during systemic banking crises — e.g., [Laeven and Valencia \(2013, 2020, 2026\)](#) document that NPLs rise by over 20% of total loans during systemic banking crises — to motivate the interpretation of Ψ_t as repayment quality, but use observed contractions in outstanding credit to discipline σ_{info} .

The persistence parameter of the repayment quality, ρ_{Ψ} , is set to 0.90 in the baseline. [Chen, Hanson, and Stein \(2017\)](#) document a sharp withdrawal of small-business credit by the largest US banks beginning in 2008, followed by a gradual adjustment: aggregate lending in affected counties remained depressed through 2014, while originations hovered at around 50 percent of pre-crisis level, and maturities on small-business credit remained affected through the end of the sample. They attribute the slow adjustment in part to the difficulty of replacing information-intensive lending relationships ([Rajan, 1992](#)) and to the gradual expansion of alternative lenders. This evidence does not identify a structural value for ρ_{Ψ} , but it demonstrates that credit-supply disruptions and their terms can exhibit multi-year persistence. I therefore use $\rho_{\Psi} = 0.90$ as the baseline and increase it to 0.95 in an additional exercise. The latter experiment asks whether greater persistence in the underlying repayment state can prolong the macroeconomic effects of an information-driven deterioration without requiring repeated realized losses ([Cerra and Saxena, 2008](#); [Hoshi and Kashyap, 2015](#)).

5 RESULTS AND DISCUSSION

This section presents the paper’s quantitative results through three experiments, organized by their analytical role. The first and central experiment, in [Section 5.1](#), compares recovery dynamics following anticipated versus realized deterioration in repayment quality within a relationship-based credit economy. This is the paper’s core exercise: the comparison holds fixed the underlying credit deterioration and asks how the timing of information changes the dynamics. The headline quantitative finding emerges here — anticipated deterioration generates a five-to-six-year recovery consistent with the lower bound of the [Reinhart and Rogoff \(2014\)](#) range; realized deterioration of identical magnitude recovers in two to three years. The second experiment, in [Section 5.2](#), compares relationship-based and arm’s-length credit economies under the identical anticipated shock. This is a mechanism-identification exercise that isolates what the relationship lending structure contributes to the transmission of the expectations shock, and not an alternative claim

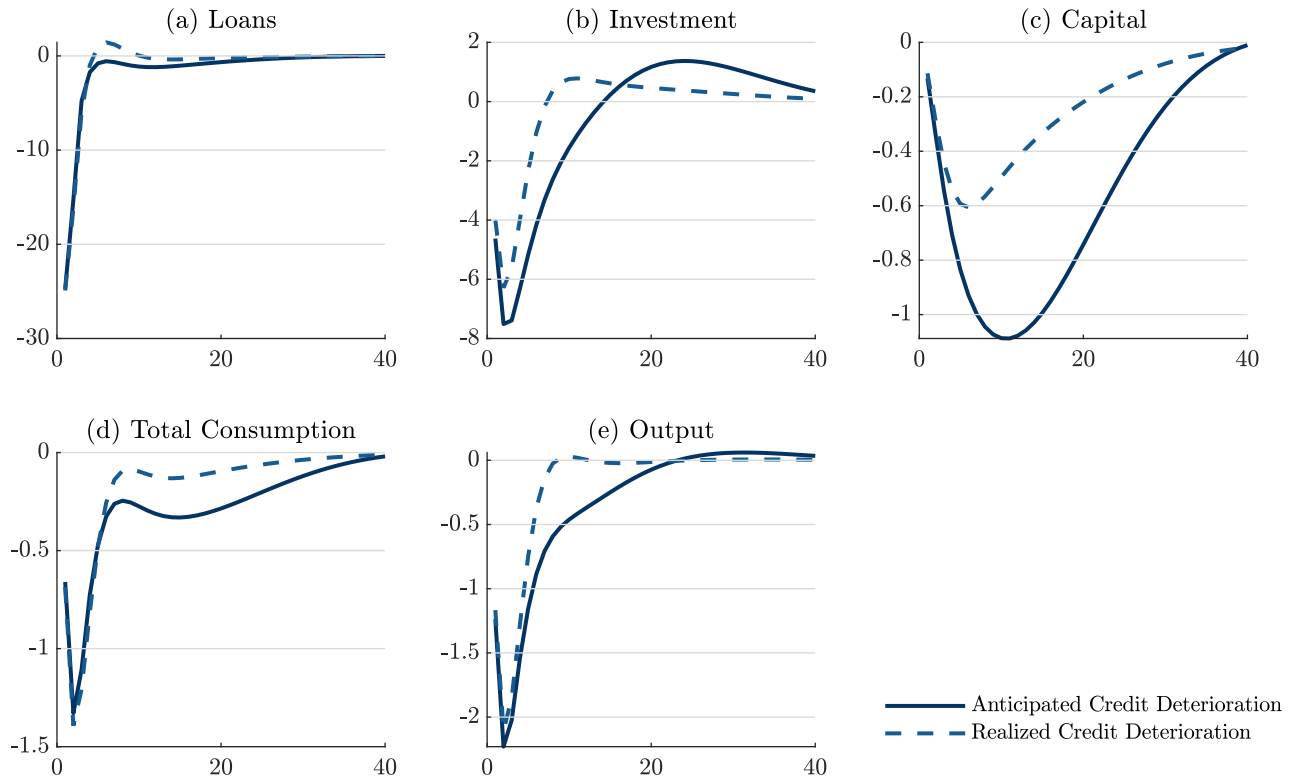
about what generates slow recovery. Though both lending regimes produce protracted recoveries consistent with the [Reinhart and Rogoff \(2014\)](#) five-to-ten-year range, the comparison reveals how the relationship structure shapes the pattern and duration of adjustment by moderating, but importantly not insulating, the impact of an anticipated credit deterioration. The third experiment, in [Section 5.3](#), is an extension: it shows that when the deterioration in repayment outlook is more persistent, the same mechanism generates decade-long stagnation consistent with the most severe historical episodes, even in absence of any additional losses. Throughout all three experiments, the paper’s mechanism — adverse revisions in repayment quality reducing the continuation value of lending relationships, generating pre-emptive credit tightening and a spread-quantity dissociation — operates identically and the structure of the channel remains unchanged.

5.1 ANTICIPATED VERSUS REALIZED CREDIT DETERIORATION

[Figure 2](#) plots impulse response functions following anticipated and realized deterioration in repayment quality within the relationship-based credit economy. By holding the magnitude of the underlying deterioration and the lending structure fixed while varying only when lenders learn about it, this comparison isolates the contribution of forward-looking repayment expectations to recovery duration. Anticipated deterioration generates a five-to-six-year recovery in output — this is the slow recovery the paper explains. It is slow by historical standards, consistent with the lower bound of the [Reinhart and Rogoff \(2014\)](#) range for financial crisis episodes, and substantially longer than the two-to-three-year recovery that realized deterioration of identical magnitude produces. The difference between the two cases — several additional years of depressed credit, investment, and output attributable entirely to the anticipatory component of the shock — constitutes the paper’s central quantitative finding. It establishes that adverse revisions in lenders’ repayment expectations can, by themselves, generate prolonged financial disintermediation and persistent real contractions even in the complete absence of contemporaneous realized credit losses. Models in which credit disruptions affect banks only upon loss realization cannot replicate these dynamics: without the anticipatory component, lending conditions remain unchanged prior to losses and normalize rapidly once losses materialize, ruling out pre-emptive tightening and the persistent recovery slumps the paper documents.

The mechanism underlying these quantitative differences operates through the continuation value of lending relationships ([Figure 3](#)). When lenders receive adverse signals about future repay-

FIGURE 2: MACROECONOMIC RECOVERY UNDER ANTICIPATED VERSUS REALIZED DETERIORATION IN REPAYMENT QUALITY

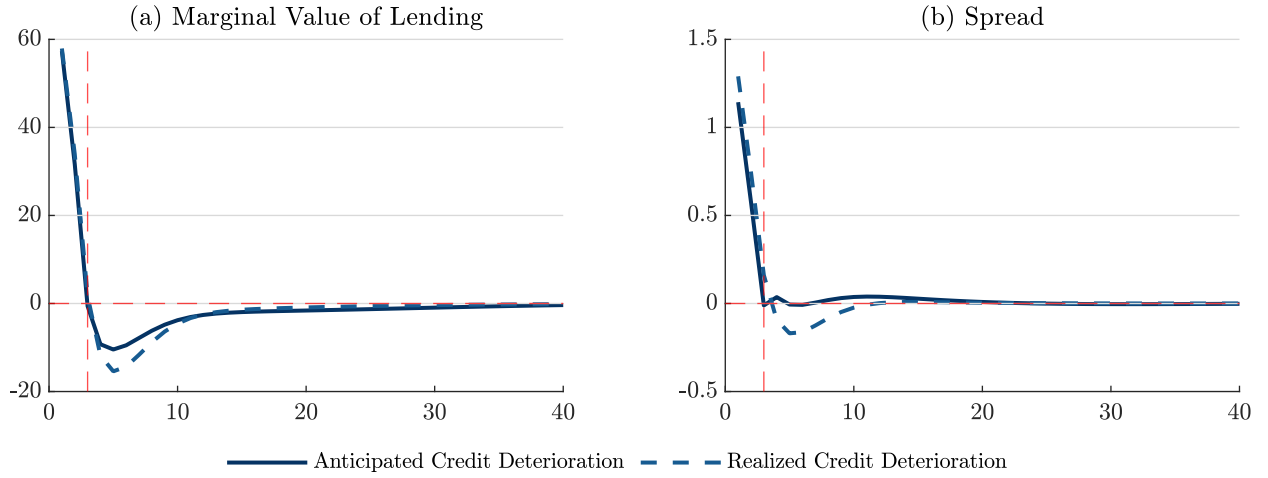


NOTE: Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state.

ment quality, two effects operate simultaneously on impact. The first is a rise in the shadow value of current lending: because future continuation values will fall as Ψ_t deteriorates, the marginal value of maintaining existing lending relationships today — while they still generate positive rents — is higher than the marginal value of those same relationships in future periods. The marginal value of lending therefore spikes sharply on impact, reflecting banks' recognition that current relationship rents are more valuable than the anticipated future rents. The second effect is quantitatively dominant: the anticipated erosion of future continuation values contracts current credit supply. The expected future profitability of maintaining and extending lending relationships falls below the cost of doing so, inducing banks to reduce lending pre-emptively. In equilibrium, credit declines immediately and sharply even as the marginal shadow value of existing relationships rises, because the pre-emptive contraction in new lending is the bank's optimal response to the anticipated future impairment of relationship rents. As adverse expectations persist, the continuation value of relationship lending collapses further: the marginal value of lending turns negative and remains persistently depressed long after credit spreads have normalized. This divergence — spreads reverting while the shadow value of lending stays impaired — is the spread-quantity

dissociation that is the paper’s central empirical prediction.

FIGURE 3: MECHANISM – ANTICIPATED VERSUS REALIZED DETERIORATION IN REPAYMENT QUALITY



NOTE: Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state. Horizontal dashed red line corresponds to 0-line (y-axis). Vertical dashed red line corresponds to period 3 (x-axis).

These findings connect to, but depart importantly from, [Christiano, Motto, and Rostagno \(2014\)](#), who show anticipatory credit contractions in an exercise in a [Bernanke, Gertler, and Gilchrist \(1999\)](#) framework. Their mechanism operates through changes in entrepreneurial risk and external finance premia. Differently from them, the mechanism in this paper instead operates through the continuation value of lending relationships. The repayment-quality state enters directly into banks’ valuation of lending relationships, so adverse news reduces not only expected current lending profitability but also the continuation value of future relationship rents. This generates a persistent decline in credit even after spreads normalize, creating a spread-quantity dissociation that is absent from standard intermediary models without relationship lending and arises from the relationship-lending structure rather than from anticipation per se. This paper’s contribution therefore is not mere anticipation; it is what anticipation does when lending relationships create a continuation value for credit supply. Additionally, the framework speaks to questions that [Christiano, Motto, and Rostagno \(2014\)](#) do not address, including the dual role of relationship lending, lender-outlook effects, and the persistence of post-crisis credit contractions despite the presence of longstanding bank-firm relationships.

These results establish that persistence in post-crisis downturns need not arise from realized balance-sheet impairments. Persistent revisions in lenders’ expectations about future repayment conditions, internalized through relationship-based lending, constitute an independent source of macroeconomic scarring that operates without binding leverage constraints, bank capital con-

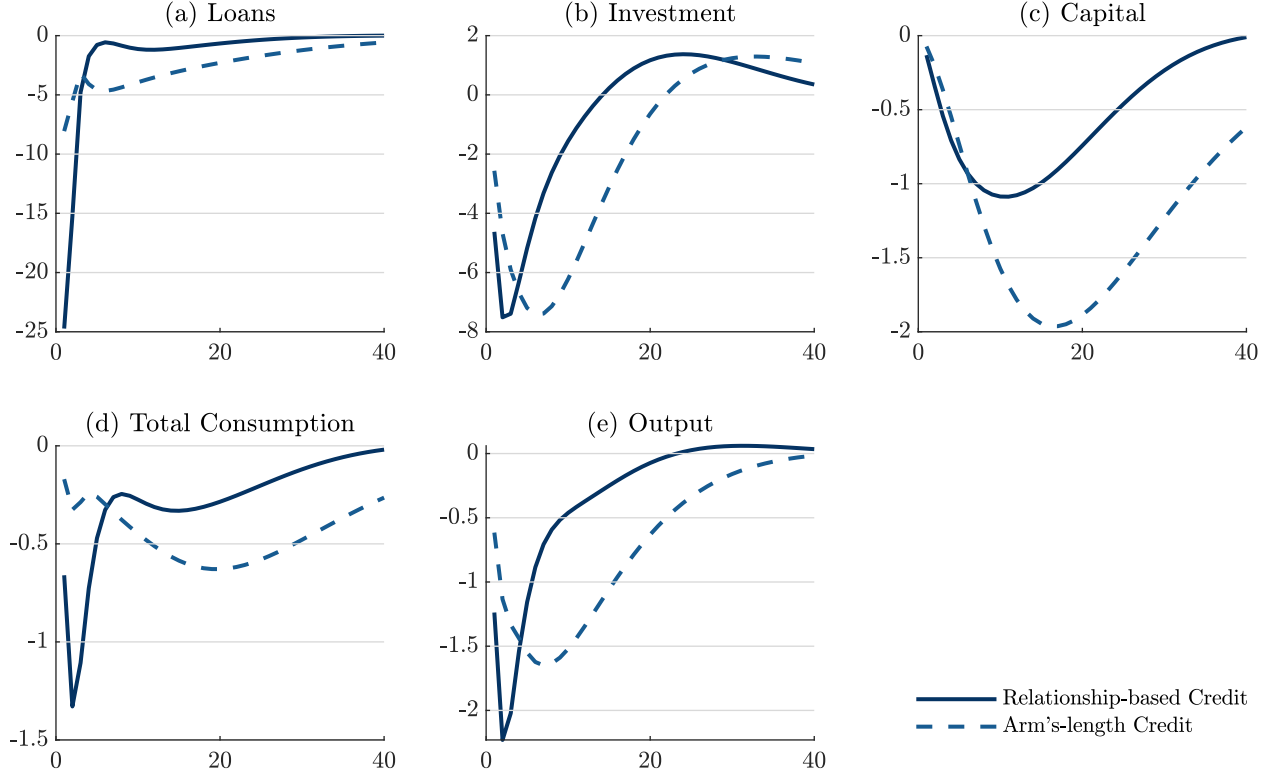
straints, or precautionary motives. This has important implications for post-crisis policy. Interventions directed at bank balance sheets — liquidity provision, capital injections, asset purchase programs — address the leverage and net-worth constraints that damaged balance sheets impose on credit supply and are effective along the channel they target. When lenders’ pessimism about future repayment quality persists after balance-sheet repair is complete, however, the continuation value of lending relationships may remain impaired independently of net-worth positions, and credit supply may stay depressed. [Bocola \(2016\)](#) documents this pattern using Italian data — bank credit to firms responds weakly to policy interventions during the sovereign debt crisis — attributing it to precautionary risk-taking by intermediaries. The present paper identifies a complementary mechanism: in a relationship-lending economy, it is the persistent impairment of continuation values by adverse repayment expectations that keeps credit supply depressed, rather than precautionary risk-taking per se. The common implication across both mechanisms is that balance-sheet repair alone may be insufficient when the channel governing credit supply operates through beliefs about future repayment conditions rather than through current positions — underscoring lender expectations as an independent variable in post-crisis recovery.

5.2 RELATIONSHIP-BASED CREDIT VERSUS ARM’S-LENGTH CREDIT

To isolate what the relationship lending structure contributes to the transmission of the information shock, the paper compares the baseline relationship-based economy to a counterfactual arm’s-length economy (meaning, $\gamma^L = \rho_s = 0$) under the identical anticipated deterioration in repayment quality. This comparison is a mechanism-identification exercise — the shock magnitude, its timing, its persistence, and all structural parameters other than the lending technology are held constant across the two economies; only the deep habits structure is removed. The purpose is to determine what the relationship structure adds to the transmission channel by removing it while keeping everything else fixed. Under anticipated deterioration, credit contracts sharply in both economies, triggering declines in investment and output that persist for extended periods ([Figure 4](#)). Under relationship-based credit, output remains below its steady-state level for five to six years — the headline result established in [Section 5.1](#), consistent with the lower bound of the [Reinhart and Rogoff \(2014\)](#) range. Under arm’s-length credit, the identical shock produces near-decade-long stagnation, consistent with the upper bound of the same range. Both outcomes confirm that adverse revisions in lenders’ repayment outlook generate protracted post-crisis recoveries across lending structures, consistent with [Reinhart and Rogoff \(2014\)](#). The model-implied

decline in investment and increase in credit spreads are of the same sign and broadly comparable magnitude to those observed during the 2007-09 Global Financial Crisis (Bordalo, Gennaioli, Shleifer, and Terry, 2026); the purpose of this comparison is to situate the model's implications within empirically plausible ranges, not to constitute quantitative validation.

FIGURE 4: EFFECTS OF LENDERS' DETERIORATING REPAYMENT OUTLOOK

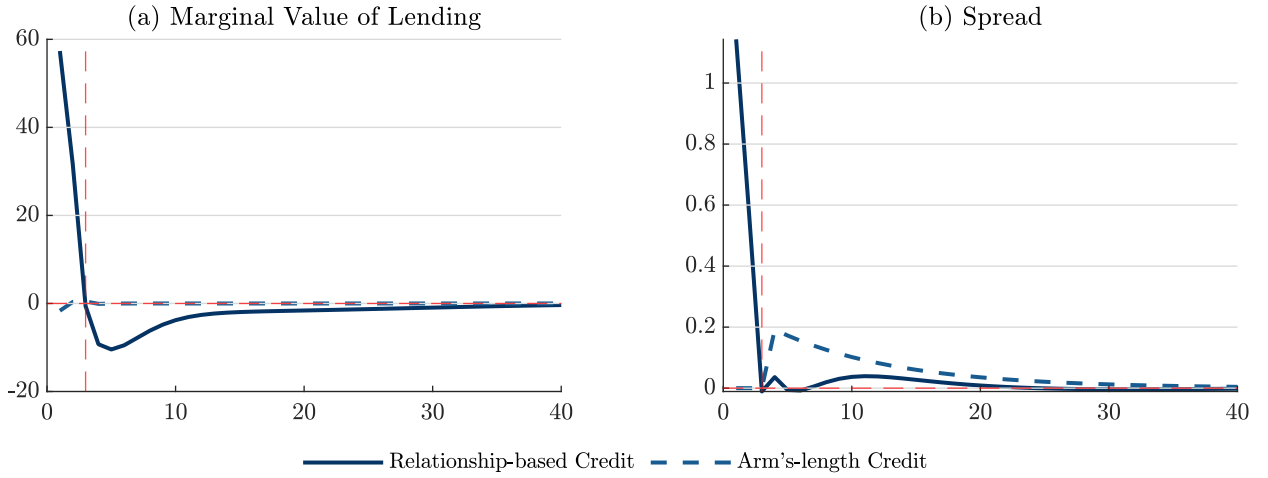


NOTE: Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state.

The mechanism through which the expectations shock transmits to the real economy differs sharply across the two lending regimes (Figure 5). In the economy with relationship-based credit, the adverse revision in repayment expectations generates an immediate spike in credit spreads — a price-based credit channel — while simultaneously driving a pre-emptive contraction in credit quantities. These two effects operate through different margins. The spread spike reflects banks' immediate repricing of the risk embedded in their loan portfolios and the hold-up premium they can extract from captive borrowers in the short run. The quantity contraction reflects the forward-looking impairment of the continuation value of lending relationships: the anticipated future deterioration in Ψ_t makes new relationship formation less attractive and optimal credit supply contracts accordingly. As adverse expectations persist, the continuation value of relationship lending collapses — the marginal value of lending turns negative and remains persistently depressed. Credit spreads normalize after a few quarters as the price-sensitive component of de-

mand adjusts, but the marginal value of lending does not recover alongside spreads because the repayment-quality state remains persistently impaired. The result is the spread-quantity dissociation: spreads revert to near-baseline levels while credit quantities remain suppressed, investment recovers only gradually, and output stays below its steady-state level for five to six years. Spreads thus may be insufficient statistics for credit market conditions when the shadow value of lending relationships — not current marginal pricing — is the operative variable governing credit supply during the recovery phase.

FIGURE 5: MECHANISM – LENDERS’ DETERIORATING REPAYMENT OUTLOOK



NOTE: Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state. Horizontal dashed red line corresponds to 0-line (y-axis). Vertical dashed red line corresponds to period 3 (x-axis).

These dynamics reflect the greater market power embedded in relationship lending. Borrower hold-up — the informational capture of established borrowers who face switching costs that arm’s-length borrowers do not — allows banks to raise spreads more aggressively following adverse signals about future repayment quality (Wilner, 2000; Santos, 2011; Carvalho, Ferreira, and Matos, 2015; Sette and Gobbi, 2015; Li, Lu, and Srinivasan, 2019; Liaudinskas, 2024). As the information shock dissipates and adverse expectations begin to normalize, spreads are reduced — but lending does not recover in parallel, because the expected future profitability of maintaining lending relationships remains low even after current pricing has normalized. The distinction between spread adjustment and continuation value adjustment is what produces the dissociation and differentiates the two lending regimes. Under arm’s-length credit, lenders lack the market power to spike spreads aggressively at the arrival of adverse news: the marginal value of lending moves little on impact, and credit spreads do not increase meaningfully until losses materialize several periods later. Once realized credit losses occur, spreads rise and return only gradually to their

pre-shock levels. Bank lending contracts less sharply on impact but remains persistently depressed as spreads stay elevated, leading to a slower and more protracted recovery in investment, capital accumulation, and output — output remaining depressed for close to a decade. The comparison confirms that the relationship structure concentrates credit adjustment pre-emptively at the time of the news signal, generating a larger initial impact that resolves within five to six years, while arm’s-length credit distributes the adjustment through the period of realized losses, extending the recovery horizon substantially.

Taken together, these results provide a possible resolution of what may be termed as the ‘relationship lending paradox’. The five-to-six-year recovery under relationship-based credit establishes that the documented beneficial properties of established lending ties — more stable credit access, lower borrowing costs, and insulation against transitory adverse shocks in normal times (Petersen and Rajan, 1994; Ongena and Smith, 2000; Kosekova, Maddaloni, Papoutsis, and Schivardi, 2025) — cannot prevent prolonged post-crisis stagnation when lenders’ repayment outlook deteriorates sharply and persistently. The relationship structure moderates recovery duration relative to arm’s-length credit — five to six years against a near-decade — but moderation is not insulation. The reason is structural: the continuation value of lending relationships is simultaneously the channel through which the expectation shock is transmitted and the source of the relationship structure’s moderating properties. When that continuation value is impaired by persistent adverse expectations, the moderating force erodes alongside it. This explains a pattern documented independently in the empirical literature. Chodorow-Reich (2014) shows that during the 2008-09 crisis, firms with pre-crisis relationships with less healthy lenders had lower probabilities of obtaining loans, paid higher interest rates if they did borrow, and reduced employment significantly — the relationship structure transmitted rather than buffered the lender’s distress. Bottero, Lenzu, and Mezzanotti (2020) document direct relationship termination during the Greek sovereign crisis: banks were more likely to terminate credit relationships and cut credit line limits when facing funding pressure. Berger, Bouwman, Norden, Roman, Udell, and Wang (2025) find that during COVID-19, relationship borrowers in financial distress received worse — not better — terms than other borrowers. The model provides a structural interpretation of these findings: deteriorating repayment outlook erodes the continuation value of relationships, converting what would otherwise be a stabilizing force into a conduit for the transmission of adverse expectations.

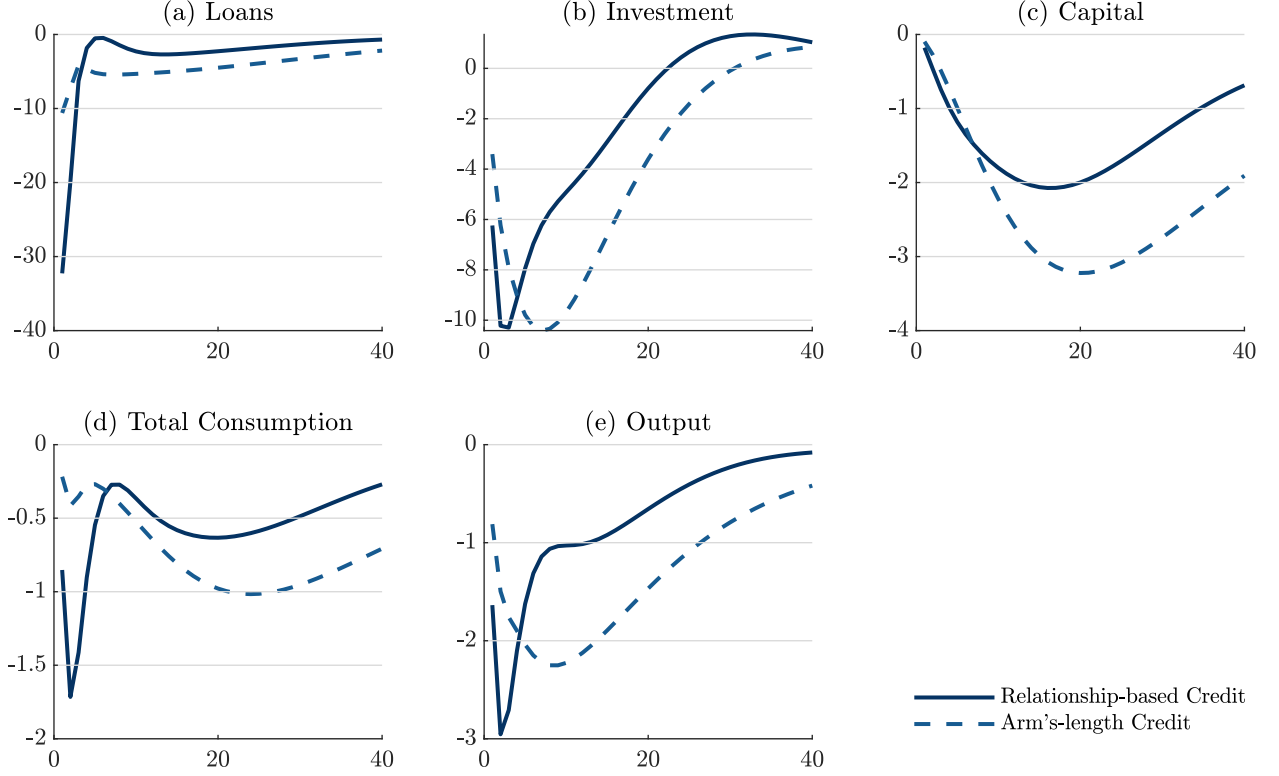
5.3 “THE LOST DECADE”

The baseline results show that relationship lending substantially shortens the recovery following an adverse deterioration in repayment prospects: output returns toward its steady state within roughly five to six years, compared with about a decade under arm’s-length lending (Section 5.1). Because the bank places value on the continuation of an ongoing lending relationship, the same relationship-specific channel that induces pre-emptive tightening also supports the subsequent recovery as repayment prospects improve.

To examine whether this recovery-supporting role is sufficient when the deterioration itself is more persistent, I increase the persistence of the repayment-quality state from $\rho_\Psi = 0.90$ to 0.95 while keeping all other parameter values fixed as in Table 1. The purpose of this exercise is to show how the recovery-supporting role of relationship lending interacts with the persistence of the adverse state itself. The results reveal an interesting insight — recovery duration is a function both of persistence of repayment state deterioration and structure of financial intermediation. Relationship lending shortens the recovery duration but does not sever its dependence on the persistence of repayment deterioration. With a more persistent deterioration in repayment prospects, output takes roughly a decade to recover even under relationship-based lending (Figure 6). The recovery is still slower under arm’s-length lending, where the continuation-value channel is absent, and the period of stagnation extends beyond that under relationship-based lending. The comparison therefore uncovers a limit to the recovery-supporting role of relationship lending. Relationship lending materially cushions the effects of persistent adverse repayment prospects, but it cannot fully offset a deterioration that remains embedded in lenders’ repayment outlook for an extended period. This provides a mechanism through which prolonged stagnation can arise: when adverse repayment prospects remain depressed for sufficiently long, even the continuation value of lending relationships cannot restore credit and output rapidly.

The exercise therefore distinguishes two margins governing recovery duration. The persistence of the deterioration in repayment prospects determines how long the adverse credit-supply environment remains relevant, while relationship lending determines how strongly that deterioration is transmitted into current lending and, subsequently, how rapidly credit and output recover relative to an arm’s-length structure. Relationship lending can therefore substantially shorten recovery times without eliminating prolonged stagnation when adverse repayment prospects themselves remain depressed for an extended period.

FIGURE 6: LONGER-LASTING DETERIORATION IN LENDERS' REPAYMENT OUTLOOK AND THE 'LOST DECADE'



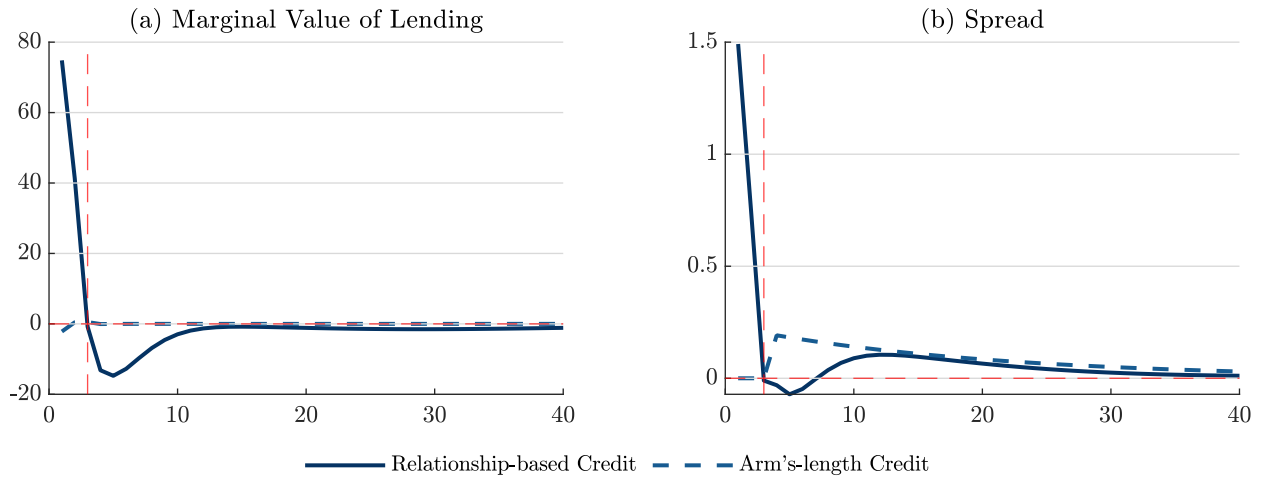
NOTE: Except parameter ρ_Ψ which governs persistence of repayment quality state, all other parameters held fixed at their baseline value in Table 1. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state.

This result provides a natural connection to the evidence on prolonged post-crisis stagnation, in which output losses persisted for a decade or longer. Cerra and Saxena (2008) document permanent output losses following a broad cross-section of financial crises. Reinhart and Rogoff (2014) place the upper bound of the typical crisis recovery at ten years. Hoshi and Kashyap (2015), in their account of Japan's lost decade, emphasize the persistence of banking-sector weakness and delayed resolution of banking problems as important obstacles to recovery. The experiment here speaks to the broader implication of that evidence: when adverse conditions in the banking sector remain persistent, even a lending structure that otherwise mitigates the propagation of credit-market disturbances may not be sufficient to prevent a prolonged recovery. The resulting decade-long recovery under relationship lending, and the still longer recovery under arm's-length lending, illustrate how recovery duration depends jointly on the persistence of lenders' repayment outlook and the structure of financial intermediation.

A higher persistence of Ψ_t can be interpreted more broadly as a setting in which lenders' assessments of borrower repayment prospects adjust only gradually, as may occur when the recognition and resolution of impaired exposures are protracted (Schäfer, 2019). This interpretation is distinct

from zombie-lending explanations: the mechanism does not require inefficient credit allocation or the continued financing of unproductive borrowers. As persistence increases, the adjustment is increasingly concentrated in credit quantities rather than sustained movements in spreads (Figure 7). Under relationship-based credit, the marginal value of lending falls sharply and remains persistently depressed as repayment prospects are expected to remain weak. In this sense, the model does not require a separate persistent bank-balance-sheet impairment to generate lost-decade-type recovery: sufficiently persistent adverse repayment prospects, transmitted through the continuation value of lending relationships, can themselves generate prolonged stagnation.

FIGURE 7: MECHANISM – LONGER-LASTING DETERIORATION IN LENDERS’ REPAYMENT OUTLOOK



NOTE: Except parameter ρ_Ψ which governs persistence of repayment quality state, all other parameters held fixed at their baseline value in Table 1. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state. Horizontal dashed red line corresponds to 0-line (y-axis). Vertical dashed red line corresponds to period 3 (x-axis).

The mechanism sheds further light on [Bocola \(2016\)](#)’s finding that bank lending responds weakly to policy interventions during financial crises. In his framework, the sluggishness reflects precautionary risk-taking: even when policy provides balance-sheet support, banks’ willingness to extend credit remains suppressed by risk concerns associated with sovereign exposure. In the present paper, the analogous sluggishness arises from a structurally different source — the persistently impaired continuation value of lending relationships. The two mechanisms therefore point to different structural reasons why credit may respond sluggishly during financial crises.

6 CONCLUDING REMARKS

This paper shows that pessimistic revisions in lenders’ expectations about future repayment can, by themselves, generate recoveries of the duration observed after major financial crises. The

mechanism operates before any realized credit loss: when banks learn that future loan repayment quality will deteriorate, the expected value of maintaining lending relationships falls, inducing banks to tighten credit pre-emptively. This information-driven contraction in financial intermediation can persist long after the initial deterioration and does not require impaired bank net worth, leverage constraints, or precautionary motives. Quantitatively, an anticipated deterioration generates a five-to-six-year recovery, compared with two to three years when the same deterioration is realized without advance information. Thus, the anticipatory component of credit deterioration alone accounts for several additional years of depressed credit, investment, and output. Advance information about the same eventual deterioration approximately doubles the duration of the recovery and in this sense, information can outlive the event it describes.

The mechanism also changes how the aftermath of a credit disruption should be read from observable credit-market prices. Because lending relationships make loan demand less responsive to current loan prices, an adverse revision in repayment prospects initially produces a sharp increase in spreads. As borrowers adjust, however, the price-sensitive component of loan demand recedes and spreads normalize within a few quarters, while the stock of relationship-based credit remains depressed. Credit quantities therefore contain information about financial conditions that spreads alone do not. The same continuation value that makes relationship lending beneficial in normal times also generates this persistence: when expected future relationship rents fall, banks tighten lending today; when those expectations recover, the value of maintaining the relationship gradually returns and credit recovers. Relationship lending is therefore neither simply an amplifier nor simply a stabilizer. It amplifies the initial transmission of an adverse information shock because the continuation value of the relationship is at stake, while its recovery provides the force that gradually restores lending.

These results suggest a broader lesson for models and policies of financial crisis recovery. Balance-sheet-based mechanisms emphasize the role of realized losses and intermediary net worth in sustaining credit contractions. The analysis here highlights a complementary margin: lenders may remain conservative because their outlook on future repayment prospects has deteriorated even after current balance-sheet conditions have stabilized. This distinction matters for stabilization policy. Interventions that repair intermediary balance sheets address realized impairment, but need not by themselves restore the continuation value of lending relationships when lenders remain pessimistic about future repayment. Understanding post-crisis credit recovery therefore requires attention not only to what lenders have lost, but also to what they expect to recover.

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APPENDIX (FOR ONLINE PUBLICATION)

LENDER EXPECTATIONS ABOUT REPAYMENT QUALITY AND SLOW RECOVERIES FROM FINANCIAL CRISES

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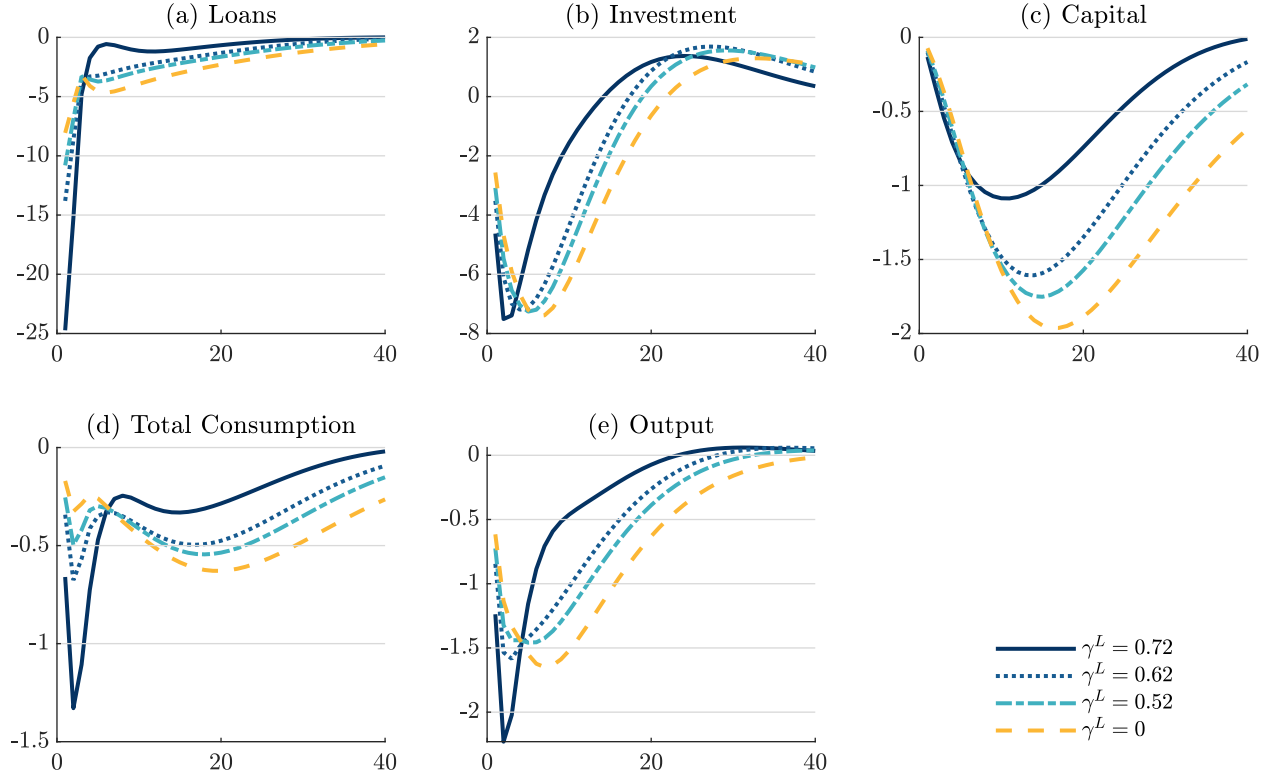
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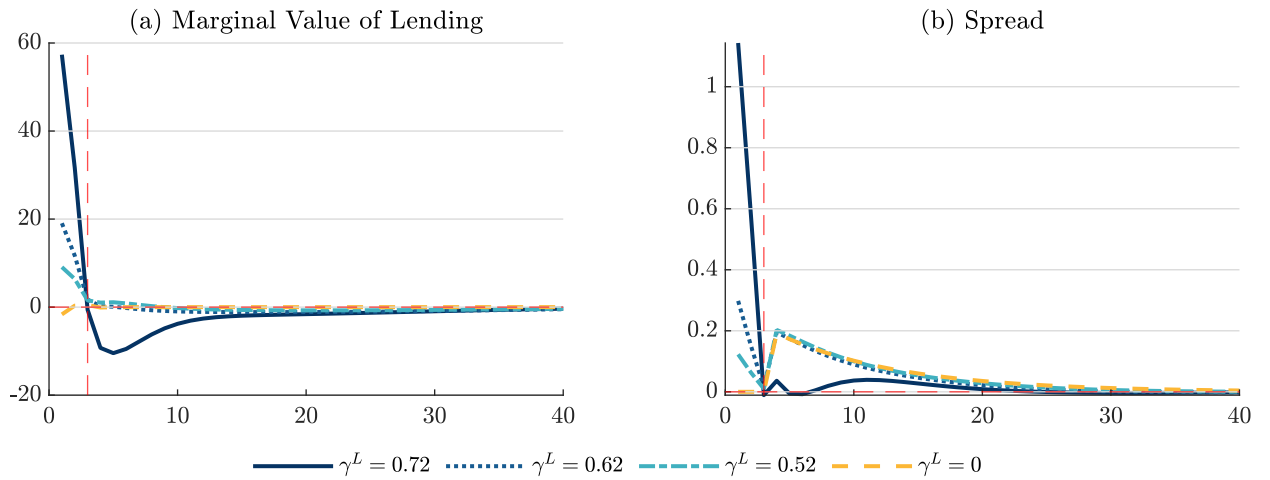
A ADDITIONAL FIGURES

FIGURE A.1: IMPACT OF LENDERS' DETERIORATING REPAYMENT OUTLOOK AND INTENSITY OF RELATIONSHIP-BASED CREDIT



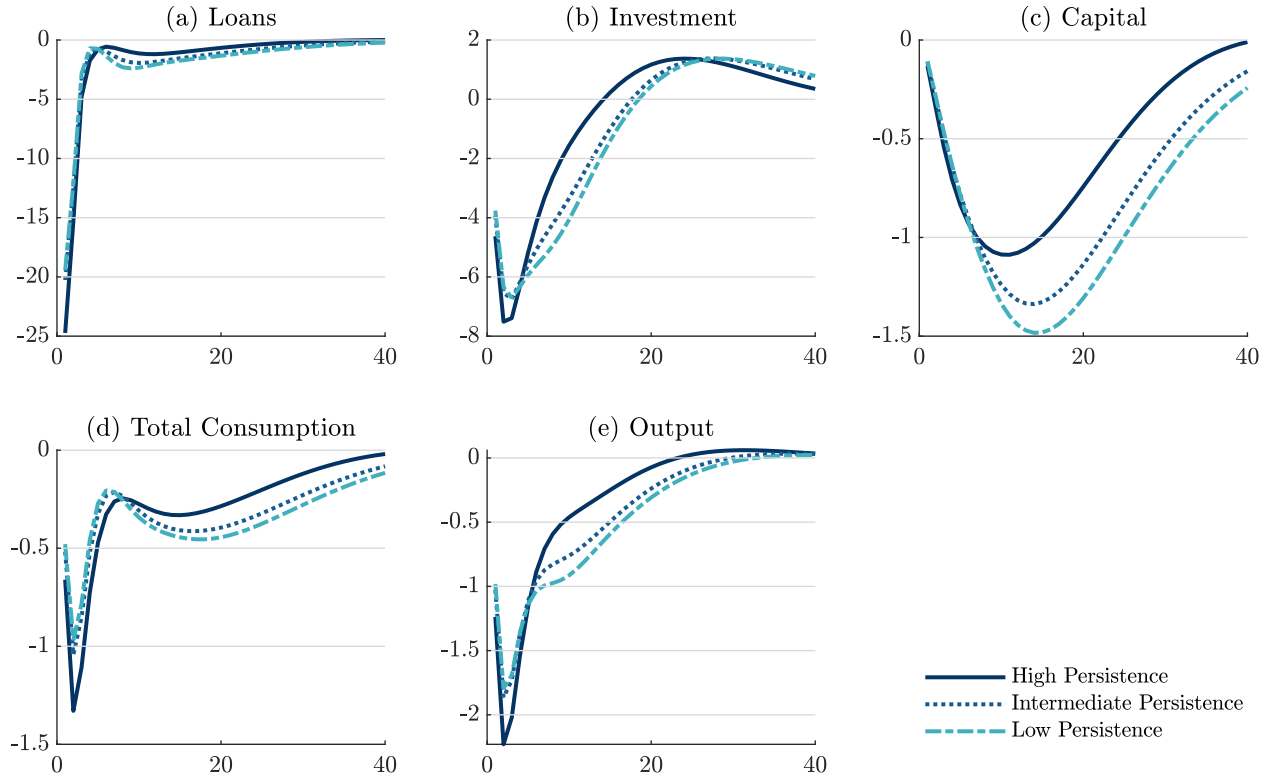
NOTE: Except intensity of relationship-based lending parameter γ^L , all other parameters held fixed at their baseline value in Table 1. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state.

FIGURE A.2: MECHANISM – LENDERS' DETERIORATING REPAYMENT OUTLOOK AND INTENSITY OF RELATIONSHIP-BASED CREDIT



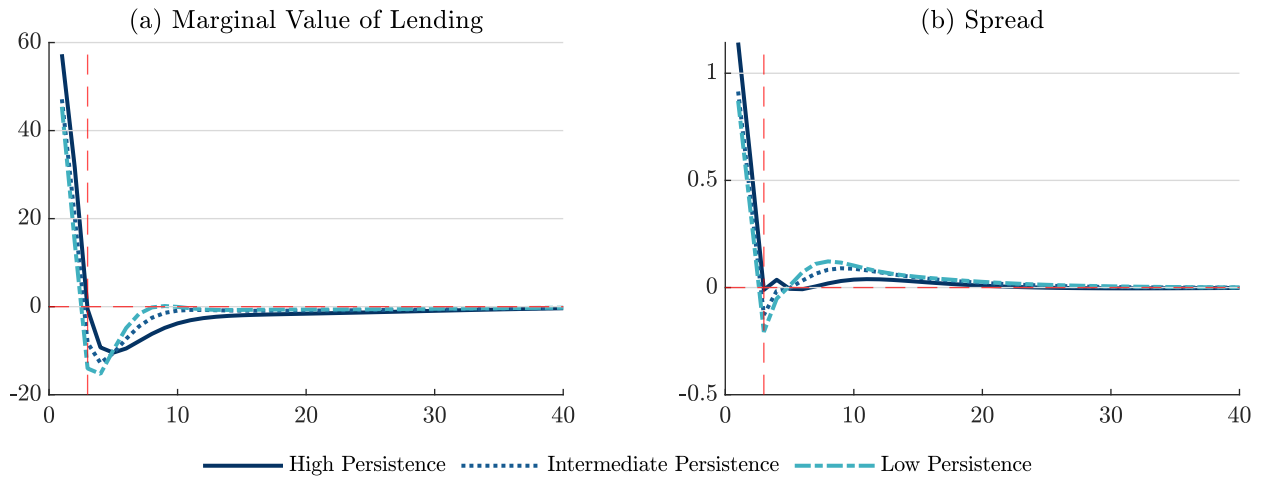
NOTE: Except intensity of relationship-based lending parameter γ^L , all other parameters held fixed at their baseline value in Table 1. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state. Horizontal dashed red line corresponds to 0-line (y-axis). Vertical dashed red line corresponds to period 3 (x-axis).

FIGURE A.3: IMPACT OF LENDERS' DETERIORATING REPAYMENT OUTLOOK AND PERSISTENCE OF RELATIONSHIP-BASED CREDIT



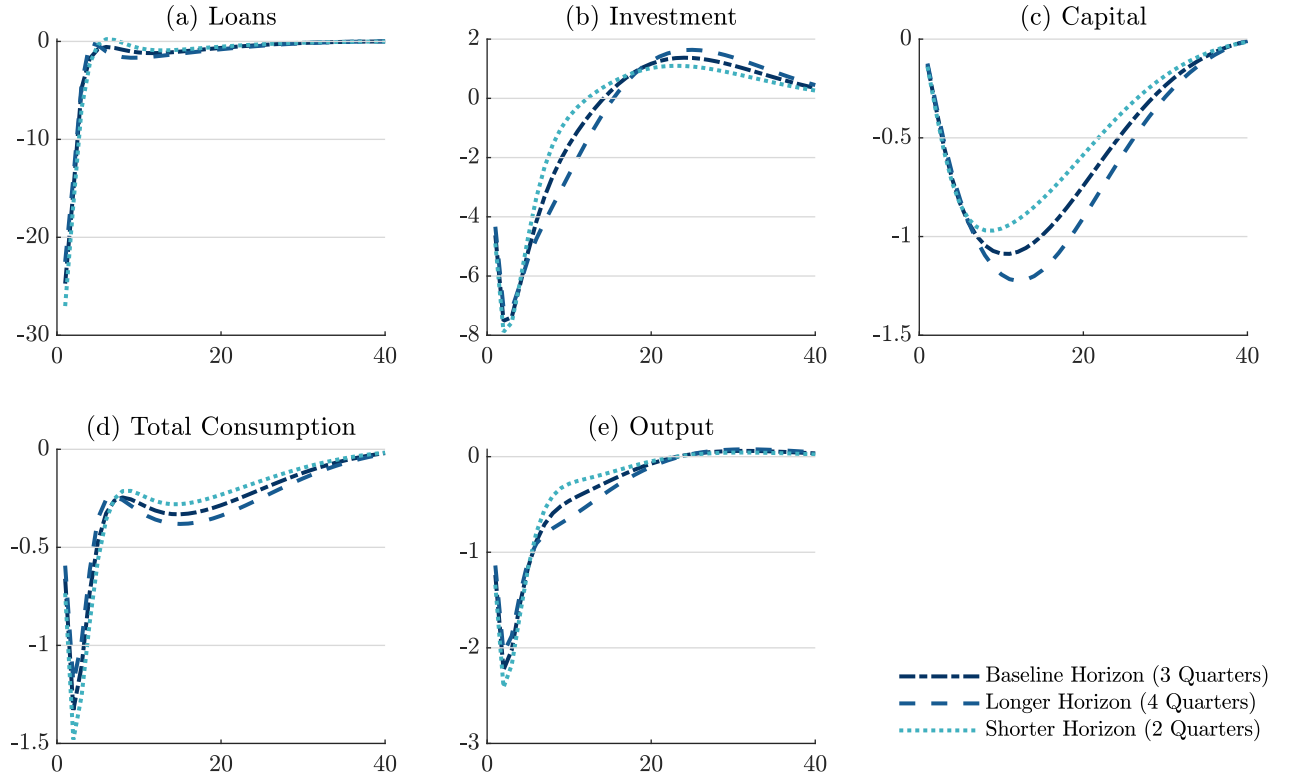
NOTE: Except persistence of stock of habits in relationship-based lending parameter ρ_s , all other parameters held fixed at their baseline value in Table 1. High persistence means 0.85 as used in the baseline exercise, intermediate persistence 0.75 and low persistence 0.65. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state.

FIGURE A.4: MECHANISM – LENDERS' DETERIORATING REPAYMENT OUTLOOK AND PERSISTENCE OF RELATIONSHIP-BASED CREDIT



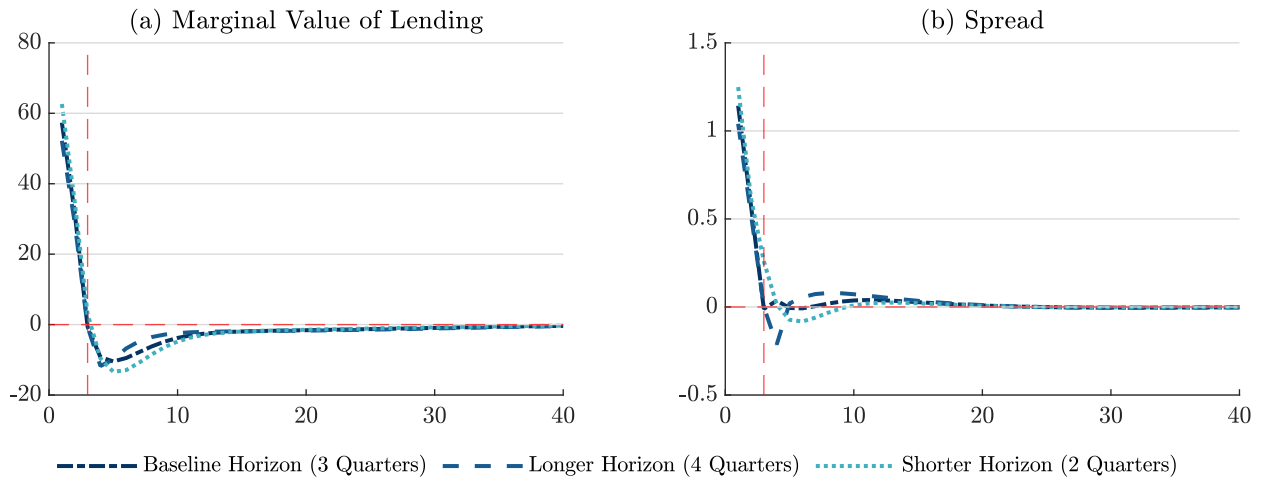
NOTE: Except persistence of stock of habits in relationship-based lending parameter ρ_s , all other parameters held fixed at their baseline value in Table 1. High persistence means 0.85 as used in the baseline exercise, intermediate persistence 0.75 and low persistence 0.65. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state. Horizontal dashed red line corresponds to 0-line (y-axis). Vertical dashed red line corresponds to period 3 (x-axis).

FIGURE A.5: IMPACT OF LENDERS' DETERIORATING REPAYMENT OUTLOOK ACROSS DIFFERENT HORIZONS



NOTE: Except horizon of information arrival, all other parameters held fixed at their baseline value in Table 1. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state.

FIGURE A.6: MECHANISM – LENDERS' DETERIORATING REPAYMENT OUTLOOK ACROSS DIFFERENT HORIZONS



NOTE: Except horizon of information arrival, all other parameters held fixed at their baseline value in Table 1. Numbers on the horizontal axis represent quarters since the shock. Numbers on the vertical axis show percentage deviation from the steady state. Horizontal dashed red line corresponds to 0-line (y-axis). Vertical dashed red line corresponds to period 3 (x-axis).

B PROOFS OF THE MECHANISM PROPOSITIONS

B.1 PROOF OF PROPOSITION 1

From the bank's lending-rate first-order condition,

$$R_t^L = \frac{R_t^D - \gamma^L(1 - \rho_s)\mathcal{V}_t}{\Psi_{t+1}} \frac{\xi\Theta_t}{\xi\Theta_t - 1} \quad (\text{B.1})$$

where Θ_t is defined in Equation (31).

Holding R_t^D , Ψ_{t+1} , and Θ_t fixed, differentiation with respect to $\mathcal{V}_t$ gives

$$\frac{\partial R_t^L}{\partial \mathcal{V}_t} = -\gamma^L(1 - \rho_s) \frac{\xi\Theta_t}{\Psi_{t+1}(\xi\Theta_t - 1)} \quad (\text{B.2})$$

Under $\gamma^L > 0$, $\rho_s < 1$, $\Psi_{t+1} > 0$, and $\xi\Theta_t > 1$, all terms in the denominator are positive. Hence

$$\frac{\partial R_t^L}{\partial \mathcal{V}_t} < 0 \quad (\text{B.3})$$

Thus, holding the other arguments of the lending-rate condition fixed, a lower continuation value of the lending relationship raises the current lending rate. ■

B.2 PROOF OF PROPOSITION 2

The bank's shadow value of lending satisfies

$$\varrho_t^E = \mathbb{E}_t [q_{t,t+1} (\Psi_{t+1} R_t^L - R_t^D + \gamma^L(1 - \rho_s) \varrho_{t+1}^E)] \quad (\text{B.4})$$

The continuation value entering the lending-rate condition is

$$\mathcal{V}_t = \frac{\mathbb{E}_t [q_{t,t+1} \varrho_{t+1}^E]}{\mathbb{E}_t [q_{t,t+1}]} \quad (\text{B.5})$$

Consider information received at date t about repayment quality Ψ_{t+h} , where $h \geq 2$. Since Ψ_{t+h} enters the current-period return component of the shadow-value condition dated $t + h - 1$, its effect on ϱ_{t+1}^E must pass through $h - 2$ continuation-value terms.

Iterating Equation (B.4) forward and collecting the component that contains Ψ_{t+h} gives

$$\varrho_{t+1}^E = \dots + [\gamma^L(1 - \rho_s)]^{h-2} \mathbb{E}_{t+1} \left[\left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} \Psi_{t+h} R_{t+h-1}^L \right] + \dots \quad (\text{B.6})$$

where the omitted terms do not contain Ψ_{t+h} .

To isolate the direct transmission of information about Ψ_{t+h} , hold lending rates, discount factors, and all other equilibrium objects fixed at their equilibrium values. The component of $\mathcal{V}_t$

associated with Ψ_{t+h} is then

$$\begin{aligned}\mathcal{V}_t|_{\Psi_{t+h}} &= \frac{[\gamma^L(1-\rho_s)]^{h-2}}{\mathbb{E}_t[q_{t,t+1}]} \mathbb{E}_t \left[q_{t,t+1} \mathbb{E}_{t+1} \left[\left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} \Psi_{t+h} R_{t+h-1}^L \right] \right] \\ &= \frac{[\gamma^L(1-\rho_s)]^{h-2}}{\mathbb{E}_t[q_{t,t+1}]} \mathbb{E}_t \left[q_{t,t+1} \left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} \Psi_{t+h} R_{t+h-1}^L \right]\end{aligned}\quad (\text{B.7})$$

where the second equality follows from the law of iterated expectations.

Accordingly, the direct marginal effect of an increase in the expected future repayment quality is

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} = [\gamma^L(1-\rho_s)]^{h-2} \frac{\mathbb{E}_t \left[q_{t,t+1} \left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} R_{t+h-1}^L \right]}{\mathbb{E}_t[q_{t,t+1}]}\quad (\text{B.8})$$

All discount factors and lending rates are positive in an interior equilibrium. Since $\gamma^L(1-\rho_s) > 0$, the right-hand side is strictly positive:

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} > 0 \quad (\text{B.9})$$

Hence, an adverse revision in expected repayment quality lowers the continuation value of the lending relationship. By [Proposition 1](#), a lower continuation value raises the current lending rate, holding the other arguments of the lending-rate condition fixed. This establishes the direct relationship-continuation channel through which advance information about sufficiently distant repayment quality affects current loan pricing.

For the baseline anticipation horizon $h = 3$,

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+3}} \right|_{\text{direct}} = \gamma^L(1-\rho_s) \frac{\mathbb{E}_t [q_{t,t+1} q_{t+1,t+2} q_{t+2,t+3} R_{t+2}^L]}{\mathbb{E}_t[q_{t,t+1}]} > 0 \quad (\text{B.10})$$

Thus, only one continuation-value link is required to transmit information about Ψ_{t+3} to $\mathcal{V}_t$, which is why the exponent is $h - 2 = 1$ when $h = 3$. ■

B.3 PROOF OF [PROPOSITION 3](#)

By [Proposition 1](#), holding R_t^D , Ψ_{t+1} , and Θ_t fixed,

$$\frac{\partial R_t^L}{\partial \mathcal{V}_t} = -\gamma^L(1-\rho_s) \frac{\xi \Theta_t}{\Psi_{t+1}(\xi \Theta_t - 1)} \quad (\text{B.11})$$

From [Proposition 2](#), the direct effect of information about Ψ_{t+h} on $\mathcal{V}_t$ is

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} = [\gamma^L(1-\rho_s)]^{h-2} \frac{\mathbb{E}_t \left[q_{t,t+1} \left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} R_{t+h-1}^L \right]}{\mathbb{E}_t[q_{t,t+1}]}\quad (\text{B.12})$$

Holding the remaining equilibrium objects fixed, the direct effect of advance information on

the current lending rate is therefore obtained by the chain rule:

$$\begin{aligned}
\left. \frac{\partial R_t^L}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} &= \left. \frac{\partial R_t^L}{\partial \mathcal{V}_t} \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} \\
&= -[\gamma^L(1 - \rho_s)]^{h-1} \frac{\xi \Theta_t}{\Psi_{t+1}(\xi \Theta_t - 1)} \\
&\quad \times \frac{\mathbb{E}_t \left[q_{t,t+1} \left(\prod_{j=1}^{h-2} q_{t+j,t+j+1} \right) q_{t+h-1,t+h} R_{t+h-1}^L \right]}{\mathbb{E}_t[q_{t,t+1}]}
\end{aligned} \tag{B.13}$$

Under the maintained interiority conditions, the fraction multiplying $-\gamma^L(1 - \rho_s)^{h-1}$ is strictly positive. Hence

$$\left. \frac{\partial R_t^L}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}} < 0 \tag{B.14}$$

Thus, holding the remaining equilibrium objects fixed, more favorable information about sufficiently distant repayment quality lowers the current lending rate, while adverse information raises it. The strength of this direct relationship-continuation transmission contains $h - 1$ factors of $\gamma^L(1 - \rho_s)$: $h - 2$ arise from transmitting the information into the continuation value, and one additional factor arises from the sensitivity of the lending rate to that continuation value. ■

B.4 PROOF OF COROLLARY 3.1

Consider the arm's-length benchmark, $\gamma^L = 0$. Equation (B.4) becomes

$$\varrho_t^E = \mathbb{E}_t [q_{t,t+1} (\Psi_{t+1} R_t^L - R_t^D)] \tag{B.15}$$

The continuation-value term is therefore absent from the shadow-value condition. For $h \geq 2$, information about Ψ_{t+h} enters the shadow-value equation only at date $t + h - 1$ and has no continuation-value link through which it can affect ϱ_{t+1}^E . Equivalently, the coefficient in Equation (B.6) satisfies

$$[\gamma^L(1 - \rho_s)]^{h-2} = 0, \quad h \geq 2 \tag{B.16}$$

Consequently,

$$\left. \frac{\partial \mathcal{V}_t}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}, \gamma^L=0} = 0, \quad h \geq 2 \tag{B.17}$$

Moreover, from the lending-rate condition,

$$\left. \frac{\partial R_t^L}{\partial \mathcal{V}_t} \right|_{\gamma^L=0} = 0 \tag{B.18}$$

Therefore,

$$\left. \frac{\partial R_t^L}{\partial \mathbb{E}_t \Psi_{t+h}} \right|_{\text{direct}, \gamma^L=0} = 0, \quad h \geq 2 \tag{B.19}$$

Thus, in the arm's-length benchmark, information about repayment quality beyond the current loan's repayment horizon does not affect current lending through the relationship-continuation channel. ■

C DERIVATION OF FOCs

C.1 HOUSEHOLDS

The Lagrangian of the household is

$$\mathcal{L}_t = \mathbb{E}_t \left\{ \sum_{t=0}^{\infty} (\beta^P)^t \left[-\lambda_{i,t}^P \begin{bmatrix} \log(C_{i,t}^P - \gamma^P C_{i,t-1}^P) - \frac{N_{i,t}^\eta}{\eta} + \varsigma \log H_{i,t}^P \\ C_{i,t}^P + Q_t^H (H_{i,t}^P - H_{i,t-1}^P) + \int_0^1 D_{ik,t} dk \\ -W_t N_{i,t} - \int_0^1 \Pi_{ik,t} dk - R_{t-1}^D \int_0^1 D_{ik,t-1} dk \end{bmatrix} \right] \right\} \quad (\text{C.1})$$

The problem yields the following first order conditions (here, I ignore all the i 's denoting individual households):

$$\frac{\partial \mathcal{L}}{\partial C_t^P} : \frac{1}{C_t^P - \gamma^P C_{t-1}^P} - \beta^P \mathbb{E}_P \frac{\gamma^P}{C_{t+1}^P - \gamma^P C_t^P} = \lambda_t^P \quad (\text{C.2})$$

$$\frac{\partial \mathcal{L}}{\partial D_t} : \beta^P \mathbb{E}_t \lambda_{t+1}^P = \frac{\lambda_t^P}{R_t^D} \quad (\text{C.3})$$

$$\frac{\partial \mathcal{L}}{\partial H_t^P} : \frac{\varsigma}{H_t^P} + \beta^P \mathbb{E}_t (\lambda_{t+1}^P Q_{t+1}^H) = \lambda_t^P Q_t^H \quad (\text{C.4})$$

$$\frac{\partial \mathcal{L}}{\partial N_t} : N_t^{\eta-1} = \lambda_t^P W_t \quad (\text{C.5})$$

C.2 ENTREPRENEURS

Entrepreneur's optimization problem features two parts. The first part consists of choosing how much to borrow from each individual bank, $l_{jk,t}$ to minimize his total interest rate expenditure.

This problem can be framed as

$$\min_{l_{jk,t}} \left[\int_0^1 R_{k,t}^L l_{jk,t} dk \right] - \chi_t^E \left[x_{j,t} - \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{\xi}{\xi-1}} \right] \quad (\text{C.6})$$

The first order condition for this problem is

$$R_{k,t}^L = -\frac{\xi}{\xi-1} \chi_t^E \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{1}{\xi-1}} \frac{\xi-1}{\xi} (l_{jk,t} - \gamma^L s_{k,t-1})^{-\frac{1}{\xi}} \quad (\text{C.7})$$

This can be rewritten as

$$\begin{aligned}
R_{k,t}^L &= -\chi_t^E \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{1}{\xi-1}} (l_{jk,t} - \gamma^L s_{k,t-1})^{-\frac{1}{\xi}} \\
R_{k,t}^L (l_{jk,t} - \gamma^L s_{k,t-1}) &= -\chi_t^E \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{1}{\xi-1}} (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} \\
\int_0^1 R_{k,t}^L (l_{jk,t} - \gamma^L s_{k,t-1}) dk &= -\chi_t^E \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{1}{\xi-1}} \int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \\
\int_0^1 R_{k,t}^L (l_{jk,t} - \gamma^L s_{k,t-1}) dk &= -\chi_t^E \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{\xi}{\xi-1}} \quad (C.8)
\end{aligned}$$

Now, using $\left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{\xi}{\xi-1}} = x_{j,t}$, the previous equation can be written as

$$x_{j,t} = -\frac{1}{\chi_t^E} \left[\int_0^1 R_{k,t}^L (l_{jk,t} - \gamma^L s_{k,t-1}) dk \right] \quad \ddagger$$

Define the aggregate lending rate as $R_t^L \equiv \left[\int_0^1 (R_{k,t}^L)^{1-\xi} \right]^{\frac{1}{1-\xi}}$ and note that at the optimum, the following condition must hold

$$R_t^L x_{j,t} = \int_0^1 R_{k,t}^L (l_{jk,t} - \gamma^L s_{k,t-1}) dk$$

Now, $\ddagger$ can be rewritten as

$$\begin{aligned}
x_{j,t} &= -\frac{1}{\chi_t^E} [R_t^L x_{j,t}] \\
-\chi_t^E &= R_t^L
\end{aligned}$$

Inserting this in first order condition (C.8)

$$\begin{aligned}
R_{k,t}^L &= -\frac{\xi}{\xi-1} \chi_t^E \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right)^{\frac{1}{\xi-1}} \frac{\xi-1}{\xi} (l_{j,t} - \gamma^L s_{k,t-1})^{-\frac{1}{\xi}} \\
R_{k,t}^L &= R_t^L \left(\int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1}) dk \right)^{\frac{1}{\xi-1}} (l_{jk,t} - \gamma^L s_{k,t-1})^{-\frac{1}{\xi}} \\
R_{k,t}^L &= R_t^L (x_t)^{\frac{1}{\xi}} (l_{jk,t} - \gamma^L s_{k,t-1})^{-\frac{1}{\xi}}
\end{aligned}$$

Rearranging the above expression

$$\begin{aligned}
(l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{1}{\xi}} &= (x_t)^{\frac{1}{\xi}} \frac{R_t^L}{R_{k,t}^L} \\
l_{jk,t} &= \left(\frac{R_t^L}{R_{k,t}^L} \right)^{\xi} x_t + \gamma^L s_{k,t-1} \\
l_{jk,t} &= \left(\frac{R_{k,t}^L}{R_t^L} \right)^{-\xi} x_t + \gamma^L s_{k,t-1}
\end{aligned}$$

The second part of entrepreneur's optimization problem can be written as

$$\mathcal{L}_t = \mathbb{E}_t \left\{ \sum_{t=0}^{\infty} (\beta^E)^t \left[\begin{aligned} & \log(C_{j,t}^E - \gamma^E C_{j,t-1}^E) \\ & - \lambda_{j,t}^E \left[C_{j,t}^E + R_{k,t-1}^L \int_0^1 l_{jk,t-1} dk - Y_{j,t} + W_t N_{j,t} + I_{j,t} \right. \\ & \quad \left. + Q_t^H (H_{j,t}^E - H_{j,t-1}^E) - x_{j,t} \right] \\ & - \mu_{j,t}^E \left[R_{k,t}^L \int_0^1 l_{jk,t} dk - \int_0^1 \theta dk \mathbb{E}_t (Q_{t+1}^H H_{j,t}^E + Q_{t+1}^K K_{j,t}) \right] \\ & - \kappa_{j,t}^E \left[K_{j,t} - (1 - \delta) K_{j,t-1} - \left\{ 1 - \frac{\Omega}{2} \left(\frac{I_{j,t}}{I_{j,t-1}} - 1 \right)^2 \right\} I_{j,t} \right] \\ & - \epsilon_{j,t}^E \left[x_{j,t} - \left\{ \int_0^1 (l_{jk,t} - \gamma^L s_{k,t-1})^{\frac{\xi-1}{\xi}} dk \right\}^{\frac{\xi}{\xi-1}} \right] \end{aligned} \right] \right\} \quad (C.9)$$

where $Y_{j,t} = A_t (N_{j,t})^{1-\alpha} \left\{ (H_{j,t-1}^E)^\phi (K_{j,t-1})^{1-\phi} \right\}^\alpha$ may be inserted for $Y_{j,t}$ in the budget constraint.

Solving entrepreneur's optimization problem, the first order conditions are (I ignore all j 's here):

$$\frac{\partial \mathcal{L}}{\partial C_t^E} : \frac{1}{C_t^E - \gamma^E C_{t-1}^E} - \beta^E \mathbb{E}_t \frac{\gamma^E}{C_{t+1}^E - \gamma^E C_t^E} = \lambda_t^E \quad (C.10)$$

$$\frac{\partial \mathcal{L}}{\partial x_t} : \lambda_t^E = \epsilon_t^E \quad (C.11)$$

$$\frac{\partial \mathcal{L}}{\partial l_t} : \epsilon_t^E = \beta^E \mathbb{E}_t \lambda_{t+1}^E R_t^L + \mu_t^E R_t^L \quad (C.12)$$

$$\frac{\partial \mathcal{L}}{\partial N_t} : W_t = (1 - \alpha) \frac{Y_t}{N_t} \quad (C.13)$$

$$\frac{\partial \mathcal{L}}{\partial H_t^E} : \lambda_t^E Q_t^H = \beta^E \mathbb{E}_t \left\{ \lambda_{t+1}^E \left(Q_{t+1}^H + \alpha \phi \frac{Y_{t+1}}{H_t^E} \right) \right\} + \mu_t^E \theta \mathbb{E}_t Q_{t+1}^H \quad (C.14)$$

$$\frac{\partial \mathcal{L}}{\partial K_t} : \kappa_t^E = \alpha (1 - \phi) \beta^E \mathbb{E}_t \left(\frac{\lambda_{t+1}^E Y_{t+1}}{K_t} \right) + \beta^E (1 - \delta) \mathbb{E}_t \kappa_{t+1}^E + \mu_t^E \theta \mathbb{E}_t Q_{t+1}^K \quad (C.15)$$

$$\frac{\partial \mathcal{L}}{\partial I_t} : \lambda_t^E = \kappa_t^E \left\{ 1 - \frac{\Omega}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 - \Omega \frac{I_t}{I_{t-1}} \left(\frac{I_t}{I_{t-1}} - 1 \right) \right\} + \beta^E \Omega \mathbb{E}_t \left\{ \kappa_{t+1}^E \left(\frac{I_{t+1}}{I_t} \right)^2 \left(\frac{I_{t+1}}{I_t} - 1 \right) \right\} \quad (C.16)$$

Using $\lambda_t^E = \epsilon_t^E$ from (C.11), (C.12) becomes

$$\beta^E \mathbb{E}_t (\lambda_{t+1}^E R_t^L) + \mu_t^E R_t^L = \lambda_t^E \quad (C.17)$$

C.3 BANKS

The problem of bank is to choose its lending rate and its demand for deposits. The bank's optimization problem can be written as

$$\mathcal{L}_t = \mathbb{E}_t \left\{ \sum_{\tau=t}^{\infty} q_{t,\tau} \left[\begin{aligned} & \Psi_\tau R_{k,\tau-1}^L L_{k,\tau-1} - R_{\tau-1}^D D_{k,\tau-1} \\ & + \varrho_\tau^E \left[\int_0^1 \left[\left(\frac{R_\tau^L}{R_{k,\tau}^L} \right)^\xi x_\tau + \gamma^L s_{k,\tau-1} \right] dj - L_{k,\tau} \right] \end{aligned} \right] \right\} \quad (C.18)$$

The first order condition with respect to $D_{k,t}$ is

$$\mathbb{E}_t q_{t,t+1} \Psi_{t+1} R_{k,t}^L - \mathbb{E}_t q_{t,t+1} R_t^D + \gamma^L (1 - \rho_s) \mathbb{E}_t (q_{t,t+1} \varrho_{t+1}^E) - \varrho_t^E = 0 \quad (C.19)$$

Rearranging terms

$$\varrho_t^E = \mathbb{E}_t q_{t,t+1} \left[(\Psi_{t+1} R_{k,t}^L - R_t^D) + \gamma^L (1 - \rho_s) \mathbb{E}_t \varrho_{t+1}^E \right] \quad (\text{C.20})$$

The first order condition with respect to $R_{k,t}^L$ is

$$\mathbb{E}_t q_{t,t+1} \Psi_{t+1} L_{k,t} + \xi \varrho_t^E \left(\frac{R_t^L}{R_{k,t}^L} \right)^{\xi-1} x_t \left(\frac{-R_t^L}{(R_{k,t}^L)^2} \right) = 0 \quad (\text{C.21})$$

Moving terms around

$$\mathbb{E}_t q_{t,t+1} \Psi_{t+1} L_{k,t} = \xi \varrho_t^E x_t \left(\frac{R_t^L}{R_{k,t}^L} \right)^{\xi-1} \left(\frac{R_t^L}{(R_{k,t}^L)^2} \right) \quad (\text{C.22})$$

In a symmetric equilibrium all banks have the same lending rate $R_{k,t}^L = R_t^L$, $\forall k$ and consequently lend the same amount $L_{k,t} = L_t$, $\forall k$. Bank's first order conditions in this case can be rewritten as

$$\varrho_t^E = \mathbb{E}_t q_{t,t+1} \left[(\Psi_{t+1} R_t^L - R_t^D) + \gamma^L (1 - \rho_s) \mathbb{E}_t \varrho_{t+1}^E \right] \quad (\text{C.23})$$

$$\frac{\xi \varrho_t^E x_t}{R_t^L} = \mathbb{E}_t q_{t,t+1} \Psi_{t+1} L_t \quad (\text{C.24})$$

where I have imposed $L_t = l_t$ in a symmetric equilibrium.

D LIST OF EQUATIONS

D.1 HOUSEHOLDS

$$\frac{1}{C_t^P - \gamma^P C_{t-1}^P} - \beta^P \mathbb{E}_t \frac{\gamma^P}{C_{t+1}^P - \gamma^P C_t^P} = \lambda_t^P \quad (\text{D.1})$$

$$\beta^P \mathbb{E}_t \lambda_{t+1}^P = \frac{\lambda_t^P}{R_t^D} \quad (\text{D.2})$$

$$\frac{\varsigma}{H_t^P} + \beta^P \mathbb{E}_t (\lambda_{t+1}^P Q_{t+1}^H) = \lambda_t^P Q_t^H \quad (\text{D.3})$$

$$N_t^{\eta-1} = \lambda_t^P W_t \quad (\text{D.4})$$

D.2 ENTREPRENEURS

$$\frac{1}{C_t^E - \gamma^E C_{t-1}^E} - \beta^E \mathbb{E}_t \frac{\gamma^E}{C_{t+1}^E - \gamma^E C_t^E} = \lambda_t^E \quad (\text{D.5})$$

$$\beta^E \mathbb{E}_t (\lambda_{t+1}^E R_t^L) + \mu_t^E R_t^L = \lambda_t^E \quad (\text{D.6})$$

$$W_t = (1 - \alpha) \frac{Y_t}{N_t} \quad (\text{D.7})$$

$$\lambda_t^E Q_t^H = \beta^E \mathbb{E}_t \left\{ \lambda_{t+1}^E \left(Q_{t+1}^H + \alpha \phi \frac{Y_{t+1}}{H_t^E} \right) \right\} + \mu_t^E \theta \mathbb{E}_t Q_{t+1}^H \quad (\text{D.8})$$

$$\kappa_t^E = \alpha (1 - \phi) \beta^E \mathbb{E}_t \left(\frac{\lambda_{t+1}^E Y_{t+1}}{K_t} \right) + \beta^E (1 - \delta) \mathbb{E}_t \kappa_{t+1}^E + \mu_t^E \theta \mathbb{E}_t Q_{t+1}^K \quad (\text{D.9})$$

$$\lambda_t^E = \kappa_t^E \left\{ 1 - \frac{\Omega}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 - \Omega \frac{I_t}{I_{t-1}} \left(\frac{I_t}{I_{t-1}} - 1 \right) \right\} + \beta^E \Omega \mathbb{E}_t \left\{ \kappa_{t+1}^E \left(\frac{I_{t+1}}{I_t} \right)^2 \left(\frac{I_{t+1}}{I_t} - 1 \right) \right\} \quad (\text{D.10})$$

$$s_t = \rho_s s_{t-1} + (1 - \rho_s) l_t \quad (\text{D.11})$$

$$x_t = (l_t - \gamma^L s_{t-1}) \quad (\text{D.12})$$

$$L_t = l_t \quad (\text{D.13})$$

$$C_t^E + R_{t-1}^L l_{t-1} = Y_t - W_t N_t - I_t - Q_t (H_t^E - H_{t-1}^E) + x_t \quad (\text{D.14})$$

$$l_t = \frac{\theta a_t}{R_t^L} \quad (\text{D.15})$$

$$a_t = \mathbb{E}_t (Q_{t+1}^H H_t^E + Q_{t+1}^K K_t) \quad (\text{D.16})$$

$$\kappa_t^E = \lambda_t^E Q_t^K \quad (\text{D.17})$$

D.3 BANKS

$$\varrho_t^E = \mathbb{E}_t q_{t,t+1} \left[(\Psi_{t+1} R_t^L - R_t^D) + \gamma^L (1 - \rho_s) \mathbb{E}_t \varrho_{t+1}^E \right] \quad (\text{D.18})$$

$$\xi \varrho_t^E x_t \frac{1}{R_t^L} = \mathbb{E}_t q_{t,t+1} \Psi_{t+1} L_t \quad (\text{D.19})$$

$$\Pi_t = \Psi_t R_{t-1}^L L_{t-1} + D_t - L_t - R_{t-1}^D D_{t-1} \quad (\text{D.20})$$

$$L_t = D_t \quad (\text{D.21})$$

$$q_{t,t+1} = \beta^P \mathbb{E}_t \frac{\lambda_{t+1}^P}{\lambda_t^P} \quad (\text{D.22})$$

D.4 MARKET CLEARING AND RESOURCE CONSTRAINTS

$$C_t^P + C_t^E + I_t = Y_t \quad (\text{D.23})$$

$$H_t^P + H_t^E = H \quad (\text{D.24})$$

$$Y_t = A_t (N_t)^{1-\alpha} \left\{ (H_{t-1}^E)^\phi (K_{t-1})^{1-\phi} \right\}^\alpha \quad (\text{D.25})$$

$$K_t = (1 - \delta) K_{t-1} + \left\{ 1 - \frac{\Omega}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 \right\} I_t \quad (\text{D.26})$$

E STEADY STATE CONDITIONS

All i 's, j 's and k 's denoting individual household, entrepreneur and bank respectively are ignored.

From household's FOC with respect to consumption (D.1) and labor (D.4), I have

$$\frac{1 - \beta^P \gamma^P}{(1 - \gamma^P) C^P} = \lambda^P \quad (\text{E.1})$$

and

$$N^{\eta-1} = \lambda^P W \quad (\text{E.2})$$

respectively. Household's FOC with respect to deposit (D.2) yields the steady-state gross interest rate

$$R^D = \frac{1}{\beta^P} \quad (\text{E.3})$$

underscoring that the time preference of most patient individual determines the steady-state rate of interest. From (D.3), I obtain

$$\begin{aligned} \frac{\varsigma}{H^P} + \beta^P \lambda^P Q^H &= \lambda^P Q^H \\ \Rightarrow Q^H H^P &= \frac{\varsigma}{\lambda^P (1 - \beta^P)} \\ \Rightarrow H^P &= \frac{\varsigma}{Q^H \lambda^P (1 - \beta^P)} \end{aligned} \quad (\text{E.4})$$

I next turn to entrepreneurs. Their consumption FOC (D.5) yields

$$\frac{1 - \beta^E \gamma^E}{(1 - \gamma^E) C^E} = \lambda^E \quad (\text{E.5})$$

Entrepreneur's FOC with respect to loans (D.6) gives

$$\begin{aligned} \beta^E \lambda^E R^L + \mu^E R^L &= \lambda^E \\ \Rightarrow \mu^E &= \frac{\lambda^E (1 - \beta^E R^L)}{R^L} \end{aligned} \quad (\text{E.6})$$

The borrowing constraint for entrepreneurs binds only if μ^E is positive. This implies that β^E must be less than R^L . In the baseline calibration, β^E is set to 0.95 whereas the steady state value of R^L is 1.0219 which implies that β^E must be less than 0.9786 which is indeed the case. The production function is

$$Y = A(N)^{1-\alpha} \left[(H^E)^\phi (K)^{1-\phi} \right]^\alpha \quad (\text{E.7})$$

From firm's labor choice for households (D.7),

$$W = (1 - \alpha) \frac{Y}{N} \quad (\text{E.8})$$

From entrepreneur's FOC with respect to housing (D.8), I have

$$\begin{aligned}\lambda^E Q^H &= \beta^E \lambda^E \left(Q^H + \alpha \phi \frac{Y}{H^E} \right) + \mu^E \theta Q^H \\ \Rightarrow \frac{Q^H H^E}{Y} &= \frac{\beta^E \alpha \phi R^L}{(1 - \beta^E) R^L - \theta (1 - \beta^E R^L)}\end{aligned}\quad (\text{E.9})$$

From aggregate law of motion for capital (D.26)

$$\begin{aligned}K &= (1 - \delta) K + \left[1 - \frac{\Omega}{2} \left(\frac{I}{I} - 1 \right) \right] I \\ \Rightarrow I &= \delta K\end{aligned}\quad (\text{E.10})$$

I have the following steady-state resource constraints

$$Y = C^P + C^E + I \quad (\text{E.11})$$

$$H = H^P + H^E \quad (\text{E.12})$$

$$L = D \quad (\text{E.13})$$

Also, I have the following steady-state version of agents' budget constraints (one of them is redundant because of Walras' Law)

$$C^P = WN - (R^D - 1)D + \Pi \quad (\text{E.14})$$

$$C^E = Y - R^L l - WN - I - x \quad (\text{E.15})$$

So the steady state is characterized by the vector

$$\left[Y, C^P, C^E, I, H^P, H^E, K, N, L, D, Q^H, Q^K, R^D, R^L, W, \lambda^P, \lambda^E, \mu^E \right]$$

From entrepreneur's optimal choice of capital (D.9), I have

$$\begin{aligned}\kappa_t^E &= \alpha (1 - \alpha) \beta^E \mathbb{E}_t \left(\frac{\lambda_{t+1}^E Y_{t+1}}{K_t} \right) + \beta^E (1 - \delta) \mathbb{E}_t \kappa_{t+1}^E + \mu_t^E \theta_t \mathbb{E}_t Q_{t+1}^K \\ \Rightarrow \frac{\kappa_t^E}{\lambda_t^E} (1 - (1 - \delta) \beta^E) &= \alpha (1 - \phi) \beta^E \frac{Y}{K} + \frac{(1 - \beta^E R^L)}{R^L} \theta Q^K\end{aligned}\quad (\text{E.16})$$

Entrepreneur's optimal choice of investment (D.10) yields

$$\begin{aligned}\lambda_t^E(j) &= \kappa_t^E(j) \left[1 - \frac{\Omega}{2} \left(\frac{I_t(j)}{I_t(j-1)} - 1 \right)^2 - \Omega \frac{I_t(j)}{I_t(j-1)} \left(\frac{I_t(j)}{I_{t-1}(j)} - 1 \right) \right] \\ &\quad + \beta^E \Omega \mathbb{E}_t \left[\kappa_{t+1}^E(j) \left(\frac{I_{t+1}(j)}{I_t(j)} \right)^2 \left(\frac{I_{t+1}(j)}{I_t(j)} - 1 \right) \right] \\ \Rightarrow \lambda^E &= \kappa^E\end{aligned}\quad (\text{E.17})$$

Combining this with steady state version of

$$\kappa^E = \lambda^E Q^K \quad (\text{E.18})$$

I obtain $Q^K = 1$ in the steady state. Plugging this into (E.16), I obtain the expression for capital-to-output ratio

$$\begin{aligned} \frac{\kappa^E}{\lambda^E} (1 - (1 - \delta) \beta^E) &= \alpha (1 - \phi) \beta^E \frac{Y}{K} + \frac{(1 - \beta^E R^L)}{R^L} \theta Q^K \\ \Rightarrow \frac{K}{Y} &= \frac{\alpha (1 - \phi) R^L \beta^E}{R^L (1 - (1 - \delta) \beta^E) - \theta (1 - \beta^E R^L)} \end{aligned} \quad (\text{E.19})$$

Next, combining (D.15) and (D.16) yields

$$l = \frac{\theta}{R^L} [Q^H H^E + Q^K K] \quad (\text{E.20})$$

Dividing by Y , the above expression becomes

$$\frac{l}{Y} = \frac{\theta}{R^L} \left[\frac{Q^H H^E}{Y} + \frac{Q^K K}{Y} \right]$$

Plugging in the values of $\frac{Q^H H^E}{Y}$ and $\frac{K}{Y}$ and using that $Q^K = 1$, I have

$$\frac{l}{Y} = \alpha \theta \beta^E \left[\frac{\phi}{R^L (1 - \beta^E) - \theta (1 - \beta^E R^L)} + \frac{(1 - \phi)}{R^L (1 - (1 - \delta) \beta^E) - \theta (1 - \beta^E R^L)} \right] \quad (\text{E.21})$$

From entrepreneur's budget constraint (D.14)

$$C^E + R^L l = Y - WN - I + x \quad (\text{E.22})$$

Rewriting this in ratios to output

$$\begin{aligned} \frac{C^E}{Y} + \frac{R^L l}{Y} &= 1 - \frac{WN}{Y} - \frac{I}{Y} + \frac{x}{Y} \\ \Rightarrow \frac{C^E}{Y} &= \alpha - \delta \frac{K}{Y} + (1 - \gamma^L - R^L) \frac{l}{Y} \end{aligned} \quad (\text{E.23})$$

Dividing (E.4) by Y and then dividing it again by (E.9) gives

$$\begin{aligned} \frac{\frac{Q^H H^P}{Y}}{\frac{Q^H H^E}{Y}} &= \frac{\frac{\varsigma}{Y \lambda^P (1 - \beta^P)}}{\frac{\beta^E \alpha \phi R^L}{(1 - \beta^P) R^L - \theta (1 - \beta^E R^L)}} \\ \Rightarrow \frac{H^P}{H^E} &= \frac{\varsigma}{Y \frac{1 - \beta^P \gamma^P}{(1 - \gamma^P) C^P} (1 - \beta^P)} \frac{(1 - \beta^E) R^L - \theta (1 - \beta^E R^L)}{\beta^E \alpha \phi R^L} \\ \Rightarrow \frac{H^P}{H - H^P} &= \frac{\varsigma (1 - \gamma^P)}{(1 - \beta^P) (1 - \beta^P \gamma^P)} \frac{(1 - \beta^P) R^L - \theta (1 - \beta^E R^L)}{\beta^E \alpha \phi R^L} \frac{C^P}{Y} \end{aligned} \quad (\text{E.24})$$

From entrepreneur's stock of habits for loans (D.11)

$$\begin{aligned} s_t &= \rho_s s_{t-1} + (1 - \rho_s) l_t \\ s &= l \end{aligned} \quad (\text{E.25})$$

Entrepreneur's effective demand for loans (D.12) gives

$$\begin{aligned} x_t &= (l_t - \gamma^L s_{t-1}) \\ \Rightarrow x &= (1 - \gamma^L) l \end{aligned} \quad (\text{E.26})$$

Total loans of entrepreneurs (D.13)

$$L = l \quad (\text{E.27})$$

From bank's balance sheet condition (D.21), total deposits must equal total loans

$$D = L \quad (\text{E.28})$$

Steady state version of stochastic discount factor (D.22) reads

$$q = \beta^P \quad (\text{E.29})$$

The steady-state version of bank's first order condition (D.18) with respect to deposits reads

$$\varrho^E = \beta^P [\Psi R^L - R^D + \gamma^L (1 - \rho_s) \varrho^E]$$

which can be simplified to yield

$$\varrho^E = \beta^P \frac{\Psi R^L - R^D}{1 - \beta^P \gamma^L (1 - \rho_s)} \quad (\text{E.30})$$

The steady-state version of bank's second first order condition with respect to lending rate (D.19) writes

$$\xi \varrho^E x \frac{1}{R^L} = \beta^P \Psi L$$

Steady-state version of aggregate resource constraint (D.23) is

$$\begin{aligned} C^P + C^E + I &= Y \\ \Rightarrow \frac{C^P}{Y} &= 1 - \frac{C^E}{Y} - \delta \frac{K}{Y} \end{aligned} \quad (\text{E.31})$$

Combining (E.1), (E.2) and (E.8) gives steady-state equilibrium condition for households

$$\begin{aligned} N^{\eta-1} &= \lambda^P W \\ \Rightarrow N^{\eta-1} &= \frac{1 - \beta^P \gamma^P}{(1 - \gamma^P) C^P} (1 - \alpha) \frac{Y}{N} \\ \Rightarrow N &= \left[\frac{(1 - \beta^P \gamma^P) (1 - \alpha)}{(1 - \gamma^P)} \left(\frac{C^P}{Y} \right)^{-1} \right]^{\frac{1}{\eta}} \end{aligned} \quad (\text{E.32})$$

From (D.25), steady state output is

$$\begin{aligned}
Y &= A(N)^{1-\alpha} \left[(H^E)^\phi (K)^{1-\phi} \right]^\alpha \\
Y^{1-\alpha} &= A(N)^{1-\alpha} \left[\left(\frac{H^E}{Y} \right)^\phi \left(\frac{K}{Y} \right)^{1-\phi} \right]^\alpha \\
Y^{1-\alpha} &= A(N)^{1-\alpha} \left[\left(\frac{H^E}{Y} \right)^\phi \left(\frac{\alpha(1-\phi)R^L\beta^E}{R^L(1-(1-\delta)\beta^E) - \theta(1-\beta^E R^L)} \right)^{1-\phi} \right]^\alpha
\end{aligned} \tag{E.33}$$

From (E.4)

$$Q^H = \frac{\varsigma}{H^P \lambda^P (1 - \beta^P)} \tag{E.34}$$

F SYSTEM OF LOGLINEAR EQUATIONS

The system of equations log-linearized around their steady state is as below:

F.1 OPTIMALITY CONDITIONS OF HOUSEHOLDS

Equations (D.1), (D.2) and (D.3) become

$$\beta^P \gamma^P \mathbb{E}_t \widehat{C}_{t+1}^P - \left(1 + (\gamma^P)^2 \beta^P \right) \widehat{C}_t^P + \gamma^P \widehat{C}_{t-1}^P = (1 - \beta^P \gamma^P) (1 - \gamma^P) \widehat{\lambda}^P \tag{F.1}$$

$$\mathbb{E}_t \widehat{\lambda}_{t+1}^P = \widehat{\lambda}_t^P - \widehat{R}_t^D \tag{F.2}$$

$$\beta^P \mathbb{E}_t \left[\widehat{\lambda}_{t+1}^P + \widehat{Q}_{t+1}^H + \widehat{H}_t^P \right] = \widehat{\lambda}_t^P + \widehat{Q}_t^H + \widehat{H}_t^P \tag{F.3}$$

Log-linearization of (D.4) gives

$$(\eta - 1) \widehat{N}_t = \widehat{\lambda}_t^P + \widehat{W}_t \tag{F.4}$$

F.2 OPTIMALITY CONDITIONS OF ENTREPRENEURS

From (D.5) and (D.6), I have

$$\beta^E \gamma^E \mathbb{E}_t \widehat{C}_{t+1}^E - \left(1 + (\gamma^E)^2 \beta^E \right) \widehat{C}_t^E + \gamma^E \widehat{C}_{t-1}^E = (1 - \beta^E \gamma^E) (1 - \gamma^E) \widehat{\lambda}_t^E \tag{F.5}$$

and

$$\widehat{\lambda}_t^E = \widehat{R}_t^L + \beta^E R^L \mathbb{E}_t \widehat{\lambda}_{t+1}^E + (1 - \beta^E R^L) \widehat{\mu}_t^E \tag{F.6}$$

Equation (D.7) yields

$$\widehat{W}_t = \widehat{Y}_t - \widehat{N}_t \tag{F.7}$$

From (D.8), I derive

$$\begin{aligned} (\widehat{\lambda}_t^E + \widehat{Q}_t^H) &= \beta^E \mathbb{E}_t(\widehat{\lambda}_{t+1}^E + \widehat{Q}_{t+1}^H) + \left(\frac{1}{R^L} - \beta^E\right) \theta \mathbb{E}_t(\widehat{\mu}_t^E + \widehat{Q}_{t+1}^H) \\ &\quad + \left[(1 - \beta^E) - \theta\left(\frac{1}{R^L} - \beta^E\right)\right] \mathbb{E}_t[\widehat{\lambda}_{t+1}^E + \widehat{Y}_{t+1} - \widehat{H}_t^E] \end{aligned} \quad (\text{F.8})$$

(D.9) becomes

$$\begin{aligned} \widehat{Q}_t^K &= \left[1 - \beta^E(1 - \delta) - \theta\left(\frac{1}{R^L} - \beta^E\right)\right] \mathbb{E}_t[\widehat{\lambda}_{t+1}^E - \widehat{\lambda}_t^E + \widehat{Y}_{t+1} - \widehat{K}_t] \\ &\quad + \beta^E(1 - \delta) \mathbb{E}_t(\widehat{Q}_{t+1}^K + \widehat{\lambda}_{t+1}^E - \widehat{\lambda}_t^E) + (1 - \beta^E R^L) \frac{1}{R^L} \theta \mathbb{E}_t[\widehat{\mu}_t^E - \widehat{\lambda}_t^E + \widehat{Q}_{t+1}^K] \end{aligned} \quad (\text{F.9})$$

(D.10) is approximated as

$$\widehat{Q}_t^K = (1 + \beta^E) \Omega \widehat{I}_t - \beta^E \Omega \mathbb{E}_t \widehat{I}_{t+1} - \Omega \widehat{I}_{t-1} \quad (\text{F.10})$$

From (D.11) and (D.12), I get

$$\widehat{s}_t = \rho_s \widehat{s}_{t-1} + (1 - \rho_s) \widehat{l}_t \quad (\text{F.11})$$

and

$$\widehat{x}_t = \frac{\widehat{l}_t}{1 - \gamma^L} - \frac{\gamma^L \widehat{s}_{t-1}}{1 - \gamma^L} \quad (\text{F.12})$$

From (D.13), I obtain

$$\widehat{L}_t = \widehat{l}_t \quad (\text{F.13})$$

Equation (D.14) becomes

$$C^E \widehat{C}_t^E + R^L l \left(\widehat{R}_{t-1}^L + \widehat{l}_{t-1} \right) = Y \widehat{Y}_t - W N \left(\widehat{W}_t + \widehat{N}_t \right) - I \widehat{I}_t - Q^H H^E \left(\widehat{H}_t^E - \widehat{H}_{t-1}^E \right) + x \widehat{x}_t \quad (\text{F.14})$$

(D.15) gives

$$\widehat{l}_t = \widehat{a}_t - \widehat{R}_t^L \quad (\text{F.15})$$

(D.16) yields

$$\widehat{a}_t = \frac{Q^H H^E}{Q^H H^E + Q^K K} \mathbb{E}_t \left(\widehat{Q}_{t+1}^H + \widehat{H}_t^E \right) + \frac{Q^K K}{Q^H H^E + Q^K K} \mathbb{E}_t \left(\widehat{Q}_{t+1}^K + \widehat{K}_t \right) \quad (\text{F.16})$$

Linearized versions of (D.17) is

$$\widehat{\kappa}_t^E = \widehat{\lambda}_t^E + \widehat{Q}_t^K \quad (\text{F.17})$$

F.3 OPTIMALITY CONDITIONS OF BANKS

From Equation (D.18), I obtain

$$\frac{\varrho^E}{\beta^P} \hat{\varrho}_t^E - \varrho^E \gamma^L (1 - \rho_s) \mathbb{E}_t \hat{\varrho}_{t+1}^E = [\Psi R^L - R^D + \varrho^E \gamma^L (1 - \rho_s)] \mathbb{E}_t \hat{q}_{t,t+1} + \Psi R^L (\hat{\Psi}_{t+1} + \hat{R}_t^L) - R^D \hat{R}_t^D \quad (\text{F.18})$$

Log-linearization of (D.19) yields

$$\xi \varrho^E x (\hat{\varrho}_t^E + \hat{x}_t) = \beta^P R^L \Psi L \left(\hat{R}_t^L + \hat{\Psi}_{t+1} + \hat{L}_t + \mathbb{E}_t \hat{q}_{t,t+1} \right) \quad (\text{F.19})$$

From (D.21), I get

$$\hat{L}_t = \hat{D}_t \quad (\text{F.20})$$

Linearized versions of (D.22) is

$$\hat{q}_{t,t+1} = \hat{\lambda}_{t+1}^P - \hat{\lambda}_t^P \quad (\text{F.21})$$

F.4 MARKET CLEARING AND RESOURCE CONSTRAINTS

Equations (D.23) and (D.24) yield

$$\hat{Y}_t = \frac{C^P}{Y} \hat{C}_t^P + \frac{C^E}{Y} \hat{C}_t^E + \frac{I}{Y} \hat{I}_t \quad (\text{F.22})$$

and

$$H^P \hat{H}_t^P + H^E \hat{H}_t^E = 0 \quad (\text{F.23})$$

From (D.25), I have

$$\hat{Y}_t = \hat{A}_t + (1 - \alpha) \hat{N}_t + \alpha \phi \hat{H}_{t-1}^E + \alpha (1 - \phi) \hat{K}_{t-1} \quad (\text{F.24})$$

(D.26) gives

$$\hat{K}_t = (1 - \delta) \hat{K}_{t-1} + \delta \hat{I}_t \quad (\text{F.25})$$