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Domestic and International Political Economy of Banking Regulation

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"αιέν αριστεύειν και υπείροχον έμμεναι άλλων,
μηδέ γένος πατέρων αισχυνέμεν"

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Abstract

Banking regulation affects the allocation of resources among interest groups within an economy, and among jurisdictions across the globe. Thus, domestic and international political forces aim to shape banking regulation—besides purely economic considerations in terms of total welfare-maximization. These forces are formally modeled and analyzed in this thesis. The general equilibrium approach of the analysis allows a thorough understanding of the impact of the political economy of banking regulation on risk-taking and the allocation of resources, and consequently, on financial stability and social welfare.

The mechanism at work when competing governments set capital requirements, that can be complemented by taxation, is modeled in Chapter 2. This mechanism is driven by the trade-off between accentuating benefits over costs from banking on the one hand, and enhancing banks' competitiveness on the other hand. Benefits and costs take the form of tax revenues and bailout costs, respectively. Governments, economizing on equity issuance costs, set capital requirements at the minimum level and counteract bailout costs by raising tax revenues. Regulatory competition yields the socially optimal outcome by preventing both excessive taxation—which would harm banks' competitiveness—and taxation below the optimal level—which would yield excessive bailout costs. In Chapter 3, bank resolution is also endogenized, thus allowing governments to decide whether failed banks should be bailed out or bailed in. The socially optimal outcome of regulatory competition is sustained. Yet, regulatory competition yields an inefficient outcome when competing governments cannot counteract potential bailout costs by taxation. The results of the base model of Chapter 2 are tested with regard to households' risk-aversion, and found robust, in Chapter 4.

Aspects of domestic political economy of banking regulation are studied in Chapter 5. The misalignment of interests between ordinary households and politicians allows bankers to offer lobbying contributions to politicians, who, in turn, set favorable regulation for bankers. The misalignment of interests arises because politicians can receive lobbying contributions that are not shared by the rest of households. Lobbying results in over-investment in the risky sector, undermining financial stability and harming social welfare. Market-based tools such as bail-in and equity funding restore the socially optimal allocation. Broader political participation can also mitigate resource misallocation.

Résumé

Les régulations bancaires ont un impact sur la répartition des ressources entre différents groupes d'intérêt ainsi que sur la répartition des ressources entre les nations. Les forces politiques nationales et internationales ont donc pour but de mettre en œuvre un cadre de régulations bancaires. Ces forces sont formellement modélisées et analysées dans la présente thèse. L'approche par un modèle d'équilibre général permet une compréhension précise de l'impact de l'économie politique des régulations bancaires sur la répartition des ressources et par conséquent sur le bien-être général.

Le mécanisme à l'œuvre dans le processus de sélection de la régulation sur les capitaux propres par des gouvernements en compétition et potentiellement d'une imposition complémentaire est modélisé dans le Chapitre 2, dans lequel les gouvernements renflouent les banques en faillite. Les gouvernements qui économisent sur les coûts d'émission des capitaux propres instaurent le niveau de régulation sur les capitaux propres le plus faible, tout en neutralisant les coûts de renflouement par une imposition sur les entreprises risquées ou par une imposition liée au risque systémique sur les bilans des banques. La compétition entre les gouvernements produit une constellation qui maximise le bien-être en empêchant à la fois une imposition excessive et une imposition trop faible. Dans le Chapitre 3, le processus de résolution de la faillite des banques est rendu endogène, ce qui permet aux gouvernements de décider si les banques en faillite seront renflouées ou non. La compétition entre les gouvernements engendre un bien-être suboptimal lorsque ceux-ci sont incapables de compenser les coûts de renflouement potentiels par l'imposition. Le Chapitre 4 montre que les résultats du modèle de base restent valables si l'on considère que les ménages sont averses au risque.

Les aspects liés à l'économie politique nationale des régulations bancaires sont étudiés dans le Chapitre 5. L'écart entre les intérêts des ménages et ceux des politiciens donne la possibilité aux banquiers de faire du lobbying par des donations en échange de régulations bancaires plus favorables. Cette différence d'intérêts tient au fait que les politiciens peuvent recevoir des dons qu'ils ne partagent pas avec le reste des ménages. Les instruments basés sur le marché, comme l'absence de renflouement et le financement par les capitaux propres, rétablissent un niveau de bien-être général optimal. Une participation politique plus importante peut aussi atténuer la mauvaise affectation des ressources.

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1 Introduction

As a form of economic regulation, banking regulation can be justified from an economic point of view as a tool to correct market failures which take place in the intermediation process between savers and borrowers, and which might be most accentuated in the banking sector. Following this interpretation, all we need is a benevolent regulator considering the optimal banking regulation within his jurisdiction. Yet, this thesis suggests that regulator's considerations should extend beyond his jurisdiction, and that his benevolence cannot be taken for granted. That is, domestic and international political economy of banking regulation is studied.

Aspects of domestic political economy stem from the fact that banking regulation affects the allocation of resources among interest groups within an economy. Aspects of international political economy come into play because banking regulation affects the allocation of resources among states within the globe, especially in an environment of internationally integrated financial markets.

One could nevertheless argue that in the presence of international standard-setting bodies, staffed by politically independent technocrats, the study of the political economy of banking regulation is obsolete. However, the standards recommended by these bodies are non-binding ("soft law") instruments. For example, the Charter of the Basel Committee on Banking Supervision (BCBS) states that

> *"BCBS does not possess any formal supranational authority. Its decisions do not have legal force."*

Indeed, although market discipline mechanisms enforce BCBS recommendations as minimum standards, the decision to what extent these standards should be tightened remains a national prerogative.

A concrete example, where aspects of domestic and international political economy in banking regulation can be clearly identified, is the Federal Act on the Swiss Financial Market Supervisory Authority, which outlines the regulation principles in Switzerland. Specifically, according to Article 7(2),

> *"[The Swiss Financial Market Supervisory Authority] exercises its regulatory powers (...). In doing so, it takes account in particular of:*
>
> *a. the costs that the supervised persons and entities incur due to regulation;*

b. the effect that regulation has on competition, innovative ability and the international competitiveness of Switzerland's financial centre;

c. the various business activities and risks incurred by the supervised persons and entities; and

d. the international minimum standards."

In this thesis, the above considerations are discussed in connection with the results of the analysis, or taken into account in the form of assumptions.

1.1 The Case of the European Union

Besides the impact of banking regulation on the allocation of resources among different groups, which naturally entails political considerations, the study of the political economy of banking regulation can be further motivated from an institutional perspective. In particular, the constitutional framework within the European Union (EU) as well as the substance of the EU banking legislation are now analyzed with a twofold objective:

- The analysis of the EU constitutional framework reveals that the understanding of the pros and cons of legislating at national or supranational level is an essential part of the legislative process.[1]

- The analysis of the substance of EU banking legislation supports a number of legal rules that are used as assumptions for the economic modeling in the next chapters, and establishes an empirical benchmark to which the theoretical results can be compared.[2]

1.1.1 Constitutional Framework

In the absence of a formal constitution of the EU,[3] the Treaty on European Union (henceforth TEU) and the Treaty on the Functioning of the European Union (henceforth TFEU) serve as the constitutional framework for legal acts within the EU.[4] Thus, banking legislation is also confined within this framework.

[1] This analysis only covers provisions that are relevant to this thesis. For a comprehensive analysis of the EU constitutional framework, see Schütze (2016).

[2] This analysis only covers aspects of EU banking legislation that are relevant to this thesis, namely, capital regulation, deposit guarantees and bank resolution. For a legal and institutional analysis of recent developments of the EU banking legislation, see Alexander (2015).

[3] The Treaty establishing a Constitution for Europe, although signed on 29 October 2004, was never ratified.

[4] The EU is founded on TEU and TFEU, jointly referred to as *"the Treaties"*, both of which have the same legal value; see Article 1 TEU.

Principles of Conferral, Subsidiarity and Proportionality

The authority of the EU—which is a supranational entity—to make laws that are legally binding at national level, as well as the limits of this authority, stem from the principles of conferral, subsidiarity and proportionality.[5]

According to Article 5(2) TEU,

> *"[u]nder the principle of **conferral**, the Union[6] shall act only within the limits of the competences conferred upon it by the Members States in the Treaties to attain the objectives[7] set out therein. Competences not conferred upon the Union in the Treaties remain with the Member States."*

According to Article 5(3) TEU,

> *"[u]nder the principle of **subsidiarity**, in areas which do not fall within its exclusive competence, the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at Union level."*

Finally, according to Article 5(4) TEU,

> *"[u]nder the principle of **proportionality**, the content and form of Union action shall not exceed what is necessary to achieve the objectives of the Treaties."*

The principles of conferral and subsidiarity allow actions at both national and supranational level. The principles of subsidiarity and proportionality indicate that whether a legal act shall be taken at the supranational level, and to what extent, depends upon the understanding of, and the comparison between, the pros and cons of law-making at national and supranational level in the respective policy area.

Legal Acts

Legal acts are made at supranational level in the form of *regulations*, *directives*, *decisions*, *recommendations* and *opinions*.[8] Recommendations and opinions are not binding. The other legal acts are binding to differing degrees. In particular, regulations are binding and applicable to all Member States, while decisions are binding only to those specified in these decisions. Directives are only binding as to the expected results, allowing Member States to deviate with respect to the employed forms and methods. The choice of the legal act must be in accordance with the principles of conferral, subsidiarity and proportionality.

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[5] Article 5 TEU.

[6] Union's acts imply legal acts that are decided at the supranational level.

[7] The promotion of the well-being of its peoples, as well as full employment belong, among others, to the objectives of the EU; see Article 3 TEU. In the following chapters, that is approximated in terms of economic modelling by the maximization of social welfare, as a social planner's objective.

[8] Article 288 TFEU.

National and Supranational Competences on Banking Legislation

A number of TFEU provisions—that often serve as the legal basis for legal acts on banking legislation—further detail the level at which legislation in specific policy areas must be decided. Article 114(1) TFEU allows actions to be taken at supranational level for the establishment and functioning of the internal market.[9] Note that all restrictions on the movement of capital within the internal market are prohibited.[10] Still, Member States keep the right to set national laws on taxation, and prudential supervision of financial institutions.[11] Nevertheless, Article 127(6) TFEU reserves the right for the Council to confer specific tasks upon the European Central Bank (ECB) with respect to prudential supervision of credit and financial institutions.[12]

It becomes clear that the Treaties aim to strike a balance between national and supranational competences in general and with respect to banking legislation in particular. Thus, and in accordance with the principles of conferral, subsidiarity and proportionality, the analysis of the virtues and limitations of legal acts at the national and supranational level is warranted.

1.1.2 Legal Framework

Although the framework defined by TEU and TFEU allows the adoption of legal acts at supranational level, when the financial crisis of 2007-2008 and the subsequent sovereign debt crisis hit the EU, banking legislation was a primarily national prerogative. The understanding that the fragmentation of banking legislation within the EU could contribute to the persistence and the contagion of these crises motivated a number of legal acts at supranational level, aiming at the establishment of a banking union with common rules across the EU. The aspects of the EU banking legislation that are relevant to the economic modeling of this thesis, i.e., capital requirements, deposit guarantees and bank resolution, are reviewed below.

Capital Requirements

The capital requirements for financial institutions operating within the EU are laid down by Regulation (EU) No 575/2013, known as Capital Requirements Regulation (henceforth CRR). Capital requirements are determined in the form of minimum own funds, as a ratio

[9] The internal market is defined as *"an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured"*; see Article 26(2) TFEU.
[10] Article 63(1) TFEU.
[11] Article 65(1) TFEU.
[12] Council Regulation (EU) No 1024/2013, which confers supervisory tasks, previously defined as national competence, upon the ECB is an example of the exercise of the rights defined in Article 127(6) TFEU.

to the total amount of risk exposure of a bank. The total amount of risk exposure of a bank is a measure of the credit risk, market risk, operational risk and settlement risk faced by this bank.[13] That implies that two banks holding the same amount of assets might be required to own different amount of capital, depending on the riskiness of their assets.

Own funds are classified into three categories; Common Equity Tier 1, Additional Tier 1 and Tier 2, ranked in a declining order of quality. Common Equity Tier 1 and Additional Tier 1 are described by Articles 25-61 CRR and mainly consist of common shares and retained earnings. Common Equity Tier 1 is classified as capital of higher quality than Additional Tier 1 because the former can be used by a financial institution immediately and without restrictions to cover losses. Tier 1 capital is equal to the sum of Common Equity Tier 1 and Additional Tier 1.[14] Tier 2, which is defined in detail by Articles 62-71 CRR, includes capital that does not qualify as Tier 1 capital and loans of more than 5 years maturity, owned by creditors that are always subordinated to guaranteed creditors. Total capital is the sum of Tier 1 and Tier 2 capital.

According to Article 92 CRR, banks shall own:

- a Common Equity Tier 1 capital ratio of 4.5%,
- a Tier 1 capital ratio of 6%, and
- a total capital ratio of 8%.

The above requirements are identical to the minimum capital requirements stipulated by the international standards of BCBS (2011). The reluctance of the EU authorities to tighten these minimum standards can be compared to, and explained by, the theoretical results in the next chapters.

CRR is complemented by Directive 2013/36/EU, known as Capital Requirements Directive IV (henceforth CRD IV),[15] which contains, among others, provisions for the authorization of banks to operate and bank supervision. The initial capital required for the authorization of a bank shall not be less than EUR 5 million.[16] This authorization can be withdrawn if capital requirements, as specified by CRR, or the conditions under which the authorization was granted, are violated.[17] The strictly positive amount of equity that

[13] Article 1 CRR.

[14] Article 25 CRR.

[15] Note that already three directives preceded CRD IV, whereas there is only one regulation with regard to capital requirements, namely CRR, which was adopted as late as 2013. Given the legal quality of directives and regulations, as described in Subsection 1.1.1, that indicates a shift of law-making within the EU from the national to the supranational level in the aftermath of the financial crisis 2007-2008 and the subsequent sovereign debt crisis.

[16] Article 12 CRD IV. Although exceptions are allowed, the initial capital can never be less than EUR 1 million.

[17] Article 18 CRD IV.

is required for a new bank to be authorized, and the provision that the authorization of a bank that does not comply with the capital requirements can be withdrawn are taken into consideration for the economic modeling in the chapters that follow.

Deposit Guarantees

Deposit guarantees are established within the EU according to Directive 2014/49/EU, known as Deposit Guarantee Scheme Directive (henceforth DGSD). At least one Deposit Guarantee Scheme (DGS) is required to be functioning within each Member State,[18] and each bank that operates within the EU is required to participate in, and thus be covered by, a DGS.[19] Lending between DGSs within the EU is allowed at certain conditions.[20] The amount of EUR 100 000 is set as the coverage level per depositor.[21] DGSs are financed by bank contributions,[22] and the raised funds should be invested in a low-risk and diversified portfolio.[23] Bank contributions are risk-based,[24] namely, banks that undertake riskier activities are expected to pay higher contributions to their DGS.

Banks are required to inform both potential and actual depositors about the DGS by which they are covered.[25] The ex ante depositors' awareness of the existence of deposit guarantee schemes is taken into consideration for the following chapters' economic modeling. DGSD, which as a directive only offers a minimum level of harmonization within the EU with respect to deposit guarantees, allows Member States to choose their own methods to achieve its purpose. In the next chapters, and in line with the current EU legislation, deposit guarantees will be modeled as being provided at national level.

It is worth noting, however, that the European Commission proposes a regulation in order to establish a European Deposit Insurance Scheme (EDIS).[26] EDIS will be composed of the national DGSs and is expected to build a Deposit Insurance Fund (DIF), managed at EU level, which will be financed by banks that are already members of DGSs. The basic argument for a European Deposit Insurance Scheme is that such an institutional development would complement the Single Supervisory Mechanism and the Single Resolution Mechanism that are already in place, thus completing the banking union. That, in turn, will level the playing field, facilitating banking activities across borders, diver-

[18] Article 4(1) DGSD.
[19] Article 4(3) DGSG.
[20] Article 12 DGSD.
[21] Article 6(1) DGSD.
[22] Article 10(1) DGSD
[23] Article 10(7) DGSD.
[24] Article 13(2) DGSD.
[25] Article 16 DGSD.
[26] European Commission, Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) 806/2014 in order to establish a European Deposit Insurance Scheme, COM/2015/586, 24.11.2015.

sifying the financial system within the EU and thus enhancing its resilience. Concerns against this solution stress that introduction of risk-sharing tools (i.e., sharing the risk of compensating depositors of failed banks) shall go hand in hand with improvements with regard to risk-reduction tools (i.e., reduction of non-performing loans and breaking the link between banks and sovereigns). A detailed elaboration on the debate can be found in the Communication of the European Commission COM (2017) 592 on completing the banking union.

Bank Resolution

Directive 2014/59/EU (henceforth BRRD) sets the provisions on the resolution and recovery of failed banks. BRRD is complemented by Regulation (EU) 806/2014 (known as SRM Regulation) which establishes the Single Resolution Mechanism (SRM) within the framework of which BRRD is applied.

The EU legislation on bank recovery and resolution aims at preventing the use of taxpayers' money for bailing out insolvent banks. To this end, bail-in is introduced as one of the resolution tools.[27] Bail-in tool is further specified by Articles 43-58 BRRD and Article 27 SRM Regulation. The bail-in tool is based on the principle that not only shareholders but also creditors bear losses in case of bank default, be it in the form of write-down of claims or conversion of debt to equity.[28]

Bank resolutions is facilitated by the Single Resolution Fund that is funded by contributions from banks.[29] These contributions are raised annually (ex-ante),[30] although extraordinary contributions (ex-post) might also be needed if the available funds are not sufficient.[31] These contributions are distinct from bank contributions to deposit guarantee schemes. The rationale of a resolution fund—that is ex-ante financed by banks—moves in the direction of a systemic risk tax in the form of taxing bank balance sheets. Such a tax is modeled and discussed in Chapter 3.

Note that, despite the primary objective of the EU bank resolution and recovery legislation for preventing the use of taxpayers' money for bailing out banks, Recital 83 BRRD states that the bail-in tool can only be partially implemented when the overall public interest would be harmed by full implementation, while Member States are also allowed to provide financial support during a bank resolution process.[32] Because of this ambiguity as to the use of the bail-in tool, and given the legacy of the 2007-2008 crisis that resulted

[27] Article 37(3) BRRD.
[28] Covered deposits by a deposit guarantee scheme are excluded from bail-in provisions; see Article 44(2) BRRD and Article 27(3) SRM Regulation.
[29] Article 67(4) SRM Regulation.
[30] Article 70 SRM Regulation.
[31] Article 71 SRM Regulation.
[32] Article 56 BRRD.

in a severe erosion of market discipline,[33] both the cases of bailout and bail-in will be considered throughout the analysis.

1.2 Contribution

The analysis of the EU case shows that the understanding of the political economy of banking regulation—and particularly of the virtues and disadvantages of legislating at national or supranational level—is warranted from an institutional perspective. Further, the analysis of the substance of EU banking legislation supports a number of assumptions that are introduced as legal rules in the economic modeling of the political economy of banking regulation. The research questions presented below, together with the approach for addressing these questions, aim to contribute to the theoretical study of the domestic and international political economy of banking regulation. This thesis is based on the premise that banking regulation, affecting the allocation of resources among different groups, is shaped by both domestic and international political forces—besides purely economic considerations in terms of total welfare-maximization.

1.2.1 Research Questions

This thesis addresses the following research questions:

1. What mechanisms are at work when competing governments set banking regulation?

2. What is the impact of regulatory competition in banking regulation on social welfare, in general, and financial stability, in particular?

3. What is the mechanism through which special interest groups can affect banking regulation?

4. What is the impact of lobbying on banking regulation on social welfare, in general, and financial stability, in particular?

[33] The cascade effects of the bankruptcy of Lehman Brothers and the unprecedented government interventions around the world to restore financial stability have lead to entrenched bailout expectations. For example, the Troubled Asset Relief Program (TARP) was initially authorized with 700 billion US dollars to stabilize the US financial system (see Emergency Economic Stabilization Act of 2008). The gross assistance to the financial sector of the Eurozone during the period 2008-2014 amounts to 8% of the Eurozone GDP (see Economic Bulletin Issue 6/2015 of European Central Bank). A theoretical framework and empirical evidence of the erosion of market discipline as a result of the 2007-2008 crisis are presented by Hett and Schmidt (2017).

1.2.2 Approach

The above research questions are addressed by developing and analyzing formal mathematical models that describe the political economy of banking regulation at domestic and international level. The general equilibrium approach of the analysis allows a thorough understanding of the impact of domestic and international political forces on banking regulation, and consequently, on the allocation of resources within and across jurisdictions. The models are built by adopting attributes from two strands of the economic literature; the theory of economic regulation and the theory of banking regulation. These two strands and the relevant position of this thesis are outlined below.

Economic Regulation

In his seminal work, Pigou (1920) justifies regulation, in the form of taxation, as a means for correcting market failures. That is, regulators, aiming to maximize total social welfare, impose a tax on activities that produce externalities. Thus, externalities are internalized and the resources are optimally allocated among the economic activities. That is the foundation of the *public interest theory* of economic regulation, which was further developed by Ramsey (1927).

Public interest theory offers a solid justification for economic regulation and is widely used in economic modeling, often by assuming the existence of a *"social planner"* that intervenes in economic activity in order to affect the allocation of resources in favor of social welfare. Yet, an implication of this intervention is overlooked by the public interest theory. In particular, since economic regulation affects the allocation of resources among different groups, it is natural that these groups can benefit by influencing, or even capturing, economic regulation.

The existence of political forces that aim to influence economic regulation is acknowledged and studied by the *regulatory capture theory*, pioneered by Stigler (1971) and formalized by Peltzman (1976).[34] According to their theory, regulation is primarily a political process rather than an effort to enhance social welfare. This argument is further developed by Becker (1983) who, focusing on the demand-side of regulation, assumes that politicians' decisions are merely the outcome of competition among special interest groups. Laffont and Tirole (1991) contribute fresh insights into the politics of regulation by considering both the demand- and the supply-side of regulation.

Attributes stemming from both public interest theory and regulatory capture theory will be used in this thesis. For the study of international political economy, regulators are

[34] A review of the public interest theory and the regulatory capture theory is offered by Posner (1974) concluding that the latter, adopting the assumption of self-interest motivated individuals, has a greater potential of explaining the political process of regulation.

considered to be immune to the influence of special interest groups, but they regulate with the aim of a resource allocation that will benefit the households that reside within their jurisdiction. Namely, they act in line with public interest theory domestically, but they do not pursue to maximize global social welfare. For the study of domestic political economy, regulators are assumed to act on behalf of public interest only to the extent that they benefit as members of the society, whereas they act on behalf of their narrow interests to the extent that they benefit from exchanging their regulatory power for benefits that cannot be distributed to the society as a whole.

Banking Regulation

Regulators intervene in the banking sector either to prevent a crisis through prudential regulation, or to mitigate the consequences of an already materialized crisis through crisis management tools. A comprehensive discussion on banking regulation—in the form of both prudential regulation and crisis management—can be found in Rochet (2008) where the amplification of banking crises is partly attributed to political interference.[35] By studying the role of political considerations with regard to the design of banking regulation (ex ante), this thesis conceptually complements the work of Rochet (2008) where political interference is considered in the form of time inconsistency with politicians exercising pressure on regulators with regard to the implementation of existing rules (ex post).

The focus in this thesis is primarily on prudential regulation which, in general, aims to prevent bank failures that can be the result of either insolvency, i.e., capital inadequacy, or illiquidity. However, central banks' functioning as lender-of-last-resort largely ensures that illiquid, but solvent, banks do not fail.[36] Thus, the scope of this thesis with regard to prudential regulation is narrowed down to capital regulation, and is complemented by crisis management aspects in the form of bank resolution tools.

This means that banks and the role of bank capital structure have to be integrated into the next chapters' models. The role of bank capital structure under asymmetric information in financial intermediation is studied by Bolton and Freixas (2000), while Morrison and White (2005), Gersbach (2013) and Gersbach et al. (2015) have specifically justified capital requirements as a means towards social welfare maximization. More specifically, Morrison and White (2005) show that capital requirements can reduce moral hazard and can be a substitute for low screening ability of regulators. Gersbach (2013) also shows that capital requirements can mitigate moral hazard on the bank-side and can lead to a

[35] A comprehensive overview of banking theory in general can be found in Freixas and Rochet (2008).

[36] Nevertheless, the importance of bank liquidity for the maintenance of confidence in the banking system, and the reduction of spillovers, should not be underestimated. In fact, the reforms that followed the financial crisis of 2007-2008, as described within the Basel III regulatory framework, include the introduction of liquidity requirements in order for distressed, but still solvent, banks to be able to absorb economic shocks (see BCBS (2013) and BCBS (2014)).

socially optimal outcome, at the expense of increasing moral hazard on the firm-side. Finally, Gersbach et al. (2015) show that an upper bound on banks' debt-to-equity ratio can eliminate inefficient equilibria that arise when banks act as financial intermediaries between households and firms running a risky technology and when failed banks are bailed out by the government.

In this thesis, the role of banks' capital structure is motivated building on Gersbach et al. (2015). Four main deviations from Gersbach et al. (2015) allow the study of the political economy of banking regulation.[37] First, banks actively decide on their capital structure. Second, governments assume an explicit regulatory role. Third, an international perspective can be studied by considering a two-country setting. Fourth, the base model analysis—under the assumption that failed banks are bailed out—is complemented by the analysis under the assumption that failed banks are bailed in. That means bank resolution in this thesis is essentially reduced to the simple form of either government rescue—in the form of capital injection—of all the debt holders or absence of any government intervention with regard to the rescue of failed banks.[38]

1.3 Structure of the Thesis

The mathematical models for answering the research questions—outlined in the preceding section—and thus, studying aspects of political economy of banking regulation are developed and analyzed in Chapters 2-5. Specifically, international political economy of banking regulation is studied in Chapters 2-4, while domestic political economy of banking regulation is studied in Chapter 5. The structure of the rest of the thesis is outlined below.

Chapter 2: Regulatory Competition in Banking

The base model for the analysis of regulatory competition in banking regulation is developed in Chapter 2. In a two-country general equilibrium model, households can invest directly in a free-of-risk technology or indirectly in a risky technology via banks. Households can invest in both domestic and foreign banks in the form of equity and deposits that are assumed to be guaranteed by governments which bailout banks operating within their jurisdiction. The government of each jurisdiction also sets capital regulation that

[37] Further deviations from Gersbach et al. (2015) are explained in detail in the next chapters.

[38] This simplicity does not hinder the study of the general equilibrium effects of government intervention with respect to bank resolution in the next chapters. Nevertheless, bank resolution in practice is a complicated process that includes a number of tools, e.g. capital injection, asset separation, liquidity provision, management changes, etc. Different aspects of bank resolution have been studied by Freixas et al. (2004), Kocherlakota and Shim (2007) and Freixas and Rochet (2013).

can be complemented by tax policy in the form of output taxation. The model is initially solved by assuming that capital regulation and tax policy are exogenously given, showing that jurisdictions that adopt a laxer approach can better attract banking activities. When capital regulation and tax policy are endogenized, it is shown that competing governments set capital requirements at a minimum level—allowing banks to economize on equity issuance costs—and counteract potential bailout costs by raising tax revenues. Regulatory competition yields the socially optimal outcome preventing both excessive taxation—that would harm the international competitiveness of banks—and taxation below the optimal level—that would generate excessive bailout costs. Yet, this outcome results in a positive likelihood of banking crisis.

Chapter 3: Extensions and Generalizations of the Base Model

In Chapter 3, the base model is generalized by endogenizing bank resolution, i.e., by allowing governments to decide whether banks operating within their jurisdiction will be bailed out or bailed in. We show that regulatory competition can still yield the socially optimal outcome. Several extensions of the base model are also presented in Chapter 3. Specifically, we show that the socially optimal outcome can be achieved by replacing output taxation with a systemic risk tax on the banks' balance sheet, and we study the behavior of competing governments in the presence of banking crisis repercussions—in the form of costs besides bailout expenditures. A scenario where tax rate is exogenously set at zero is also investigated, and it is shown that regulatory competition yields an inefficient outcome. This shows that without a policy tool that can counteract potential bailout costs, regulatory competition yields inefficient banking regulation.

Chapter 4: Regulatory Competition with Risk-averse Households

The robustness of the base model in regard to households' risk-aversion is examined in Chapter 4. The socially optimal allocation is initially characterized in a simple model with risk-averse households and without banks. It is then shown that there exists a combination of capital regulation and tax policy that yields the optimal allocation of resources in the presence of banks. The results are generalized in a two-country setting, showing that the mechanism at work when competing governments set capital regulation and tax policy with risk-neutral households still exists when households are risk-averse. It is also shown that the optimal tax rate—for any given level of capital regulation—depends on the interaction between the effects of capital regulation and risk aversion on the equilibrium returns.

Chapter 5: On Banking Regulation and Lobbying

In Chapter 5 the focus turns to a particular aspect of the domestic political economy of banking regulation, namely, lobbying on banking regulation. In a general equilibrium setting, banks act as financial intermediaries between households and firms running a risky technology. A fraction of households are also politicians who run the government. The banks' capital structure must comply with capital regulation set by the government which also bails out failed banks. We show that politicians and bankers can reach an agreement according to which bankers contribute a part of their revenues to politicians, in exchange for favorable regulation. This agreement results in over-investment in the risky sector, harming social welfare and undermining financial stability. In a first extension of the base model, bank resolution is endogenized, whereas in a second extension, the equilibrium is characterized in the absence of communication between bankers and politicians. Normative implications of political nature, as well as in the form of market-based tools are discussed.

The answers to the research questions of Chapter 1 are summarized in Chapter 6 where an outlook for future research is also presented. The proofs are given in Appendices A-D. A list of important notations is given in Appendix E and a glossary of important terms is given in Appendix F.

2 Regulatory Competition in Banking*

2.1 Introduction

The analysis begins with an aspect of international political economy, namely, regulatory competition with regard to banking regulation. This chapter is based on the premise that banking regulation affects the allocation of resources among jurisdictions within the globe. The relevance of this premise is particularly underpinned by the mobility of capital in an environment of globalized financial markets. Further, as seen in Chapter 1, the understanding of the virtues and disadvantages of legislation at the national and supranational level is an essential part of the legislative process in the EU and thus, is warranted from an institutional perspective as well.

The objective of this chapter is twofold. First, the mechanism at work when competing governments set banking regulation is studied. Banking regulation takes the form of capital requirements and provisions on deposit guarantees as the result of the assumption that failed banks are bailed out. Adopting a broader perspective, banking regulation can be complemented by taxation in this chapter. That is, hosting banking activities entail benefits in the form of tax revenues and risks in the form of potential bailout costs. Note that although the benevolence of national governments with regard to households' welfare within their jurisdiction is not questioned in this chapter,[1] political considerations come into play because national governments—free of the burden to maximize global welfare—compete internationally, aiming to affect the allocation of resources in favor of their jurisdiction. Second, the outcome that arises in a two-country scenario under regulatory competition is compared, in terms of social welfare and financial stability, against the benchmark outcome in which a supranational government maximizes the aggregate welfare across countries. That is, the first and second research question, as outlined in Chapter 1, are addressed.

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* This chapter is based on joint research with Hans Gersbach and Hans Haller.

[1] Questions on government's benevolence at domestic level are postponed to Chapter 5.

2.1.1 Model Features and Main Results

In this chapter, banks are integrated into a general equilibrium model by building on Gersbach et al. (2015) and extending their model with respect to four main aspects. First, we consider two homogeneous countries. That allows us to study the mechanisms that arise when national authorities compete with respect to regulations and policies. Second, we model international capital flows by allowing households to invest in foreign banks. Third, we assume that equity issuance is costly and allow bankers to actively decide on the capital structure of their banks. Finally, governments have an active role by setting the legislation with respect to banking regulation and tax policy.

In particular, a two-country two-period general equilibrium model is developed in this chapter. In each country, there are households and entrepreneurs. Households hold an initial endowment which is invested in the first period. The returns on their investments are consumed in the second period. The initial endowment is converted into a consumption good by means of two different technologies: a free-of-risk technology (FT) and a risky technology (RT). Investments in RT are only possible via banks that act as intermediaries between households and RT. The returns in RT are uncertain and depend on the macroeconomic conditions. Banks finance their lending operations by raising deposits and equity from both residents and foreigners. Raising equity involves costs.

Governments intervene in their economies by setting capital requirements that can be complemented with taxation. Governments have also a role with regard to the resolution of failed banks. In particular, in this chapter we assume that failed banks are bailed out by governments which thus, guarantee deposits. Governments' decision on capital regulation must comply with an *a priori* internationally agreed minimum level of capital requirements.

All government decisions are only applicable within their jurisdiction. In this chapter, following the tradition that can be traced back to Pigou (1920) and Ramsey (1927), we consider government interventions as a means towards social welfare maximization by correcting market failures.[2] Whether government intervention under regulatory competition yields the aggregate welfare that could arise when a supranational social planner decided on the same policy instruments is *a priori* unclear. In fact, that is the core question of this chapter.

In this model, governments can use tax revenues to finance bank bailouts. Any remaining revenues are distributed by governments to the households that reside within their juris-

[2] That essentially implies no political frictions within the countries, which allows us to turn our focus to the international political economy of banking regulation, and more specifically, to regulatory competition in regard to banking regulation and tax policy. The impact of political frictions and the role of special interest groups, in the tradition of Peltzman (1976) and Becker (1983), in banking regulation is studied in Chapter 5.

diction. If bailout expenditures exceed tax revenues, then governments impose lump sum taxation on households to cover the difference. That is, lump sum taxes are residually determined in equilibrium and thus not an instrument of tax policy. The tax rate on output is thus the sole instrument of tax policy.

The mechanism at work when competing governments set banking regulation is driven by the trade-off between accentuating benefits over costs from banking on the one hand, and enhancing banks' competitiveness on the other hand. Benefits take the form of tax revenues. Costs refer to bail-out expenditures. Banks' competitiveness depends on the effect of policy tools on bank returns, which in turn depend on revenues, costs and capital structure of banks: Taxation depress bank revenues; a bail-out provision decreases bank costs by making deposits a risk-free asset; and capital requirements raise the bank equity-to-deposits ratio. This mechanism precludes both too strict and too lax banking regulation in equilibrium. As will be shown, a rather lax decision regarding one tool of banking regulation is counteracted by a rather strict decision with respect to another tool of banking regulation. Hence, the equilibrium policy mix of banking regulation reflects a balance with regard to the aforementioned trade-off.

It is shown that when bailout is set exogenously as the resolution mechanism and countries compete with respect to capital regulation that can be complemented with taxation, an efficient outcome is obtained, i.e., the outcome that could be obtained when a supranational social planner decided on the policy instruments. In particular, capital requirements are set equal to the *a priori* level—even if that induces a positive likelihood of a banking crisis. Taxes are set such that any expected bailout expenditures are covered. Taxation below that level would result in an over-investment in the risky sector and thus excessive bailout costs. At the same time, regulatory competition prevents excessive taxation because that would harm the international competitiveness of banks.

The results in this chapter deviate from the predominant narrative according to which governments, under the fear of regulatory arbitrage, engage in a *"race-to-the-bottom"*. In fact, in our model, the concern regarding regulatory arbitrage—that is indeed revealed—induces the efficient use of policy instruments by governments. Thus, our results move in the direction suggested by Karolyi and Taboada (2015), who show that a benign form of regulatory arbitrage is also possible.

2.1.2 Relation to the Literature

Important insights into regulatory competition in banking regulation have been revealed by Buck and Schliephake (2013). In particular, they show that in the absence of cross-border banking, regulators minimize the cost of preventing the collapse of financial intermediation by choosing an optimal mix of capital requirements and supervisory effort.

However, when banks are allowed to finance projects abroad, the optimal mix of policy cannot be reached and the capital standards reduce to the minimum if the quality of domestic supervisors is unobservable.

Acharya (2003) also studies the competition between regulators with respect to two instruments: capital requirements and closure policy. In an infinite horizon multiple-economy model, Acharya (2003) shows that under harmonized capital requirements, national regulators, who aim at maximizing the continuation value of all bank claims, increase their level of forbearance, or in other words, the regulatory standards are reduced with respect to closure policies. Reduced regulatory standards set by national regulators, as opposed to a centralized regulator, have been found by Dell'Ariccia and Marquez (2006) as well. In their model, aiming to maximize the weighted sum of the probability that banks do not fail and banks' profits, the national regulators have incentives to support the competitiveness of their banks by setting lower capital standards.

Morrison and White (2009) also contribute to the literature on competition with regard to banking regulation in the form of assignment of banking licenses to banks that are either sound or unsound. In their model, regulators aim to maximize the expected volume of funds deposited at sound banks, and bankers benefit if they are licensed by a regulator of better reputation because of the resulting depositors' confidence. In this setting, Morrison and White (2009) find that the country that is regulated by a stricter licensing process benefits from competition because it is able to attract the banks of the highest quality.

This literature review is completed with the work of Boyer and Kempf (2016) who show that regulatory competition yields an inefficient outcome. More specifically, competing regulators, facing informational asymmetries with regard to banks' efficiency levels, make their decisions aiming to control banks' riskiness and size, given that banks are able to choose the jurisdiction under which they operate. In this setting, the inefficient outcome arises as the result of regulators' inability to exercise discretion in regulating banks of different efficiency levels.

The contribution of this chapter to the literature is threefold. First, the models of Acharya (2003), Dell'Ariccia and Marquez (2006), Morrison and White (2009) and Buck and Schliephake (2013) are complemented by allowing public authorities to decide on both banking-specific and non-banking-specific instruments. Thus, the impact of competition between national governments with two interacting policy instruments at their disposal is studied. In this chapter, this interaction takes place between capital regulation and tax policy. In terms of the policy instruments that are taken into consideration, the work of Boyer and Kempf (2016) is the closest to this chapter's model since they study the decisions of competing national regulators with respect to liquidity requirements[3] and bank

[3] Boyer and Kempf (2016) consider liquidity requirements as an instrument for controlling banks' risk.

profit taxation.[4] Yet, adopting a general equilibrium approach, we are able to explicitly express the impact of banking regulation and tax policy on the endogenously determined equilibrium returns, and thus, on the allocation of resources as well.
Second, it is shown that tax policy can complement capital regulation. That can enhance efficiency since side-effects of high capital requirements, e.g. in the form of high cost of capital, can be eliminated.
Finally, the results of this chapter contribute to the broader literature of regulatory competition (or systems competition)[5] that does not necessarily focus on banking regulation. For example, the efficient outcome that is obtained under regulatory competition in this chapter's model—provided that capital requirements are not seen in isolation from other policy instruments—is in the spirit of the seminal work of Tiebout (1956) who shows that tax policy by local governments can be efficient. At the same time, our results suggest that regulatory competition may work better than suggested by the literature exploring the downside of such forms of competition (see, for example, Sinn (1997)).

2.1.3 Organization of the Chapter

The rest of the chapter is organized as follows. The setup of the model is presented in Section 2.2. The existence of an equilibrium, assuming that capital regulation and tax policy are set exogenously, is investigated in Section 2.3. The governments' decisions on capital regulation and tax policy are endogenized in Section 2.4. The outcome under regulatory competition is compared against the benchmark outcome of a supranational solution in Section 2.5. We conclude in Section 2.6. Proofs are given in Appendix A.

2.2 Model Setup

We consider a model with two homogeneous countries and two periods ($t = 1, 2$). At $t = 1$, there is a single non-storable and non-consumable investment good, which can be transformed into a consumption good in period $t = 2$ by means of two different tech-

Thus, liquidity requirements in Boyer and Kempf (2016) can be interpreted as the analogous instrument to capital regulation in our model.

[4] Although taxation is imposed on firms that are financed by banks in the base model, in an extension in Chapter 3, direct taxation on banks' balance-sheet is studied as well. In a further extension in Chapter 3, we also take the decision of governments to bail out—or not—failed banks into consideration, studying hence competition between regulators in three dimensions.

[5] After the competition between centrally planned and market economies has become obsolete, *"systems competition"* assumes novel forms. A system in the new sense comprises taxes and subsidies, public goods, regulatory provisions, laws and other institutions provided, determined or controlled by national or supranational governments. In systems competition, each government attempts to influence the movement of people, services, goods and capital to the advantage of its own economy, by adjusting various components of its system. See Sinn (2003) for further elaboration and discussion.

nologies, namely, a technology that is free-of-risk (FT), and a risky technology (RT). There is a total endowment K $(K > 0)$ of the investment good in each country. Thus, the global endowment equals $2K$. There are two different types of agents, namely, entrepreneurs and households, who live for two periods. We will also introduce banks and governments. Perfect competition prevails in all markets, and therefore, all agents are price-takers (contract-takers).

We now describe the model in detail. Note that the term *"returns"* always refers to the gross returns per unit of investment, i.e., the entire return of a debt contract or the output from production. Furthermore, a generic country is denoted by j $(j = 1, 2)$ or k $(k = 1, 2)$ with $j \neq k$ if both labels are used concurrently.

2.2.1 Entrepreneurs

The technologies are operated by representative entrepreneurs that stand for a continuum of entrepreneurs who behave competitively. The features of the two technologies are now described.

Free-of-risk Technology (FT)

The production in FT in Country j is described by the production function $f(\cdot)$ that satisfies $f'(\cdot) > 0$, $f''(\cdot) < 0$, and the Inada conditions $\lim_{k_F^j \to 0} f'(k_F^j) = +\infty$ and $f'(K) = 0$, where k_F^j is the amount of capital invested in FT in Country j. An investment of k_F^j in FT in Country j at $t = 1$ yields $f(k_F^j)$ of the consumption good in period $t = 2$. The returns per unit of capital for investing k_F^j are denoted by

$$R_F^j \equiv f'\left(k_F^j\right), \tag{2.1}$$

and are free of risk. Note that because of the Inada conditions, if $k_F^j = 0$, then R_F^j becomes infinitely large, whereas $R_F^j = 0$ for $k_F^j = K$.

FT firm in Country j can be financed by issuing risk-free bonds, B_F^j, directly to households of Country j. In order for the bond market in Country j to clear, $k_F^j \equiv B_F^j$. These bonds are repaid in period $t = 2$ with R_F^j per unit of invested capital. The profits generated by FT in Country j are denoted by Π_F^j and read as follows:

$$\Pi_F^j = f(k_F^j) - R_F^j k_F^j. \tag{2.2}$$

Risky Technology (RT)

The output in RT is uncertain. In particular, there are two states of the world that can be realized at the beginning of $t = 2$: the *good state* occurs with probability σ $(0 < \sigma < 1)$ and the *bad state* occurs with probability $1 - \sigma$. An investment of one unit of investment good in RT in Country j in period $t = 1$ returns $\overline{R}$ and $\underline{R}$ units of consumption good in period $t = 2$ in the good state and the bad state of the world, respectively, with $0 < \underline{R} < \overline{R}$. Therefore, the expected returns of investing one unit of the investment good in RT are

$$\mathbb{E}[\widetilde{R}] = \sigma\overline{R} + (1 - \sigma)\underline{R}. \tag{2.3}$$

These returns might be taxed with a tax rate τ^j, depending on the tax policy of Country j's government.

The entrepreneur who operates RT in Country j is interpreted as the manager of a newly established firm. Henceforth, it will be sufficient to consider a representative firm in RT in Country j. RT in Country j needs to be monitored and, hence, can only be funded by bank loans, L^j_R, from banks of Country j, with state-contingent returns $\overline{R}^j_R$ and $\underline{R}^j_R$ in the good state and the bad state of the world, respectively. Thus, expected returns for investing one unit of capital in L^j_R in Country j are

$$\mathbb{E}[R^j_R] = \sigma\overline{R}^j_R + (1 - \sigma)\underline{R}^j_R. \tag{2.4}$$

The amount of capital invested in RT in Country j is denoted by k^j_R, and in order for the loan market in Country j to clear, $k^j_R \equiv L^j_R$. The expected profits of RT are denoted by $\mathbb{E}[\Pi^j_R]$ and are given by

$$\mathbb{E}[\Pi^j_R] = \sigma\overline{\Pi}^j_R + (1 - \sigma)\underline{\Pi}^j_R, \tag{2.5}$$

where $\overline{\Pi}^j_R$ and $\underline{\Pi}^j_R$ are the RT profits in the good state and the bad state of the world, respectively, and read as follows:

$$\overline{\Pi}^j_R = \Big((1 - \tau^j)\overline{R} - \overline{R}^j_R\Big) \cdot k^j_R \tag{2.6}$$

$$\underline{\Pi}^j_R = \Big((1 - \tau^j)\underline{R} - \underline{R}^j_R\Big) \cdot k^j_R. \tag{2.7}$$

2.2.2 Banks

A friction in RT gives rise to the role of banks. In particular, we assume that entrepreneurs running RT are prone to moral hazard with two features: partial investment of raised funds in production and partial repayment of investors. Hence, RT entrepreneurs can only be funded via banks that, having access to monitoring technology and being able to enforce repayment obligations, are assumed to be able to alleviate moral hazard in RT. We also assume that there are no monitoring costs.[6]

Specifically, we consider a continuum of identical banks that are operated by bank managers who only play a passive role in that we assume that there is no conflict of interest between bank managers and shareholders. Since banks are identical and perfectly competitive, it is sufficient to consider a representative bank (henceforth, bank) in each country.

Bank Liabilities and Assets

The bank in Country j can be funded by deposits, D^j, and equity, E^j. The units of bank liabilities are the units of the investment good. D^j is the sum of deposits from households of Country j, denoted by D^{jj}, and from households of Country k, denoted by D^{jk}. E^j is composed of equity from households of Country j, denoted by E^{jj}, and from households of Country k, denoted by E^{jk}. That is, $D^j = D^{jj} + D^{jk}$ and $E^j = E^{jj} + E^{jk}$. The capital structure of the bank in Country j is depicted by the equity-to-debt ratio,

$$\Theta^j \equiv \frac{E^{jj} + E^{jk}}{D^{jj} + D^{jk}} = \frac{E^j}{D^j} \, .$$

E^j is issued at cost δ per unit of issued equity ($0 < \delta < \underline{R}$). We further assume the existence of a legal requirement for a strictly positive amount of equity for banks to be licensed.[7] That is, the case of $E^j = 0$ automatically implies the absence of a banking sector in Country j. The dummy variable b^j indicates the existence or the absence of a banking sector in Country j, as follows:

$$b^j = \begin{cases} 0 & \text{if there is no banking sector in Country j} \\ 1 & \text{if there is a banking sector in Country j.} \end{cases} \tag{2.8}$$

The entire amount of funds received by banks in Country j in the form of deposits, D^j, and equity, E^j, net of the equity issuance cost, δE^j, is invested in RT in Country j, with the objective to maximize the bank expected returns on equity, denoted by $\mathbb{E}[R_E^j]$. Namely, bank assets are equal to

$$k_R^j \equiv D^j + (1 - \delta)E^j. \tag{2.9}$$

Banks of Country j are contractually bound to repay their depositors with R_D^j per unit of deposit in period $t = 2$. Thus, deposits are banks' debt. Further, in period $t = 2$,

[6] Neglecting monitoring costs merely simplify the formal presentation. Adding monitoring costs m ($m > 0$) per unit of loan does not affect the results.

[7] This requirement is a common practice. For example, as shown in Subsection 1.1.2, Article 12 of Directive 2013/36/EU requires an initial capital that is not less than EUR 5 million in order for a bank to be licensed.

bank profits are distributed among shareholders. Since banks invest in the risky sector, banks' revenues, and profits, are also risky. Therefore, the returns on equity are state-contingent and denoted by $\overline{R}_E^j$ and $\underline{R}_E^j$ in the good state and bad state of the world, respectively. We also assume limited liability of shareholders. Thus, in case of negative profits, shareholders receive zero returns and do not need to inject new equity into the banks.

Bank Resilience

Banks do not default as long as they are able to fulfill their repayment obligations to their depositors. That requires non-negative profits, even if the bad state of the world occurs. That is,[8]

$$\left(D^j + (1-\delta)E^j\right) \cdot \underline{R}_R^j - D^j \cdot R_D^j \geq 0. \tag{2.10}$$

The non-defaulting condition (2.10) can also be expressed as

$$\Theta^j \geq \bar{\Theta}^j, \tag{2.11}$$

where

$$\bar{\Theta}^j = \frac{R_D^j - \underline{R}_R^j}{(1-\delta)\underline{R}_R^j}. \tag{2.12}$$

We call $\bar{\Theta}^j$ the *"resilience boundary"* in Country j.

Definition 2.1

The representative bank in Country j is resilient if and only if $\Theta^j \geq \bar{\Theta}^j$. The representative bank in Country j is fragile if and only if $\Theta^j < \bar{\Theta}^j$.

Bank fragility in Country j is indicated by the variable X^j, as follows:

$$X^j = \begin{cases} 1 & \text{if } \Theta^j < \bar{\Theta}^j \\ 0 & \text{if } \Theta^j \geq \bar{\Theta}^j. \end{cases} \tag{2.13}$$

We call X^j the *"fragility index"* in Country j. In equilibrium, it will turn out that resilient banks have the capacity to withstand a negative macroeconomic shock,[9] while fragile banks do not. In particular, once the bad state of the world is materialized, fragile banks become insolvent and fail. The returns on equity in the good state and bad state of the

[8] It turns out in equilibrium that the respective condition if the good state of the world occurs is always satisfied. That is, $\left(D^j + (1-\delta)E^j\right) \cdot \overline{R}_R^j - D^j \cdot R_D^j \geq 0$ holds regardless of banks' capital structure.

[9] This shock is modeled by the realization of the bad state of the world which implies a reduction of RT returns, from $\overline{R}$ to $\underline{R}$, and is materialized with probability $1-\sigma$.

world can therefore be expressed as follows:

$$\overline{R}_E^j = \frac{k_R^j \cdot \overline{R}_R^j - D^j \cdot R_D^j}{E^j} \tag{2.14}$$

$$\underline{R}_E^j = (1 - X^j) \cdot \frac{\left(k_R^j \cdot \underline{R}_R^j - D^j \cdot R_D^j\right)}{E^j}. \tag{2.15}$$

Since all banks are identical, the failure of the representative bank in Country j amounts to a banking crisis, i.e., such a failure essentially means that the entire banking system collapses. Note that if the representative bank in Country j is resilient, then the likelihood of a banking crisis in Country j is zero. If the representative bank in Country j is fragile, then the likelihood of a banking crisis in Country j is strictly positive.

2.2.3 Governments

In this subsection the threefold role of governments—with respect to capital regulation, tax policy, and bank resolution—is introduced.

Capital Regulation

At the beginning of period $t = 1$, the government decides on capital regulation in the form of minimal equity-to-debt ratios. Capital requirements in Country j are described by Θ_{reg}^j and fulfill

$$\Theta_{\text{reg}}^j \geq \vartheta, \tag{2.16}$$

where Θ_{reg}^j is the minimum equity-to-debt ratio that a bank in Country j must satisfy in order to be allowed by the regulator to operate in this country. We require that the regulatory choice in Country j is at least equal to ϑ $(\vartheta > 0)$ which is an *a priori* minimal capital requirement. This minimal, and strictly positive, capital requirement may reflect the fact that a bank is only a legal entity and can operate if it has some minimal equity. In fact, as explained in Footnote 7, founding a bank typically requires a minimal level of equity. Since the maximum amount of deposits in the economy is bounded, we obtain a positive value of ϑ.[10] This lower bound may also reflect internationally given minimal standards the country has agreed to.[11]

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[10] ϑ can be arbitrarily small but must be positive. Otherwise, the optimization problems of banks are not well-defined.

[11] For instance, ϑ can be interpreted in the spirit of the capital regulation by the Basel Committee on Banking Supervision (BCBS) the Charter of which states that *"BCBS standards constitute minimum requirements and BCBS members may decide to go beyond them"*.

Tax Policy

At the beginning of period $t = 1$, governments set the tax policy in the form of a tax rate that is imposed on the RT output, namely, on the output of the sector that is financed by banks. The tax rate, set in Country j, is denoted by τ^j. Once the consumption good has been produced in period $t = 2$, the government in Country j raises tax revenues that are equal to

$$\overline{\Phi}^j = k_R^j \cdot \tau^j \cdot \overline{R} \text{ and} \tag{2.17}$$

$$\underline{\Phi}^j = k_R^j \cdot \tau^j \cdot \underline{R} \tag{2.18}$$

in the good state and the bad state of the world, respectively. Thus, and because of (2.3), the expected tax revenues are given by

$$\mathbb{E}[\Phi^j] = k_R^j \cdot \tau^j \cdot \mathbb{E}[\widetilde{R}]. \tag{2.19}$$

The tax revenues—in the form of consumption good—are distributed to and consumed by households. We see below that in the bad state of the world, these tax revenues might be spent to cover potential bailout expenditures.

Bank Resolution

In the base model, we assume that governments guarantee deposits by bailing out failed banks.[12] Bailout expenditures are financed by tax revenues. If bailout expenditures exceed tax revenues the government covers the difference by imposing a lump sum taxation on households. Each government is only responsible for bailing out banks that operate in its own jurisdiction. Thus, a bailout of banks in Country j, should it be needed, is carried out by the government in Country j, which uses tax revenues raised by taxing RT in its country and covers any remaining bailout expenditures by imposing a lump sum taxation on households that reside within the jurisdiction of Country j's government. Note that governments guarantee that depositors of banks that operate in their country are always repaid irrespective of whether depositors reside in the country, or not.

Bailout expenditures amount to the promised returns on deposits net of the liquidation value of the bank, and can be materialized if banks are fragile. That is,

$$T^j = X^j \cdot \left(D^j \cdot R_D^j - (D^j + (1 - \delta)E^j) \cdot \underline{R}_R^j \right). \tag{2.20}$$

[12] In an extension of the base model in Chapter 3, the decision on the resolution of failed banks is endogenized by allowing governments to decide whether failed banks that operate in their jurisdiction are bailed out or not.

The expected bailout expenditures are denoted by $\mathbb{E}[T^j]$ and, taking Footnote 8 into consideration, read as follows:

$$\mathbb{E}[T^j] = (1 - \sigma) \cdot T^j. \tag{2.21}$$

Legislative Scheme

Since bank resolution is set exogenously in this chapter, deciding on the level of capital requirements, Θ^j_{reg}, and the tax rate, τ^j, the government in Country j fully determines the legislative scheme within its jurisdiction. That is,

Definition 2.2
The legislative scheme in Country j, $(\Theta^j_{\text{reg}}, \tau^j)$, is the set of capital requirements, Θ^j_{reg}, and tax rate, τ^j.

We assume that capital requirements, tax policy and bank resolution are publicly announced in advance of households' investment decisions, i.e., before the allocation of capital takes place. We further assume no time inconsistency problems, namely, all provisions that are announced at the beginning of period $t = 1$ are implemented without changes afterwards.

2.2.4 Households

We assume that in each country resides a continuum of risk-neutral households, represented by the unit interval [0,1]. All households own the same amount of investment good in period $t = 1$, and they are equally endowed with non-tradable property rights to FT and RT that operate in their home countries. Thus, we consider a representative household (henceforth, household) in each country, endowed with K.

The household in Country j invests its endowment K in period $t = 1$ by choosing a portfolio composed of five assets: B^j_F, D^{jj}, D^{kj}, E^{jj} and E^{kj}. In period $t = 2$, the household in Country j consumes $\overline{c}^j$ and $\underline{c}^j$ in the good state and the bad state of the world, respectively. Household's expected utility, which depends on its expected consumption in $t = 2$, is denoted by $\mathbb{E}[U^j]$. The consumption good is obtained by exchanging the returns on household's investments plus the profits from FT and RT plus the tax revenues, net of any bailout expenditures, against the consumption good that has been produced by FT and RT.

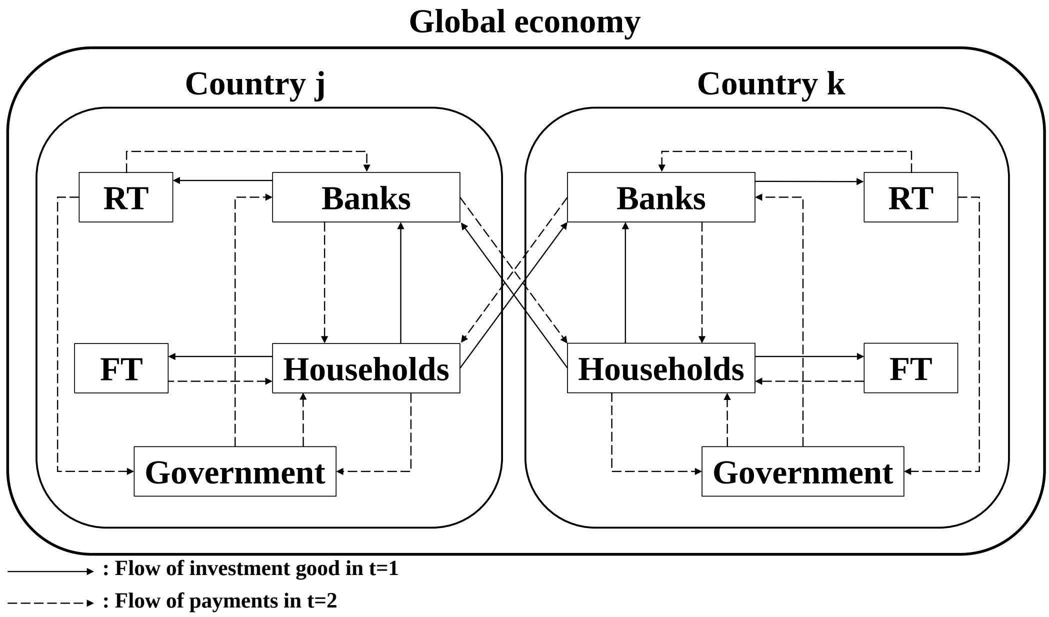

Figure 2.1: Two-country model setup

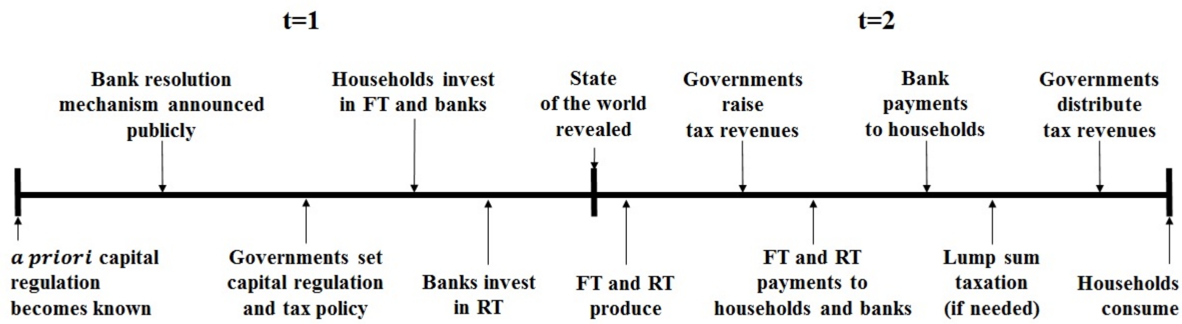

Figure 2.2: Timeline of the two-country model

The expected (per unit of investment) returns on each asset read as follows:

$$\mathbb{E}[R_F^j] = R_F^j \tag{2.22}$$
$$\mathbb{E}[R_D^j] = R_D^j \tag{2.23}$$
$$\mathbb{E}[R_D^k] = R_D^k \tag{2.24}$$
$$\mathbb{E}[R_E^j] = \sigma \cdot \overline{R}_E^j + (1-\sigma) \cdot \underline{R}_E^j \tag{2.25}$$
$$\mathbb{E}[R_E^k] = \sigma \cdot \overline{R}_E^k + (1-\sigma) \cdot \underline{R}_E^k. \tag{2.26}$$

The setup of the model is graphically presented in Figure 2.1. The timeline of the model is presented in Figure 2.2.

2.2.5 Markets

The excess demand functions of the capital market, the consumption good market in the good state, and the consumption good market in the bad state are determined as follows:

$$z_K = \left(\sum_{j=1}^{2} \left(k_F^j + E^j + D^j \right) \right) - (K + K) \tag{2.27}$$

$$\overline{z_c} = \left(\sum_{j=1}^{2} \overline{c}^j \right) - \left(\sum_{j=1}^{2} \left(f(k_F^j) + k_R^j \cdot \overline{R} \right) \right) \tag{2.28}$$

$$\underline{z_c} = \left(\sum_{j=1}^{2} \underline{c}^j \right) - \left(\sum_{j=1}^{2} \left(f(k_F^j) + k_R^j \cdot \underline{R} \right) \right) \tag{2.29}$$

We say that a market clears if its excess demand equals zero.[13]

2.3 Competitive Equilibrium with Exogenous Legislative Schemes

In this section, we investigate the existence of a competitive equilibrium when the legislative schemes of the two countries are given exogenously. We introduce first the equilibrium concept.

Definition 2.3
A competitive equilibrium with exogenous legislative schemes, $(\hat{\Theta}^j_{\text{reg}}, \hat{\tau}^j)$*, is a set of returns* $\left\{R_D^j, R_F^j, \mathbb{E}[R_E^j]\right\}$*, allocations* $\left\{k_F^j, k_R^j\right\}$*, asset holdings* $\left\{B_F^j, L_R^j, D^j, E^j\right\}$*, and capital structures* $\{\Theta^j\}$ *for* $j = 1, 2$ *such that*

(i) the household in Country j *maximizes its expected utility,* $\mathbb{E}[U^j]$*,*

(ii) FT in Country j *maximizes its profits,* Π_F^j*,*

(iii) RT in Country j *maximizes its expected profits,* $\mathbb{E}[\Pi_R^j]$*,*

(iv) the bank in Country j *maximizes its expected returns on equity,* $\mathbb{E}[R_E^j]$*, and*

(v) all markets clear, i.e., $z_K = \overline{z_c} = \underline{z_c} = 0$*.*

We now describe and solve the problems faced by households, entrepreneurs and banks in Country j.[14]

[13] As already seen in Subsection 2.2.1, the bond market and the loan market clear by construction.
[14] The governments' problems are described and solved in Section 2.4, where the decisions on the legislative schemes are endogenized.

2.3.1 Problem of Households

The risk-neutral household in Country j aims to maximize its expected utility, $\mathbb{E}[U^j]$, which linearly depends on household's consumption in the good state of the world, $\overline{c}^j$, and household's consumption in the bad state of the world, $\underline{c}^j$. The investment decisions of Country j's household are made by deciding the values of the variables λ^j, ε^j, γ^j and ν^j in period $t = 1$ such that the representative household in Country j invests $((1-\lambda^j)\varepsilon^j\gamma^j) \cdot K$ in FT in Country j, $(\lambda^j\varepsilon^j\gamma^j) \cdot K$ in deposits in Country j, $(\varepsilon^j(1-\gamma^j)) \cdot K$ in equity in Country j, $(1-\varepsilon^j)(1-\nu^j) \cdot K$ in deposits in Country k and $(1-\varepsilon^j)\nu^j \cdot K$ in equity in Country k.

Thus, the representative household in Country j solves the following problem:

$$\max_{\overline{c}^j, \underline{c}^j} \left\{ \mathbb{E}[U^j] = \sigma\overline{c}^j + (1-\sigma)\underline{c}^j \right\} \tag{2.30}$$

s.t.

$$\Big((1-\lambda^j)\varepsilon^j\gamma^j + \lambda^j\varepsilon^j\gamma^j + \varepsilon^j(1-\gamma^j) + (1-\varepsilon^j)(1-\nu^j) + (1-\varepsilon^j)\nu^j\Big) \cdot K \leq K. \tag{2.31}$$

Expressing the household's consumption in the good state and the bad state of the world as functions of the returns on household's investment choices, the profits from FT and RT, tax revenues and bailout expenditures (if any), we observe that the household's objective function is linear with respect to the expected returns on its investment choices and we immediately obtain

Lemma 2.1

The representative household in Country j invests in the asset with the highest expected returns. If multiple assets are associated with the highest expected returns, the representative household is indifferent among those assets.

The proof of Lemma 2.1 is given in Appendix A. The following assumption will facilitate the characterization of equilibrium in case of households' indifference between domestic and foreign assets.[15]

Assumption 2.1

If the expected returns on domestic assets are at least equal to the expected returns on foreign assets, then households strictly prefer the former.

[15] The assumption can be justified by arbitrarily small fixed costs incurred by households when they invest abroad, e.g. translations, travels, etc. These costs can be neglected, but they break ties in case of indifference.

From Lemma 2.1, and because investments in equilibrium need to be strictly positive in FT of both countries, and in deposits and equity in at least one country, we obtain

Lemma 2.2
In a competitive equilibrium, the prevailing returns, R_D, satisfy

$$R_D = \begin{cases} R_F^j = R_F^k = R_D^j = R_D^k = \mathbb{E}[R_E^j] = \mathbb{E}[R_E^k] & \textit{if } b^j = b^k = 1 \\ R_F^j = R_F^k = R_D^j = \mathbb{E}[R_E^j] & \textit{if } b^j = 1 \textit{ and } b^k = 0, \end{cases} \tag{2.32}$$

with

$$R_D^j(\Theta^j, \hat{\tau}^j) = \begin{cases} R_D^{j,\text{frg}} = (1-\hat{\tau}^j)\dfrac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j}\cdot\sigma\overline{R} & \forall\Theta^j \in \left(0, \bar{\Theta}^j\right) \\ R_D^{j,\text{rsl}} = (1-\hat{\tau}^j)\dfrac{1+(1-\delta)\Theta^j}{1+\Theta^j}\cdot\mathbb{E}[\widetilde{R}] & \forall\Theta^j \in \left[\bar{\Theta}^j, +\infty\right) \end{cases} \tag{2.33}$$

and

$$\bar{\Theta}^j = \bar{\Theta}^k = \bar{\Theta} = \frac{\sigma\left(\overline{R} - \mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}. \tag{2.34}$$

The proof of Lemma 2.2 is given in Appendix A. We call R_D the *"equilibrium returns"*. Calculating the partial derivatives of the equilibrium returns with respect to Θ^j and $\hat{\tau}^j$, we obtain

Corollary 2.1
Equilibrium returns are monotonically decreasing in Θ^j and $\hat{\tau}^j$.

The proof of Corollary 2.1 is given in Appendix A.

2.3.2 Problem of Entrepreneurs

We now solve the problems of entrepreneurs who operate the technologies that transform the capital, which has already been invested in period $t = 1$, into a consumption good in period $t = 2$.

FT Entrepreneur

The representative entrepreneur in FT in Country j aims to maximize his profits by solving the following problem:

$$\max_{k_F^j} \left\{ \Pi_F^j(k_F^j) = f(B_F^j) - R_F^j k_F^j \right\}. \tag{2.35}$$

From the first-order condition (henceforth FOC) and because of the assumption that $f'(k_F^j) > 0$ and $f''(k_F^j) < 0$, we obtain that in period $t = 1$, the entrepreneur optimally raises funds equal to

$$k_F^j = f'^{-1}(R_F^j). \tag{2.36}$$

Thus, and taking (2.32) into account, we obtain

Lemma 2.3
In a competitive equilibrium, the amount of capital allocated to FT of each country equals $k_F = f'^{-1}(R_D)$ *and the profits in FT of each country are equal to* $\Pi_F = f(k_F) - R_D k_F$.

In other words, the amount of capital allocated to the free-of-risk sectors of the two countries and the consequent profits, are identical, namely, $k_F^j = k_F^k =: k_F$ and $\Pi_F^j = \Pi_F^k =: \Pi_F = f(k_F) - R_D k_F$. We call k_F and Π_F the *"equilibrium FT allocation"* and the *"equilibrium FT profits"*, respectively. Note that in equilibrium, $0 < k_F < K$ always holds. Otherwise, the returns in FT would be either infinite or zero, which would violate (2.32). Finally, in order for the bond market in Country j to clear, the following holds:

$$k_F^j = B_F^j = \Big((1 - \lambda^j)\varepsilon^j \gamma^j\Big) \cdot K. \tag{2.37}$$

RT Entrepreneur

The representative entrepreneur in RT in Country j solves the following problem:

$$\max_{k_R^j} \Big\{\mathbb{E}[\Pi_R^j] = \Big(\sigma \Big((1 - \hat{\tau}^j)\overline{R} - \overline{R}_R^j\Big) + (1 - \sigma) \Big((1 - \hat{\tau}^j)\underline{R} - \underline{R}_R^j\Big)\Big) \cdot k_R^j\Big\} \tag{2.38}$$

$$\text{s.t.} \quad \Big((1 - \hat{\tau}^j)\overline{R} - \overline{R}_R^j\Big) \cdot k_R^j \geq 0 \tag{2.39}$$

$$\Big((1 - \hat{\tau}^j)\underline{R} - \underline{R}_R^j\Big) \cdot k_R^j \geq 0. \tag{2.40}$$

Constraints (2.39) and (2.40) imply that the repayment obligations of RT are fulfilled in both states of the world.[16] These constraints also imply that $\mathbb{E}[\Pi_R^j] \geq 0$. We further observe that because of the linear production function in RT, the entrepreneur would demand an infinite amount of capital in case of strictly positive profits. That, however, cannot be satisfied because the amount of the investment good is limited to $2K$ at a global level. Hence, in equilibrium $\mathbb{E}[\Pi_R^j] = 0$, implying that RT entrepreneur is indifferent with re-

[16] That means the risk faced by banks in our model can be interpreted as a market risk, as opposed to other risk types, e.g. credit risk or operational risk.

gard to k_R^j. Because $\mathbb{E}[\Pi_R^j] = 0$, we obtain

$$\overline{R}_R^j = (1 - \hat{\tau}^j)\overline{R} \tag{2.41}$$

$$\underline{R}_R^j = (1 - \hat{\tau}^j)\underline{R}, \tag{2.42}$$

and consequently, $\mathbb{E}[R_R^j] = (1 - \hat{\tau}^j)\mathbb{E}[\widetilde{R}]$.
Note that in order for the loan market to clear, the following holds:

$$k_R^j = L_R^j = D^j + (1 - \delta)E^j.$$

From the market-clearing condition (2.27), and taking Lemma 2.3 into consideration, we know that

$$E^j + E^k + D^j + D^k = 2(K - k_F), \tag{2.43}$$

and because RT in Country j can be financed only by banks in Country j, we obtain

Lemma 2.4

$$k_R^j = \beta^j \cdot (K - k_F) - b^j \cdot \delta E^j, \tag{2.44}$$

where $\beta^j \in \{0, 1, 2\}$ *with* $\sum_{j=1}^{2} \beta^j = 2$. *If* $b^j = 1$ *and* $b^k = 0$, *then* $\beta^j = 2$ *and* $\beta^k = 0$. *If* $b^j = b^k = 1$, *then* $\beta^j = \beta^k = 1$.

2.3.3 Problem of Banks

The banks' problem is solved in two steps. In the first step, banks aim to raise an initial amount of equity, and obtain an amount say $E^{j\prime}$, in order to be licensed and start operating.[17] Whether banks can raise equity, or not, depends on households' expectations. If $\mathbb{E}[R_E^j] = \mathbb{E}[R_E^k]$—and knowing that, because of Lemma 2.2, risk-neutral households are indifferent between equity and deposits—banks of both countries can raise equity. Taking (2.13), (2.32) and (2.33) into account, we know that banks operate in both countries if and only if one of the following inequalities is satisfied with equality:

$$\frac{1 - \hat{\tau}^j}{1 - \hat{\tau}^k} \geq \frac{1 + (1 - \delta)\Theta^k}{1 + (1 - \delta)\Theta^j} \cdot \frac{\sigma + \Theta^j}{\sigma + \Theta^k} \qquad \text{if } X^j = X^k = 1 \tag{2.45}$$

$$\frac{1 - \hat{\tau}^j}{1 - \hat{\tau}^k} \geq \frac{1 + (1 - \delta)\Theta^k}{1 + (1 - \delta)\Theta^j} \cdot \frac{1 + \Theta^j}{1 + \Theta^k} \qquad \text{if } X^j = X^k = 0 \tag{2.46}$$

$$\frac{1 - \hat{\tau}^j}{1 - \hat{\tau}^k} \geq \frac{1 + (1 - \delta)\Theta^k}{1 + (1 - \delta)\Theta^j} \cdot \frac{\sigma + \Theta^j}{1 + \Theta^k} \cdot \frac{\mathbb{E}[\widetilde{R}]}{\sigma\overline{R}} \qquad \text{if } X^j = 1, X^k = 0. \tag{2.47}$$

[17] This step fulfills the requirement for a strictly positive amount of equity as described in Subsection 2.2.2.

Otherwise, the expected returns on equity offered by the representative banks in the two countries are different, say $\mathbb{E}[R_E^j] > \mathbb{E}[R_E^k]$. In that case, the representative bank in Country k cannot raise equity and therefore, it is not licensed and cannot operate. Namely, $b^j = 1$ and $b^k = 0$.

In the second step, the initial shareholders appoint a bank manager who is acting on their behalf.[18] The bank manager aims to maximize the expected returns on equity, $\mathbb{E}[R_E^j]$, which are given by substituting for $\overline{R}_E^j$ and $\underline{R}_E^j$ from (2.14) and (2.15) into (2.25). Thus, the manager of the representative bank in Country j faces the following problem:

$$\max_{E^j, D^j} \left\{ \mathbb{E}[R_E^j] \right\} \tag{2.48}$$

$$\text{s.t. } \Theta^j \geq \hat{\Theta}^j_{\text{reg}}. \tag{2.49}$$

By showing that the expected returns on equity are monotonically decreasing in E^j, whereas they are monotonically increasing in D^j, we obtain

Lemma 2.5

Suppose that the representative bank in Country j is subject to the legislative scheme $(\hat{\Theta}^j_{\text{reg}}, \hat{\tau}^j)$. If $b^j = 1$, the manager of the representative bank demands deposits such that $\Theta^j = \hat{\Theta}^j_{\text{reg}}$.

The proof of Lemma 2.5 is given in Appendix A. The intuition of Lemma 2.5 runs as follows. For any given level of equity, the bank manager is better off by raising more deposits, namely, by leveraging his balance sheet. The bank's leveraging is limited by (2.49). Thus, taking into account that the bank already raised $E^{j\prime}$ in the first step, we obtain that in the second step, the bank manager raises no further equity, i.e., $E^j = E^{j\prime}$, but demands deposits D^j such that $\dfrac{E^j}{D^j} = \hat{\Theta}^j_{\text{reg}}$. At this stage, it is not clear whether the bank obtains the amount of deposits such that $\Theta^j = \hat{\Theta}^j_{\text{reg}}$. However, bank manager's demand will be satisfied for the equilibrium returns that make households indifferent between deposits and equity.

Because $\Theta^j = \hat{\Theta}^j_{\text{reg}}$, and taking into account that equilibrium returns are decreasing in Θ^j, as well as that banks operate in the country with the highest expected returns on equity, we obtain

Corollary 2.2

Suppose $X^j = X^k$, $\hat{\tau}^j = \hat{\tau}^k$ and $\hat{\Theta}^j_{\text{reg}} \neq \hat{\Theta}^k_{\text{reg}}$. There exists a unique equilibrium capital structure $\Theta = \min\left\{\hat{\Theta}^j_{\text{reg}}, \hat{\Theta}^k_{\text{reg}}\right\}$. Banks operate in the country with the smaller capital requirements.

[18] The bank manager's interests are considered to be fully aligned with the shareholders'.

Finally, taking Assumption 2.1 and Lemma 2.2 into consideration, we obtain

Corollary 2.3
Suppose $\hat{\tau}^j = \hat{\tau}^k$ *and* $\hat{\Theta}^j_{\text{reg}} = \hat{\Theta}^k_{\text{reg}}$. *Then* $X^j = X^k$, $b^j = b^k$ *and* $E^{jk} = E^{kj} = D^{jk} = D^{kj} = 0$, *yielding* $E^j = E^k$ *and* $D^j = D^k$.

2.3.4 Competitive Equilibrium

Having characterized the optimal decision of all the agents, we now establish the existence of a competitive equilibrium with exogenous legislative schemes.

Proposition 2.1
Let $(\hat{\Theta}^j_{\text{reg}}, \hat{\tau}^j)$ *and* $(\hat{\Theta}^k_{\text{reg}}, \hat{\tau}^k)$ *be exogenously given legislative schemes. There exists a unique competitive equilibrium and the expected utility of Country* j*'s households is*

$$\mathbb{E}[U^j] = R_D \cdot K + \Pi_F + \mathbb{E}[\Phi^j] - \mathbb{E}[T^j], \tag{2.50}$$

where

$$R_D = \max\left\{R^j_D, R^k_D\right\} \tag{2.51}$$

$$R^j_D = \begin{cases} R^{j,\text{frg}}_D = (1-\hat{\tau}^j)\dfrac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j}\cdot\sigma\overline{R} & \forall\Theta^j \in \left(0,\bar{\Theta}\right) \\ R^{j,\text{rsl}}_D = (1-\hat{\tau}^j)\dfrac{1+(1-\delta)\Theta^j}{1+\Theta^j}\cdot\mathbb{E}[\widetilde{R}] & \forall\Theta^j \in \left[\bar{\Theta},+\infty\right) \end{cases} \tag{2.52}$$

$$b^j = \begin{cases} 0 & \textit{if } R^j_D < R^k_D \\ 1 & \textit{if } R^j_D \geq R^k_D \end{cases} \tag{2.53}$$

$$\Pi_F = f(k_F) - R_D k_F \tag{2.54}$$

$$k_F = f'^{-1}(R_D) \tag{2.55}$$

$$\mathbb{E}[\Phi^j] = k^j_R \cdot \hat{\tau}^j \cdot \mathbb{E}[\widetilde{R}] \tag{2.56}$$

$$\mathbb{E}[T^j] = \begin{cases} k^j_R \cdot (1-\sigma)\cdot(1-\hat{\tau}^j)\left(\dfrac{\sigma\overline{R}}{\sigma+\Theta^j} - \underline{R}\right) & \forall\Theta^j \in \left(0,\bar{\Theta}\right) \\ 0 & \forall\Theta^j \in \left[\bar{\Theta},+\infty\right) \end{cases} \tag{2.57}$$

$$k^j_R = \beta^j(W - k_F) - b^j\delta E^j \tag{2.58}$$

$$\beta^j = \begin{cases} 0 & \textit{if } R^j_D < R^k_D \\ 1 & \textit{if } R^j_D = R^k_D \\ 2 & \textit{if } R^j_D > R^k_D \end{cases} \tag{2.59}$$

with $\Theta^j = \hat{\Theta}^j_{\text{reg}} \geq \vartheta$ *and* $\bar{\Theta} = \dfrac{\sigma\left(\overline{R} - \mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}$.

The proof of Proposition 2.1 is given in Appendix A. Proposition 2.1 highlights the channel through which the legislative schemes affect the allocation of the investment good between the two countries and the consequent impact on households' welfare. In particular, we note that, due to capital mobility, countries do not differ from each other with respect to the returns on capital, $R_D K$, and the FT profits, Π_F. But, differences in the legislative schemes can differentiate countries with regard to tax revenues and bailout expenditures. Namely, a country that adopts a laxer approach towards capital regulation and tax policy can be more attractive to banking activities,[19] enjoying thus high tax revenues but also suffering from large bailout expenditures, should its banks fail.

2.4 Competitive Equilibrium with Endogenous Legislative Schemes

In Section 2.3, we have shown that for any given legislative scheme, $(\hat{\Theta}^j_{\text{reg}}, \hat{\tau}^j)$, a unique competitive equilibrium exists. In this section, we investigate the equilibrium that arises when the legislative schemes are determined endogenously. The equilibrium definition is as follows:

Definition 2.4
A competitive equilibrium with endogenously determined legislative schemes is a set of returns $\left\{R^j_D, R^j_F, \mathbb{E}[R^j_E]\right\}$, allocations $\left\{k^j_F, k^j_R\right\}$, asset holdings $\left\{B^j_F, L^j_R, D^j, E^j\right\}$, capital structures $\{\Theta^j\}$ and legislative schemes $\left(\Theta^j_{\text{reg}}, \tau^j\right)$ with $j = 1, 2$ such that

(i) the household in Country j maximizes its expected utility, $\mathbb{E}[U^j]$,

(ii) FT in Country j maximizes its profits, Π^j_F,

(iii) RT in Country j maximizes its expected profits, $\mathbb{E}[\Pi^j_R]$,

(iv) the bank in Country j maximizes its expected returns on equity, $\mathbb{E}[R^j_E]$,

(v) all markets clear, i.e., $z_K = \overline{z_c} = \underline{z_c} = 0$, and

(vi) the legislative scheme as determined by the national government in Country j maximizes the expected utility of households within its jurisdiction, $\mathbb{E}[U^j]$.

[19] This result is in line with Houston et el. (2012) who show that international bank flows are directed to markets with laxer regulation. In the same spirit, Ongena et al. (2013) show that stricter regulation in one country yields a shift of the risky activities to the country with laxer regulation, while Karolyi and Taboada (2015) show that regulatory arbitrage takes place with regard to cross-border bank acquisitions as well.

Note that a competitive equilibrium with endogenous legislative schemes must satisfy all the conditions of a competitive equilibrium with exogenous legislative schemes, as characterized by Proposition 2.1. In other words, the solutions of agents' problems, as characterized in Section 2.3 still hold and thus, in this section, we focus on the government decisions for maximizing the expected utility of their households.

The investigation begins with an analysis of the two-dimension policy space, characterized by capital regulation and tax policy. The equilibrium that arises when governments set their legislation with regard to the two policy instruments under regulatory competition is then studied.

2.4.1 Two-Dimension Policy Space

When the legislative scheme is determined endogenously, the governments choose one point out of the policy space which is defined by

Definition 2.5
A policy space is a two-dimension space that is fully characterized by $(\Theta^j_{\text{reg}}, \tau^j)$ *with* $\Theta^j_{\text{reg}} \geq \vartheta$ *and* $0 \leq \tau^j \leq 1$.

We know from Proposition 2.1 that households' expected utility in countries with different legislative schemes only differ with respect to the expected tax revenues, $\mathbb{E}[\Phi^j]$, and expected bailout expenditures, $\mathbb{E}[T^j]$.[20] Therefore, we are particularly interested in the impact of different points of the policy space on $\mathbb{E}[\Phi^j]$ and $\mathbb{E}[T^j]$. We call the difference between these two variables the *"net expected tax revenues"* and by substituting for $\mathbb{E}[\Phi^j]$ and $\mathbb{E}[T^j]$ from (2.56) and (2.57), respectively, we obtain

$$\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] = k^j_R \cdot \phi^j(\Theta^j, \tau^j), \tag{2.60}$$

where

$$k^j_R = \beta^j(K - k_F) - b^j \delta E^j \tag{2.61}$$

$$\phi^j = \begin{cases} \dfrac{1+\Theta^j}{\sigma+\Theta^j} \cdot \sigma \overline{R} \tau^j - (1-\sigma) \cdot \left(\dfrac{\sigma \overline{R}}{\sigma + \Theta^j} - \underline{R} \right) & \forall \Theta^j \in \left(0, \bar{\Theta}\right) \\ \tau^j \cdot \mathbb{E}[\widetilde{R}] & \forall \Theta^j \in \left[\bar{\Theta}, +\infty\right) \end{cases} \tag{2.62}$$

$$b^j = \begin{cases} 0 & \text{if } R^j_D < R^k_D \\ 1 & \text{if } R^j_D \geq R^k_D \end{cases} \tag{2.63}$$

[20] Indeed, in equilibrium we obtain $R^j_D \cdot K + \Pi^j_F = R^k_D \cdot K + \Pi^k_F = R_D \cdot K + \Pi_F$.

$$\beta^j = \begin{cases} 0 & \text{if } R_D^j < R_D^k \\ 1 & \text{if } R_D^j = R_D^k \\ 2 & \text{if } R_D^j > R_D^k \end{cases} \tag{2.64}$$

with $\Theta^j = \Theta^j_{\text{reg}}$.
We observe that $\phi^j \geq 0$ for all $\Theta^j \in [\bar{\Theta}, +\infty)$ and $\tau^j \geq 0$, provided that $R_D^j \geq R_D^k$. Therefore, if $b^j = 1$,

$$\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \geq 0 \qquad \forall \Theta^j \in [\bar{\Theta}, +\infty) \text{ and } \tau^j \geq 0. \tag{2.65}$$

However, for all $\Theta^j \in \left(0, \bar{\Theta}\right)$, the net expected tax revenues, $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j]$, are strictly positive if and only if $R_D^j \geq R_D^k$ and $\phi^j(\Theta^j, \tau^j) > 0$. The latter is equivalent to the following condition:

$$\tau^j > \bar{\tau}(\Theta^j), \tag{2.66}$$

where[21]

$$\bar{\tau}(\Theta^j) = \frac{1-\sigma}{1+\Theta^j} \cdot \left(1 - \frac{\underline{R}(\sigma + \Theta^j)}{\sigma \overline{R}}\right) \qquad \forall \Theta^j \in (0, \bar{\Theta}). \tag{2.67}$$

Note that $\bar{\tau}(\Theta^j)$ is a continuous and decreasing function in Θ^j in the interval $\left(0, \bar{\Theta}\right)$ with $\bar{\tau}(\bar{\Theta}) = 0$. We hence say that the policy space is dichotomized by $\bar{\tau}$ into two subspaces, one with negative net expected tax revenues for all $\tau^j < \bar{\tau}$, and one with positive net expected tax revenues for all $\tau^j > \bar{\tau}$. We call $\bar{\tau}$ the *"policy space dichotomy"*. An illustration of the policy space dichotomy for a certain specification[22] is shown in Figure 2.3.
Because governments are better off by shifting abroad banking activities as long as their legislative schemes lie in the subspace of negative net expected tax revenues, or by attracting banking activities as long as their legislative schemes lie in the subspace of positive net expected tax revenues, we obtain

Lemma 2.6
Let $\vartheta < \bar{\Theta}$.

(i) If $\left(\Theta^j_{\text{reg}}, \tau^j\right) = \left(\Theta^k_{\text{reg}}, \tau^k\right)$ with $\Theta^j_{\text{reg}} < \bar{\Theta}$ and $\tau^j < \bar{\tau}$, then the government in Country j is strictly better off by increasing Θ^j_{reg} and/or τ^j.

(ii) If $\left(\Theta^j_{\text{reg}}, \tau^j\right) = \left(\Theta^k_{\text{reg}}, \tau^k\right)$ with $\Theta^j_{\text{reg}} < \bar{\Theta}$ and $\tau^j > \bar{\tau}$, or $\Theta^j_{\text{reg}} \geq \bar{\Theta}$ and $\tau^j > 0$, then the government in Country j is strictly better off by decreasing, at least marginally,

[21] Because of (2.65), $\bar{\tau} = 0$ for all $\Theta^j \geq \bar{\Theta}$.
[22] $f(k_F) = 2\sqrt{k_F} - k_F$, $K = 1$, $\underline{R} = 0.5$, $\overline{R} = 2$, and $\vartheta = 0.05$.

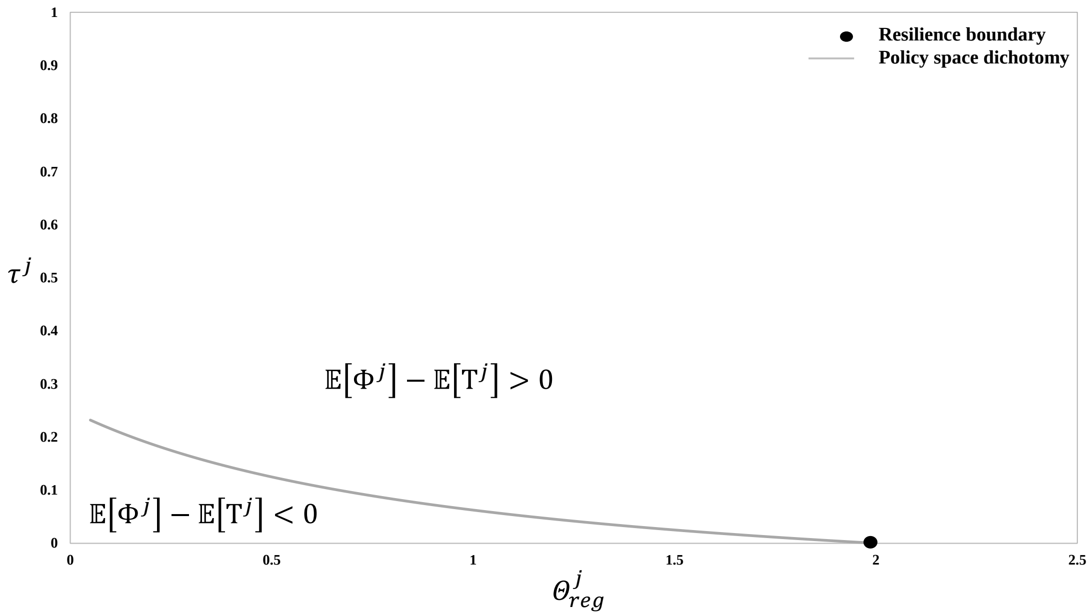

Figure 2.3: Policy space of capital regulation and tax policy

Θ^j_{reg} *and/or* τ^j.

The proof of Lemma 2.6 is given in Appendix A. Claim (i) of Lemma 2.6 implies that there is no equilibrium with $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] < 0$. Claim (ii) of Lemma 2.6 implies that there is no equilibrium with $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] > 0$. That is, there is no equilibrium with $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \neq 0$. We complete the analysis of the policy space by noting that $\mathbb{E}[\Phi^j(\Theta^j, \bar{\tau}(\Theta^j))] - \mathbb{E}[T^j(\Theta^j, \bar{\tau}(\Theta^j))] = 0$ for all $\Theta^j \in \left(0, \bar{\Theta}\right)$.

By substituting for $\bar{\tau}$ into (2.33), and by showing that the equilibrium returns with $\tau^j = \bar{\tau}(\Theta^j)$ for all $\Theta^j \in \left(0, \bar{\Theta}\right)$ are decreasing in both τ^j and Θ^j_{reg}, we obtain

Lemma 2.7
If $\vartheta < \bar{\Theta}$, *then* $R_D(\vartheta, \bar{\tau}(\vartheta))$ *is the maximum equilibrium returns that satisfy* $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \geq 0$. *If* $\vartheta \geq \bar{\Theta}$, *then* $R_D(\vartheta, 0)$ *is the maximum equilibrium returns that satisfy* $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \geq 0$.

The proof of Lemma 2.7 is given in Appendix A. Taking into consideration that $b^j = 1$ if $R^j_D \geq R^k_D$, Lemma 2.7 implies that the government in Country j can make sure that banks operate within its jurisdiction, while net expected tax revenues are non-negative, by setting $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, \bar{\tau}(\vartheta))$ if $\vartheta < \bar{\Theta}$ and $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, 0)$ if $\vartheta \geq \bar{\Theta}$.

2.4.2 Regulatory Competition

The equilibrium that arises when competing governments decide on the legislative scheme within their jurisdiction is now investigated. The problem faced by the national government in Country j is the following:

$$\max_{(\Theta^j_{\text{reg}},\tau^j)} \left\{\mathbb{E}[U^j] = R_D \cdot K + \Pi_F + \mathbb{E}[\Phi^j] - \mathbb{E}[T^j]\right\}, \tag{2.68}$$

where

$$R_D = \max\left\{R^j_D, R^k_D\right\} \tag{2.69}$$

$$R^j_D = \begin{cases} R^{j,\text{frg}}_D = (1-\tau^j)\dfrac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j}\cdot\sigma\overline{R} & \forall\Theta^j \in \left(0,\bar{\Theta}\right) \\ R^{j,\text{rsl}}_D = (1-\tau^j)\dfrac{1+(1-\delta)\Theta^j}{1+\Theta^j}\cdot\mathbb{E}[\widetilde{R}] & \forall\Theta^j \in \left[\bar{\Theta},+\infty\right) \end{cases} \tag{2.70}$$

$$b^j = \begin{cases} 0 & \text{if } R^j_D < R^k_D \\ 1 & \text{if } R^j_D \geq R^k_D \end{cases} \tag{2.71}$$

$$\Pi_F = f(k_F) - R_D k_F \tag{2.72}$$

$$\mathbb{E}[\Phi^j] = k^j_R \cdot \tau^j \cdot \mathbb{E}[\widetilde{R}] \tag{2.73}$$

$$\mathbb{E}[T^j] = \begin{cases} k^j_R\cdot(1-\sigma)\cdot(1-\tau^j)\left(\dfrac{\sigma\overline{R}}{\sigma+\Theta^j} - \underline{R}\right) & \forall\Theta^j \in \left(0,\bar{\Theta}\right) \\ 0 & \forall\Theta^j \in \left[\bar{\Theta},+\infty\right) \end{cases} \tag{2.74}$$

$$k^j_R = \beta^j(W-k_F) - b^j\delta E^j \tag{2.75}$$

$$\beta^j = \begin{cases} 0 & \text{if } R^j_D < R^k_D \\ 1 & \text{if } R^j_D = R^k_D \\ 2 & \text{if } R^j_D > R^k_D \end{cases} \tag{2.76}$$

with $\Theta^j = \Theta^j_{\text{reg}} \geq \vartheta$ and $\bar{\Theta} = \dfrac{\sigma\left(\overline{R}-\mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}$.

We initially assume that $\vartheta \geq \bar{\Theta}$ which, because of (2.10), (2.16) and (2.34), also implies that banks remain resilient and therefore, $\mathbb{E}[T^j] = 0$. In the absence of potential bailout costs, governments engage into competition to attract banks by reducing capital requirements and tax rate and we obtain

Lemma 2.8

Suppose that $\vartheta \geq \bar{\Theta}$. In equilibrium, the government in Country j sets $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, 0)$ with $j = 1, 2$.

The proof of Lemma 2.8 is given in Appendix A. The above described behavior of the competing governments is based on the results in Section 2.3 according to which countries can attract banking activities by adopting a laxer approach with regard to capital regulation and tax policy. Since $\vartheta \geq \bar{\Theta}$, namely, banks are resilient, potential bailout costs are zero and hence, regulatory competition yields a zero tax rate.

We now turn our focus to the most general case, where ϑ is smaller than $\bar{\Theta}$, which implies that competing governments can choose capital requirements that render their banks fragile. We know from the analysis in Subsection 2.4.1 that in this case, different legislative schemes can result in negative, zero, or positive net expected tax revenues. We also know from Lemma 2.6 that governments have incentives to avoid hosting banks by increasing their capital requirements and tax rate in the case of strictly negative net expected tax revenues, whereas they have incentives to attract banks by decreasing their capital requirements and tax rate in the case of strictly positive net expected tax revenues. The above indicate that, in equilibrium, the net expected tax revenues are zero. Indeed, by proving that there is no utility-increasing deviation from $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, \bar{\tau}(\vartheta))$ if $\vartheta < \bar{\Theta}$, we establish

Proposition 2.2

There exists a unique competitive equilibrium with endogenously determined legislative schemes where the government in Country j sets $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, \bar{\tau}(\vartheta))$ with $\bar{\tau}(\vartheta) = \frac{1-\sigma}{1+\vartheta} \cdot \left(1 - \frac{R(\sigma+\vartheta)}{\sigma \overline{R}}\right)$ for all $\vartheta < \bar{\Theta}$, and $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, 0)$ for all $\vartheta \geq \bar{\Theta}$, with $j = 1, 2$.

The proof of Proposition 2.2 is given in Appendix A. The intuition runs as follows. Being able to counteract potential bailout costs, the governments can allow banks to economize on equity issuance costs by setting capital requirements at the minimum level. That means banks in both countries can compete internationally in a level playing field with regard to capital regulation, namely, $\Theta^j_{\text{reg}} = \Theta^k_{\text{reg}} = \vartheta$. National governments counteract potential bailout costs by setting a strictly positive tax rate which is set at the optimal level in equilibrium as the result of the following reaction pattern of the government in Country j:

$$\tau^j \begin{cases} < \tau^k & \text{if } \tau^k > \bar{\tau}(\vartheta) \\ = \tau^k & \text{if } \tau^k = \bar{\tau}(\vartheta) \\ > \tau^k & \text{if } \tau^k < \bar{\tau}(\vartheta). \end{cases} \tag{2.77}$$

That is, if Country k sets an excessive tax rate, i.e., $\tau^k > \bar{\tau}(\vartheta)$, then Country j can be more competitive in attracting banks by setting $\tau^j < \tau^k$, with τ^j still greater than $\bar{\tau}(\vartheta)$, thus, achieving strictly positive net expected tax revenues. If Country k sets $\tau^k < \bar{\tau}(\vartheta)$, then Country j has no incentive to compete to attract banks by setting an even lower tax rate because that would yield excessive bailout costs as compared to tax revenues. In other words, regulatory competition prevents excessive taxation, i.e., taxation that would yield positive net expected tax revenues, because that would harm the international competitiveness of banks operating within their jurisdiction. A tax rate below the optimal level would result in an over-investment in the risky sector, which in turn, would generate excessive bailout costs.

This equilibrium yields a strictly positive likelihood of a banking crisis since it renders banks fragile if $\vartheta < \bar{\Theta}$.[23] That is, financial stability is undermined. Yet, this is the optimal legislation set by national governments aiming at maximizing the social welfare of households that reside within their jurisdiction.

2.5 Social Welfare Analysis

The outcome that arises under regulatory competition, as described by Proposition 2.2, is now assessed from a global social welfare perspective, as well as from a financial stability point of view. Specifically, the equilibrium when a supranational government decides on the same policy instruments, aiming to maximize the aggregate expected utility of the households across both countries, denoted by $\mathbb{E}[U^s]$, is characterized, and will serve as a benchmark against the solution that arises under regulatory competition.

2.5.1 Supranational Solution

We begin with the equilibrium that arises when a supranational government sets both capital regulation and tax policy to maximize the aggregate expected utility of households across the countries. The problem faced by the supranational government is the following:

$$\max_{(\tau^s, \Theta^s_{\text{reg}})} \left\{ \mathbb{E}[U^s] = 2R_D \cdot K + 2\Pi^s_F + \mathbb{E}[\Phi^s] - \mathbb{E}[T^s] \right\}, \tag{2.78}$$

where

$$R_D = \begin{cases} R_D^{\text{frg}} = (1-\tau^s)\dfrac{1+(1-\delta)\Theta}{\sigma+\Theta} \cdot \sigma\overline{R} & \forall \Theta \in \left(0, \bar{\Theta}\right) \\ R_D^{\text{rsl}} = (1-\tau^s)\dfrac{1+(1-\delta)\Theta}{1+\Theta} \cdot \mathbb{E}[\widetilde{R}] & \forall \Theta \in \left[\bar{\Theta}, +\infty\right) \end{cases} \tag{2.79}$$

[23] Note that the analysis in this chapter assumes no banking crisis repercussions besides the bailout expenditures. In Chapter 3, banking crisis repercussions—in the form of a reduction in risky returns in the bad state of the world below the prediction of $\underline{R}$—are modeled. In that case, it will be shown that there is a threshold of such a reduction, below of which governments set $(\Theta^j_{\text{reg}}, \tau^j) = (\bar{\Theta}, 0)$ with $j = 1, 2$ in order to render their banks resilient even if $\vartheta < \bar{\Theta}$.

$$\Pi_F^s = f(k_F) - R_D k_F \tag{2.80}$$

$$\mathbb{E}[\Phi^s] - \mathbb{E}[T^s] = k_R^s \cdot \phi^s \tag{2.81}$$

$$\phi^s = \begin{cases} \frac{1+\Theta}{\sigma+\Theta}\sigma\overline{R}\tau^s - (1-\sigma)\left(\frac{\sigma\overline{R}}{\sigma+\Theta} - \underline{R}\right) & \forall\Theta \in \left(0, \bar{\Theta}\right) \\ \tau^s \cdot \mathbb{E}[\widetilde{R}] & \forall\Theta \in \left[\bar{\Theta}, +\infty\right) \end{cases} \tag{2.82}$$

$$k_R^s = 2(K - k_F) - \delta E^s \tag{2.83}$$

$$\Theta = \Theta_{\text{reg}}^s \geq \vartheta. \tag{2.84}$$

From FOC with respect to τ^s we obtain

Lemma 2.9
In equilibrium, the supranational government sets

$$\tau^s = \begin{cases} \frac{1-\sigma}{1+\Theta}\left(1 - \frac{\underline{R}(\sigma+\Theta)}{\sigma\overline{R}}\right) & \forall\Theta \in \left(0, \bar{\Theta}\right) \\ 0 & \forall\Theta \in \left[\bar{\Theta}, +\infty\right), \end{cases} \tag{2.85}$$

where $\Theta = \Theta_{\text{reg}}^s \geq \vartheta$.

The proof of Lemma 2.9 is given in Appendix A. We note that $\tau^s = \bar{\tau}$ implying that $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] = 0$ with $j = 1, 2$. Substituting for $\bar{\tau}$ into the aggregate expected utility as given by (2.78), we re-formulate the problem as follows:

$$\max_{\Theta_{\text{reg}}^s} \left\{ \mathbb{E}[U^s] = \frac{1 + (1-\delta)\Theta}{1+\Theta} \cdot \mathbb{E}[\widetilde{R}] \cdot 2 \cdot (K - k_F) + 2f(k_F) \right\}, \tag{2.86}$$

with $\Theta = \Theta_{\text{reg}}^s$. Because

$$\frac{\partial \mathbb{E}[U^s]}{\partial \Theta} = -\frac{\delta}{(1+\Theta)^2}\mathbb{E}[\widetilde{R}] \cdot 2(K - k_F) < 0 \tag{2.87}$$

we obtain

Proposition 2.3
The supranational government sets $(\Theta_{\text{reg}}^s, \tau^s) = (\vartheta, \bar{\tau}(\vartheta))$ *for all* $\vartheta < \bar{\Theta}$ *with* $\bar{\tau}(\vartheta) = \frac{1-\sigma}{1+\vartheta} \cdot \left(1 - \frac{\underline{R}(\sigma+\vartheta)}{\sigma\overline{R}}\right)$*, and* $(\Theta_{\text{reg}}^s, \tau^s) = (\vartheta, 0)$ *for all* $\vartheta \geq \bar{\Theta}$.

Although the socially optimal outcome can be achieved either with $b^j = b^k = 1$, or with $b^j = 1$ and $b^k = 0$, Assumption 2.1 selects the equilibrium with banks operating in both countries.

2.5.2 Comparison of Regulatory Competition and Supranational Solution

Comparing Propositions 2.2 and 2.3, we conclude that regulatory competition results in an efficient outcome since it yields the legislative scheme that arises when a supranational government aims to maximize the aggregate welfare across the two countries. At the same time, we note that both the regulatory competition and the supranational solution yield a strictly positive likelihood of a banking crisis if the *a priori* capital regulation satisfies $\vartheta < \bar{\Theta}$.

Whether regulatory competition yields an efficient outcome or not was *a priori* unclear. Indeed, whereas the choice of the same capital regulation by the competing governments and the supranational one stems from the common incentive to economize on equity issuance cost, the choice of the same tax rate occurs for different reasons.

The supranational government does not set a tax rate beyond $\bar{\tau}$ because the marginal cost due to reduced returns on capital would exceed the marginal benefits from higher tax revenues.[24] Contrariwise, a national government in the absence of regulatory competition would set a tax rate beyond the efficient level of $\bar{\tau}$ because the reduction of the returns on capital, that are only experienced at the national level, would be outweighed by the benefits from higher tax revenues that result from attracting banking activities at the global scale.[25] In fact, should a country, say Country j, be able to impose the legislative scheme of its own preference on Country k, then Country j would impose high enough capital requirements and tax rate in Country k such that all the banking activities are shifted to Country j, while it would choose $(\Theta^j_{\text{reg}}, \tau^j)$ with $\Theta^j_{\text{reg}} = \vartheta$ and $\tau^j > \bar{\tau}(\vartheta)$.[26] This is an inefficient legislative scheme that is not materialized only because of the existence of a competing government in Country k that is ready to take advantage of any deviation of Country j from the legislative scheme $(\vartheta, \bar{\tau}(\vartheta))$ that yields the maximum equilibrium returns with non-negative net expected tax revenues.

Combining Propositions 2.2 and 2.3, we can summarize our results as follows:

Theorem 2.1

In any equilibrium with endogenously determined legislative schemes under regulatory competition, the government in Country j sets $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, \bar{\tau}(\vartheta))$ *with* $\bar{\tau}(\vartheta) = \frac{1-\sigma}{1+\vartheta} \cdot \left(1 - \frac{R(\sigma+\vartheta)}{\sigma \bar{R}}\right)$ *for all* $\vartheta < \bar{\Theta}$*, and* $(\Theta^j_{\text{reg}}, \tau^j) = (\vartheta, 0)$ *for all* $\vartheta \geq \bar{\Theta}$*, with* $j = 1, 2$*. This is an efficient*

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[24] We know from Lemma 2.9 that $\partial \mathbb{E}[U^s]/\partial \tau^s = 0$ at $\tau^s = \bar{\tau}$.

[25] The contrast between national and supranational governments' motives can be better understood by noting that $\mathbb{E}[U^j] = R_D \cdot (K - k_f) + f(k_f) + \big(2(K - k_F) - \delta E^j\big) \cdot \phi^j$ if $b^j = 1$ and $b^k = 0$, whereas $\mathbb{E}[U^s] = 2 \cdot R_D \cdot (K - k_f) + 2 \cdot f(K_f) + (2(K - k_F) - \delta E^s) \cdot \phi^s$.

[26] As shown in the proof of Proposition 2.2 in Appendix A, $\partial \mathbb{E}[U^j]/\partial \tau^j > 0$ at $\tau^j = \bar{\tau}$ if $b^j = 1$ and $b^k = 0$.

outcome maximizing the expected utility at a supranational level.

2.6 Conclusions

In this chapter, the behavior of competing national governments that set capital requirements and tax policy, aiming to maximize the welfare of households that reside within their jurisdiction, is studied. Capital is mobile since households can invest in both domestic and foreign banks in the form of deposits and equity. The governments have to respect an *a priori* level of capital regulation. Tax policy is characterized by a tax rate imposed on the output of the risky sector that is financed by banks. National governments bail out failed banks so that deposits are fully guaranteed without discrimination between residents and foreigners.

It has been shown that, due to capital mobility, countries' welfare do not differ with respect to the returns on capital. Yet, differences can arise in regard to tax revenues and bailout expenditures. In particular, a country that adopts a stricter approach towards capital regulation and tax policy becomes less attractive to banking activities, avoiding thus bailout expenditures but also abandoning tax revenues.

This mechanism induces an equilibrium under regulatory competition in which competing governments set capital requirements equal to the *a priori* level—even if that allows bank leverage which implies a positive likelihood of a banking crisis—and tax rates are set such that any expected bailout expenditures are covered. That is an efficient outcome, i.e., the outcome that could be obtained when a supranational social planner decided on the two policy instruments.

In other words, regulatory competition in the presence of a policy tool that can counteract bailout costs induces an efficient level of capital regulation. It allows economizing on equity issuance costs, as well as an efficient tax policy according to (2.77), which results in the optimal allocation of resources. The efficiency obtained under regulatory competition in the presence of a counteracting policy tool seems at odds with the recent shift in legislating on banking regulation from the national to the supranational level within the EU, as outlined in Subsection 1.1.2. This shift is largely driven by concerns about the implementation of banking regulation—that might be associated with time inconsistency problems. These concerns are not taken into consideration in this thesis, its focus being the design of banking regulation. Still, the rationale of shifting regulatory and supervisory competences to the supranational level can be justified in the spirit of the mechanism that induces efficient policies under regulatory competition in this chapter's model. For example, a supranational structure that comprises of several national authorities, such as the Single Supervisory Mechanism, allows mutual checks ensuring that banks across Member

States compete in a level playing field.

Extensions and generalizations of the base model are presented in the next chapter. As will be shown, as long as bailout costs can be offset or avoided, governments set capital regulation at the minimum level and regulatory competition yields the efficient allocation of resources. In the absence of a counteracting tool, regulatory competition results in an inefficient outcome.

3 Extensions and Generalizations of the Base Model

3.1 Introduction

A number of assumptions have been made for the development of the base model in Chapter 2. These assumptions let us focus on the behavior of competing governments when they set banking regulation, as well as on the impact of regulatory competition on social welfare. Important assumptions are relaxed in this chapter in order to further understand the behavior of competing governments but also to test the robustness of the previous chapter's results.

3.1.1 Model Features and Main Results

The base model is altered in four respects. First, it is generalized by endogenizing the bank resolution mechanism. Instead of exogenously imposing a bailout mechanism, governments are allowed to decide whether failed banks will be bailed out or bailed in.[1] That results in a three-dimensional regulatory competition—in regard to capital regulation, tax policy and bank resolution, and it is shown that the efficient outcome is sustained.

Second, a special case of the base model is studied by investigating the competition between governments when they only have capital regulation at their disposal. That results in an one-dimensional regulatory competition—in regard only to capital regulation. Without a policy tool that can counteract bailout costs, it is shown that regulatory competition yields an inefficient allocation.

Third, an alternative form of tax policy is studied. More specifically, the taxation on output after loan grants, as considered in Chapter 2, is replaced by a systemic risk tax on bank balance-sheets in advance of bank loans to risky projects. Such a tax has been discussed in the aftermath of the 2007-2008 financial crisis (see, for example, IMF (2010)).[2]

[1] The consideration of both bailout and bail-in is deemed warranted, given the ambiguity with regard to the use of the bail-in tool in the context of the EU banking legislation, as described in Subsection 1.1.2.

[2] Banks' contributions to the Single Resolution Fund in the context of the EU banking legislation, as described in Subsection 1.1.2, can be considered in the same spirit.

The analysis shows that an output taxation is equivalent to a systemic risk tax on banks' balance sheet, provided that tax revenues are invested appropriately by the government.

Finally, motivated by the undeniable observation that the losses from the 2007-2008 financial crisis extended well beyond mere bailout expenditures, an extension of the base model considers banking crisis repercussions in the form of unexpected productivity reduction in the risky sector. In that case, there exist a threshold of such repercussions, above of which governments prefer to render their banking sector resilient by imposing strict capital regulation, at the expense of equity issuance costs.

3.1.2 Organization of the Chapter

The rest of the chapter is organized as follows. Three-dimensional regulatory competition is studied in Section 3.2, while one-dimensional regulatory competition is studied in Section 3.3. Systemic risk tax on banks' balance sheet is examined in Section 3.4. Banking crisis repercussions besides direct bailout costs are considered in Section 3.5. Conclusions are drawn in Section 3.6.

3.2 Three-dimensional Regulatory Competition

Throughout the analysis of the base model in Chapter 2, we considered an exogenously given resolution mechanism according to which failed banks are bailed out by national governments. This assumption is empirically supported by the entrenched bailout expectations of market participants, especially in the aftermath of the 2007-2008 financial crisis, as explained in Subsection 1.1.2. Having exogenously imposed a bailout mechanism in Chapter 2, we investigated regulatory competition with respect to two instruments; capital requirements and tax rate.

Yet, as shown in Subsection 1.1.2, Directive 2014/59/EU and Regulation(EU) 806/2014 introduce bail-in as a bank resolution tool that will prevent the use of taxpayers' funds for bailing out failed banks. Taking this legal change into consideration, we generalize the base model of Chapter 2 by allowing governments to choose their bank resolution mechanism, which is characterized according to

$$P^j = \begin{cases} 0 & \text{if failed banks in Country } j \text{ will be bailed out} \\ 1 & \text{if failed banks in Country } j \text{ will be bailed in.} \end{cases} \tag{3.1}$$

Thus, the legislative scheme is defined in this section as follows:

Definition 3.1

The legislative scheme in Country j, $(\Theta^j_{\text{reg}}, \tau^j, P^j)$*, is the set of capital requirements,* Θ^j_{reg}*, tax rate,* τ^j*, and bank resolution mechanism,* P^j*.*

At the beginning of period $t = 1$, and once the *a priori* capital regulation becomes known, the government in Country j decides on, and publicly announces, its three-dimensional legislative scheme, (Θ^j, τ^j, P^j).[3]

The expected returns on FT and equity, as given by (2.22) and (2.25), respectively, remain unchanged. However, the possibility of a bail-in affects the expected returns on deposits as follows:[4]

$$\begin{aligned}\mathbb{E}[R^j_D] =& \sigma R^j_D + (1-\sigma)(1-X^j)\cdot R^j_D + (1-\sigma)X^j(1-P^j)\cdot R^j_D \\ &+ (1-\sigma)X^j P^j \cdot \Big(1 + (1-\delta)\Theta^j\Big) \cdot (1-\tau^j)\cdot \underline{R}.\end{aligned} \tag{3.2}$$

In other words, as described by the first line of (3.2), depositors fully receive the promised returns on deposits, R^j_D, if the good state of the world occurs,[5] or the banks are resilient $(X^j = 0)$, or their banks are bailed out by government $(P^j = 0)$. As described by the second line of (3.2), depositors only receive the liquidation value of banks when fragile banks $(X^j = 1)$ are bailed in $(P^j = 1)$ in the bad state of the world.

If $\Theta^j_{\text{reg}} \geq \bar{\Theta}$, i.e., $X^j = 0$, then, (3.2) yields $\mathbb{E}[R^j_D] = R^j_D$. Therefore, as long as $\Theta^j_{\text{reg}} \geq \bar{\Theta}$, the value of P^j does not affect the equilibrium returns as given by (2.33). That also implies that Lemma 2.8 holds regardless of government decisions on their resolution mechanism. We thus focus on the more general case with $\vartheta < \bar{\Theta}$.

For the ease of notation, we refer to the free-of-risk returns as follows:

$$R^{j,\text{OUT}}_F\Big(\Theta^j, \tau^j\Big) \equiv R^j_F\Big(\Theta^j, \tau^j, P^j = 0\Big) \tag{3.3}$$

$$R^{j,\text{IN}}_F\Big(\Theta^j, \tau^j\Big) \equiv R^j_F\Big(\Theta^j, \tau^j, P^j = 1\Big). \tag{3.4}$$

We know from (2.33) that

$$R^{j,\text{OUT}}_F\Big(\Theta^j, \tau^j\Big) = (1-\tau^j)\frac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j}\cdot\sigma\overline{R} \qquad \forall \Theta^j \in (0, \bar{\Theta}) \tag{3.5}$$

[3] As in Chapter 2, we assume no time inconsistency problems with regard to the implementation of the announced legislative scheme.

[4] Note that in equilibrium, $\overline{R}^j_R = (1-\tau^j)\overline{R}$ and $\underline{R}^j_R = (1-\tau^j)\underline{R}$, as shown in Subsection 2.3.2.

[5] It turns out that in equilibrium banks do not fail if the good state of the world occurs, irrespective of their capital structure.

and substituting for $\bar{\tau}$, we obtain

$$R_F^{j,\mathrm{OUT}}\left(\Theta^j, \bar{\tau}(\Theta^j)\right) = \frac{1+(1-\delta)\Theta^j}{1+\Theta^j} \cdot \mathbb{E}[\widetilde{R}] \qquad \forall \Theta^j \in (0, \bar{\Theta}). \tag{3.6}$$

Because of Lemma 2.2, we also require $R_F^{j,\mathrm{IN}} = \mathbb{E}[R_D^j] = \mathbb{E}[R_E^j]$, where $\mathbb{E}[R_D^j]$ is given by (3.2), and we obtain[6]

$$R_F^{j,\mathrm{IN}} = (1-\tau^j)\frac{1+(1-\delta)\Theta^j}{1+\Theta^j} \cdot \mathbb{E}[\widetilde{R}] \qquad \forall \Theta^j \in (0, +\infty)\,. \tag{3.7}$$

From (3.6) and (3.7) we observe that

$$R_F^{j,\mathrm{OUT}}\left(\Theta^j, \tau^j = \bar{\tau}(\Theta^j)\right) = R_F^{j,\mathrm{IN}}\left(\Theta^j, \tau^j = 0\right) \tag{3.8}$$

and because governments want to allow banks operating within their jurisdiction to economize on equity issuance cost in order to be competitive internationally, we obtain

Proposition 3.1

In equilibrium with an endogenously determined three-dimensional legislative scheme $\left(\Theta_{\mathrm{reg}}^j, \tau^j, P^j\right)$ *with* $0 < \vartheta < \bar{\Theta}$*, the national government in Country j sets either* $\left(\Theta_{\mathrm{reg}}^j, \tau^j, P^j\right) = (\vartheta, \bar{\tau}(\vartheta), 0)$ *or* $\left(\Theta_{\mathrm{reg}}^j, \tau^j, P^j\right) = (\vartheta, 0, 1)$*..*

The proof of Proposition 3.1 is given in Appendix B. Figure 3.1 illustrates the two legislative schemes that can arise in equilibrium—yielding four possible equilibria—for a given specification.[7] Proposition 3.1 highlights that governments' unwillingness to set capital requirements beyond an *a priori* level, as already shown in Theorem 2.1, is robust under three-dimensional regulatory competition. In fact, aiming to economize on equity issuance costs, governments prefer to counteract potential banking crisis costs by adjusting their tax policy and resolution mechanism rather than increasing capital requirements. A country that deviates upwards from the minimum capital requirements becomes unable to attract banking activities. Once the playing field with regard to capital requirements is even, i.e., $\Theta_{\mathrm{reg}}^j = \Theta_{\mathrm{reg}}^k = \vartheta$, the countries choose between two approaches: Either they offer safety to their depositors by promising to bail out their deposits if banks fail, at the expense of reducing the promised returns on deposits by taxation, or they renounce taxation and induce higher returns on deposits, at the expense of pushing the risk of bail-in to depositors if banks fail. Both approaches yield identical risk-free returns, thus resulting in four possible equilibria. The two approaches can also be understood as the result of the

[6] From $\mathbb{E}[R_D^j] = \mathbb{E}[R_E^j]$ and for $P^j = 1$, we obtain $R_D^j = (1-\tau^j)\frac{1+(1-\delta)\Theta^j}{1+\Theta^j} \cdot \frac{\Theta^j}{\sigma}\left(\frac{\sigma\overline{R}}{\Theta^j} - (1-\sigma)\underline{R}\right)$. $R_F^{j,\mathrm{IN}}$ is then obtained by substituting for R_D^j and $P^j = 1$ into (3.2).

[7] $f(k_F) = 2\sqrt{k_F} - k_F$, $K = 1$, $\underline{R} = 0.5$, $\overline{R} = 2$, and $\vartheta = 0.05$.

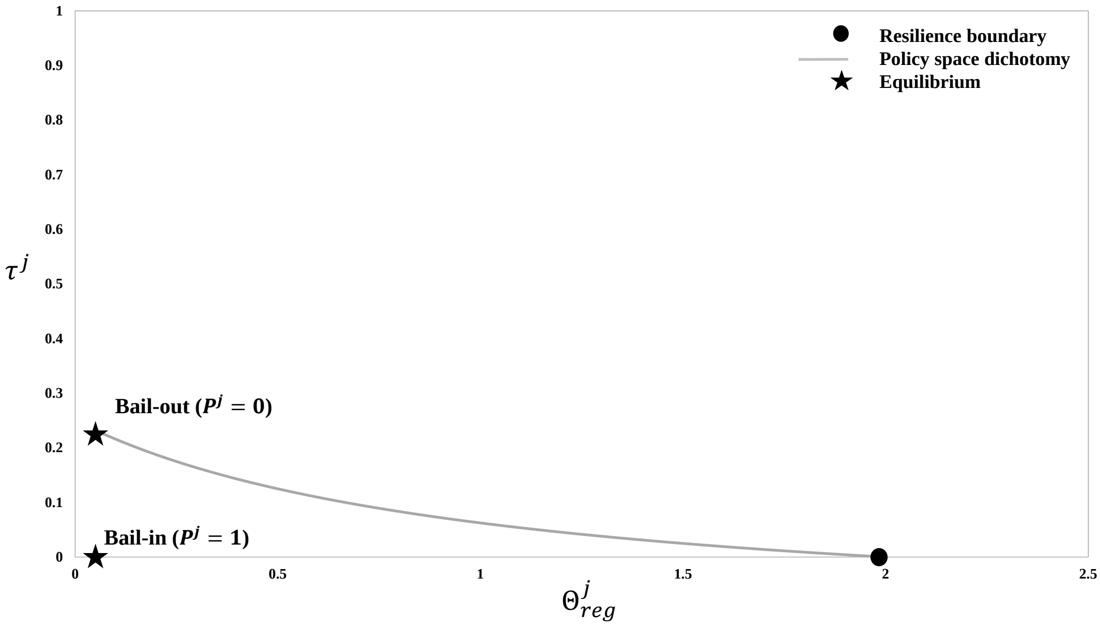

Figure 3.1: Possible equilibria in a three-dimensional policy space of capital regulation, tax policy and bank resolution

reaction pattern of Country j to Country k's policies as follows:

$$
\begin{array}{ll}
P^j = 0 \text{ and } \tau^j < \tau^k, \text{ or } P^j = 1 \text{ and } \tau^j > 0 & \text{if } P^k = 0 \text{ and } \tau^k > \bar{\tau}(\vartheta) \\
P^j = 0 \text{ and } \tau^j = \tau^k, \text{ or } P^j = 1 \text{ and } \tau^j = 0 & \text{if } P^k = 0 \text{ and } \tau^k = \bar{\tau}(\vartheta) \\
P^j = 0 \text{ and } \tau^j > \tau^k, \text{ or } P^j = 1 \text{ and } \tau^j \geq 0 & \text{if } P^k = 0 \text{ and } \tau^k < \bar{\tau}(\vartheta) \\
P^j = 0 \text{ and } \tau^j > \bar{\tau}(\vartheta), \text{ or } P^j = 1 \text{ and } \tau^j < \tau^k & \text{if } P^k = 1 \text{ and } \tau^k > 0 \\
P^j = 0 \text{ and } \tau^j = \bar{\tau}(\vartheta), \text{ or } P^j = 1 \text{ and } \tau^j = \tau^k & \text{if } P^k = 1 \text{ and } \tau^k = 0.
\end{array}
$$

The cost of a banking crisis is offset in both approaches, either by raising tax revenues or by avoiding bailout costs.

An institutional implication of the three-dimensional regulatory competition is now discussed. In particular, we assume the special case where one country, say Country j, has at its disposal all the policy instruments—capital regulation, tax policy and bank resolution—whereas Country k can only decide on capital regulation with tax rate exogenously set at zero, i.e., $\tau^k = 0$,[8] and failed banks being always bailed out, i.e., $P^k = 0$. Taking into account that the equilibrium legislative scheme as given by Proposition 2.2, where banks are also bailed out, requires strictly positive tax rates if $\vartheta < \bar{\Theta}$, we readily conclude that the optimal allocation cannot be reached in that case.

[8] The lack of infrastructure for raising tax revenues or a binding agreement with third countries, other than Country j, are two possible reasons that can prevent Country k from raising tax revenues.

However, taking Propositions 2.2 and 3.1 into account, we obtain

Corollary 3.1

Suppose that $0 < \vartheta < \bar{\Theta}$*, Country* j *can decide on all three policy instruments, whereas Country* k *can decide on* Θ^k_{reg} *and* $P^k \in \{0, 1\}$ *with* $\tau^k = 0$*. Then, in equilibrium Country* j *sets either* $\left(\Theta^j_{\text{reg}}, \tau^j, P^j\right) = (\vartheta, \bar{\tau}(\vartheta), 0)$ *or* $\left(\Theta^j_{\text{reg}}, \tau^j, P^j\right) = (\vartheta, 0, 1)$*, and Country* k *sets* $\left(\Theta^k_{\text{reg}}, P^k\right) = (\vartheta, 1)$*. This is an efficient outcome.*

That is, the optimal allocation can be achieved if the asymmetry with respect to the policy instruments is only limited to one policy instrument.

3.3 One-dimensional Regulatory Competition

The assumption that failed banks are bailed out is now re-introduced, and the scope of the analysis is further narrowed down in order to study the behavior of governments when they compete only with respect to capital regulation. This situation might reflect the case of an institutional design according to which banking regulation is set independently of tax policy, namely, banking regulator perceives tax policy as given.

In terms of the general model of Section 3.2, the model in this section can be considered a special case with the tax rate and the bank resolution mechanism being exogenously set at zero, i.e., $\tau^j = 0$[9] and $P^j = 0$.[10] Thus, the legislative scheme is defined in this section as follows:

Definition 3.2

The legislative scheme in Country j *is fully determined by capital regulation,* Θ^j_{reg}.

The problem faced by the national government in Country j is the following:

$$\max_{\Theta^j_{\text{reg}}} \left\{ \mathbb{E}[U^j] = R_D \cdot K + \Pi_F - \mathbb{E}[T^j] \right\}, \tag{3.9}$$

where

$$R_D = \max\left\{R^j_D, R^k_D\right\} \tag{3.10}$$

$$R^j_D = \begin{cases} R^{j,\text{frg}}_D = \dfrac{1 + (1-\delta)\Theta^j}{\sigma + \Theta^j} \cdot \sigma \overline{R} & \forall \Theta^j \in \left(0, \bar{\Theta}\right) \\ R^{j,\text{rsl}}_D = \dfrac{1 + (1-\delta)\Theta^j}{1 + \Theta^j} \cdot \mathbb{E}[\widetilde{R}] & \forall \Theta^j \in \left[\bar{\Theta}, +\infty\right) \end{cases} \tag{3.11}$$

[9] Consequently, $\overline{\Phi}^j = \underline{\Phi}^j = 0$ for $j = 1, 2$.

[10] Since failed banks will be bailed out in this section, while tax rate is set at zero, the equilibrium returns can be found by substituting for $\tau^j = 0$ into (2.33), as given in Lemma 2.2.

$$\Pi_F^j = f(k_F) - R_D^j k_F \tag{3.12}$$

$$\mathbb{E}[T^j] = \begin{cases} k_R^j \cdot (1-\sigma) \cdot \left(\dfrac{\sigma \overline{R}}{\sigma + \Theta^j} - \underline{R} \right) & \forall \Theta^j \in \left(0, \bar{\Theta}\right) \\ 0 & \forall \Theta^j \in \left[\bar{\Theta}, +\infty\right) \end{cases} \tag{3.13}$$

$$k_R^j = \beta^j (K - k_F) - b^j \delta E^j \tag{3.14}$$

$$b^j = \begin{cases} 0 & \text{if } R_D^j < R_D^k \\ 1 & \text{if } R_D^j \geq R_D^k \end{cases} \tag{3.15}$$

$$\beta^j = \begin{cases} 0 & \text{if } R_D^j < R_D^k \\ 1 & \text{if } R_D^j = R_D^k \\ 2 & \text{if } R_D^j > R_D^k \end{cases} \tag{3.16}$$

with $\Theta^j = \Theta^j_{\text{reg}} \geq \vartheta$ and $\bar{\Theta} = \dfrac{\sigma \left(\overline{R} - \mathbb{E}[\tilde{R}] \right)}{(1-\sigma)\underline{R}}$.

By showing that

$$\frac{\partial \mathbb{E}[U^j]}{\partial \Theta^j} = -\frac{\delta}{(1+\Theta^j)^2} \mathbb{E}[\tilde{R}] \cdot (K - k_F) < 0 \qquad \forall \Theta^j \in [\bar{\Theta}, +\infty), \tag{3.17}$$

we conclude that the expected utility is monotonically decreasing in Θ^j in the interval $[\bar{\Theta}, +\infty)$. Taking also into consideration that $\mathbb{E}[T^j] = 0$ for all $\Theta^j \in [\bar{\Theta}, +\infty]$, and because of Lemma 2.5, we obtain

Lemma 3.1
Suppose that $\vartheta \geq \bar{\Theta}$. In equilibrium, the government in Country j sets $\Theta^j_{\text{reg}} = \vartheta$ and the government in Country k sets $\Theta^k_{\text{reg}} \geq \vartheta$.

In other words, when the risk of a banking crisis, and consequent bailouts costs, is zero, governments aim to economize on equity issuance costs. Because of capital mobility, efficient capital regulation in one country suffices for the socially optimal outcome.

We now investigate the most general case where $\vartheta < \bar{\Theta}$ and we express the expected utility of households in Country j according to

$$\mathbb{E}[U^j] = \frac{1 + (1-\delta)\Theta}{\sigma + \Theta} \sigma \overline{R} \cdot (K - k_F) + f(k_F) - \mathbb{E}[T^j] \qquad \forall \Theta \in (0, \bar{\Theta}) \tag{3.18}$$

with $\Theta = \min \left\{ \Theta^j_{\text{reg}}, \Theta^k_{\text{reg}} \right\}$. Note that we drop the country index in Θ because we know from Corollary 2.2 that banks only exist in the country with the lower capital requirements if $\tau^j = \tau^k = 0$. Hence, we also know that $\mathbb{E}[T^j(\Theta; \Theta^j_{\text{reg}} < \Theta^k_{\text{reg}})] > 0$ and $\mathbb{E}[T^j(\Theta; \Theta^j_{\text{reg}} >$

$\Theta^k_{\text{reg}})] = 0$ for all $\Theta \in (0, \bar{\Theta})$. Thus, and taking (3.18) into account, we obtain

$$\mathbb{E}[U^j\left(\Theta; \Theta^j_{\text{reg}} < \Theta^k_{\text{reg}}\right)] < \mathbb{E}[U^j\left(\Theta; \Theta^j_{\text{reg}} > \Theta^k_{\text{reg}}\right)] \qquad \forall \Theta \in (0, \bar{\Theta}). \tag{3.19}$$

We call $\mathbb{E}[U^j\left(\Theta; \Theta^j_{\text{reg}} < \Theta^k_{\text{reg}}\right)]$ the *"Underlying Utility"* in Country j (henceforth UU^j), highlighting the fact that the expected utility of households in Country j can never be smaller than

$$UU^j = R_D \cdot (K - k_F) + f(k_F) - k^j_R \cdot (1 - \sigma)\left(\frac{\sigma \overline{R}}{\sigma + \Theta} - \underline{R}\right) \tag{3.20}$$

with $\Theta = \Theta^j_{\text{reg}} < \Theta^k_{\text{reg}}$. In that case, $R_D = R^j_D > R^k_D$ and $k^j_R = 2(K - k_F) - \delta E^j$. Calculating $\partial UU^j / \partial \Theta$, we obtain

Lemma 3.2
There exists a sufficiently small, but strictly positive δ with $\partial UU^j / \partial \Theta > 0$ for all $\Theta \in (0, \bar{\Theta})$.

The proof of Lemma 3.2 is given in Appendix B. We call $\mathbb{E}[U^j(\Theta; \Theta^j_{\text{reg}} > \Theta^k_{\text{reg}}]$ the *"Free-riding Utility"* in Country j (henceforth FU^j), highlighting the fact that if $\Theta^j_{\text{reg}} > \Theta^k_{\text{reg}}$, then households in Country j can enjoy the benefits of higher returns on capital—because of capital mobility—without bearing the cost of a banking default because in that case, there is no banking sector in Country j, i.e., $\mathbb{E}[T^j] = 0$. Thus,

$$FU^j(\Theta) = UU^k(\Theta) + \mathbb{E}[T^k(\Theta)] \qquad \forall \Theta \in \left(0, \bar{\Theta}\right) \tag{3.21}$$

with $\Theta = \Theta^k_{\text{reg}} < \Theta^j_{\text{reg}}$. A reference to UU^j always implies that $\Theta^j_{\text{reg}} < \Theta^k_{\text{reg}}$, i.e., $\Theta = \Theta^j_{\text{reg}}$, whereas a reference to FU^j always implies that $\Theta^j_{\text{reg}} > \Theta^k_{\text{reg}}$, i.e., $\Theta = \Theta^k_{\text{reg}}$.
For any given Θ^k_{reg}, Country j's government can choose among three types of reaction:

(i) to set $\Theta^j_{\text{reg}} < \Theta^k_{\text{reg}}$, achieving $\mathbb{E}[U^j(\Theta)] = UU^j(\Theta)$ with $\Theta = \Theta^j_{\text{reg}}$,

(ii) to set $\Theta^j_{\text{reg}} > \Theta^k_{\text{reg}}$, achieving $\mathbb{E}[U^j(\Theta)] = FU^j(\Theta)$ with $\Theta = \Theta^k_{\text{reg}}$, or

(iii) to set $\Theta^j_{\text{reg}} = \Theta^k_{\text{reg}}$, achieving $\mathbb{E}[U^j(\Theta)] \in (UU^j(\Theta), FU^j(\Theta))$ with $\Theta = \Theta^j_{\text{reg}}$.

Because of the symmetry of the model, the best responses of the two countries are identical, and therefore, if the capital requirements of at least one country lie in $(0, \bar{\Theta})$, then the capital requirements set by the two countries are never identical in equilibrium. Otherwise, because of (3.19), there would always be incentives for governments to increase their capital requirements.

3.3.1 Small Equity Issuance Cost

Regulatory Competition

We study now the equilibrium in the case of an increasing UU^j in Θ for all $\Theta \in (0, \bar{\Theta})$, which occurs for a sufficiently small δ, the existence of which is proved by Lemma 3.2. In that case, because of the monotonicity of UU^j and (3.21), we know that there is no $\dot{\Theta} \in (0, \bar{\Theta})$ such that

$$UU^j(\Theta'; \Theta' \in (0, \dot{\Theta})) \geq FU^j(\Theta''; \Theta'' \in (\dot{\Theta}, \bar{\Theta})). \tag{3.22}$$

Therefore, and because of Lemma 3.1, Country j reacts to the decision of Country k on Θ^k_{reg} according to

$$\Theta^j_{\text{reg}} \begin{cases} > \Theta^k_{\text{reg}} & \text{if } \Theta^k_{\text{reg}} \in (0, \bar{\Theta}); \\ = \bar{\Theta} & \text{if } \Theta^k_{\text{reg}} \in (\bar{\Theta}, +\infty); \\ \geq \bar{\Theta} & \text{if } \Theta^k_{\text{reg}} = \bar{\Theta}. \end{cases} \tag{3.23}$$

Thus, we obtain

Proposition 3.2
Let $\vartheta < \bar{\Theta}$ and equity issuance cost δ be sufficiently small with $\partial UU^j / \partial \Theta > 0\ \forall \Theta \in (0, \bar{\Theta})$. Then,

i) there exists a continuum of equilibria where one country, say Country j, sets $\Theta^j_{\text{reg}} = \bar{\Theta}$ and Country k sets $\Theta^k_{\text{reg}} \geq \bar{\Theta}$, and

ii) all equilibria yield the same allocation of investment and consumption goods and thus, the same expected utility which reads as follows:

$$\mathbb{E}[U^j] = \left(\mathbb{E}[\tilde{R}] - \delta\sigma(\overline{R} - \underline{R})\right) \cdot \left(K - k_F(\bar{\Theta})\right) + f(k_F(\bar{\Theta})) \quad \textit{for } j = 1, 2. \tag{3.24}$$

Note that there is no deviation from $\bar{\Theta}$ that increases the expected utility. In particular, assuming Country j chooses $\bar{\Theta}$, then if Country k chooses $\Theta^k_{\text{reg}} > \bar{\Theta}$, we obtain $R^j_D > R^k_D$, $b^j = 1$ and $b^k = 0$. Therefore, $\mathbb{E}[U^k] = \mathbb{E}[U^j]$. If Country k chooses $\Theta^k_{\text{reg}} < \bar{\Theta}$, we obtain $R^j_D < R^k_D$, $b^j = 0$ and $b^k = 1$. Therefore, and because $\partial UU^j / \partial \Theta > 0$ for all $\Theta \in (0, \bar{\Theta})$, we obtain $\mathbb{E}[U^k(\Theta = \Theta^k_{\text{reg}}; \Theta^k_{\text{reg}} < \bar{\Theta})] < \mathbb{E}[U^k(\Theta = \Theta^k_{\text{reg}}; \Theta^k_{\text{reg}} = \bar{\Theta})]$.

Supranational Solution

We now characterize the competitive equilibrium when capital regulation is decided at the supranational level. The problem of the supranational government is the following:

$$\max_{\Theta^s_{\text{reg}}} \left\{\mathbb{E}[U^s] = 2R_D \cdot K + 2\Pi_F - \mathbb{E}[T^s]\right\}, \tag{3.25}$$

where

$$R_D = \begin{cases} R_D^{\text{frg}} = \dfrac{1+(1-\delta)\Theta}{\sigma+\Theta} \cdot \sigma\overline{R} & \forall\Theta \in \left(0, \bar{\Theta}\right) \\ R_D^{\text{rsl}} = \dfrac{1+(1-\delta)\Theta}{1+\Theta} \cdot \mathbb{E}[\widetilde{R}] & \forall\Theta \in \left[\bar{\Theta}, +\infty\right) \end{cases} \tag{3.26}$$

$$\Pi_F = f(k_F) - R_D k_F \tag{3.27}$$

$$\mathbb{E}[T^s] = \begin{cases} k^s_R \cdot (1-\sigma)\left(\dfrac{\sigma\overline{R}}{\sigma+\Theta} - \underline{R}\right) & \forall\Theta \in \left(0, \bar{\Theta}\right) \\ 0 & \forall\Theta \in \left[\bar{\Theta}, +\infty\right) \end{cases} \tag{3.28}$$

$$k^s_R = 2(K - k_F) - \delta E^s \tag{3.29}$$

$$\Theta = \Theta^s_{\text{reg}} \geq \vartheta. \tag{3.30}$$

For all $\Theta \in [\bar{\Theta}, +\infty)$ with $\Theta = \Theta^s_{\text{reg}}$, $\mathbb{E}[U^s(\Theta)]$ is monotonically decreasing in Θ because

$$\frac{\partial \mathbb{E}[U^s]}{\partial \Theta} = -\frac{2\delta}{(1+\Theta)^2}\mathbb{E}[\widetilde{R}] \cdot (K - k_F) < 0 \qquad \forall\Theta \in [\bar{\Theta}, +\infty). \tag{3.31}$$

For all $\Theta \in (0, \bar{\Theta})$, the behavior of the expected utility depends on the parameterization of the economies and the production function in FT because

$$\begin{aligned} \frac{\partial \mathbb{E}[U^s]}{\partial \Theta} = & -(1-\sigma)\frac{\partial k^s_R}{\partial \Theta}\left(\frac{\sigma\overline{R}}{\sigma+\Theta} - \underline{R}\right)\Bigg\}\textit{Term 1} \\ & + k^s_R \cdot (1-\sigma) \cdot \frac{\sigma\overline{R}}{(\sigma+\Theta)^2}\Bigg\}\textit{Term 2} \\ & - 2(K-k_F) \cdot (1-(1-\delta)\sigma) \cdot \frac{\sigma\overline{R}}{(\sigma+\Theta)^2}.\Bigg\}\textit{Term 3} \end{aligned} \tag{3.32}$$

Taking into account that $k^s_R = 2(K - k_F) - \delta E^s < 2(K - k_F)$ and because $1 - \sigma < 1-(1-\delta)\sigma$, we know that *Term 3* dominates *Term 2*. Thus, and because *Term 1* approaches zero as Θ approaches $\bar{\Theta}$ from the left, we conclude that $\dfrac{\partial \mathbb{E}[U^s]}{\partial \Theta}$ becomes negative, at least in the interval $[\bar{\Theta} - \epsilon, \bar{\Theta}]$, where ϵ is a sufficiently small and strictly positive parameter. Therefore, we obtain

Proposition 3.3
If $\vartheta \geq \bar{\Theta}$, the supranational government sets $\Theta^s_{\text{reg}} = \vartheta$ and banks never fail. If $\vartheta < \bar{\Theta}$, the supranational government sets Θ^s_{reg} such that $\vartheta \leq \Theta^s_{\text{reg}} < \bar{\Theta}$ and the likelihood that banks fail is strictly positive.

Comparing Propositions 3.2 and 3.3, we observe that the outcome under regulatory competition deviates from the benchmark outcome of supranational capital regulation. That happens because the supranational government economizes on equity issuance cost—by setting laxer capital regulation—at a global scale, whereas national governments perceive economies on equity issuance cost only at a national scale.[11] At the same time, national governments bear the cost of bailing out failed banks at a global scale because of the free-riding incentives that arise in the absence of tax revenues. In other words, the pressure on national governments to avoid a banking crisis—relative to the temptation to economize on equity issuance cost—is stronger than the respective pressure on supranational governments. Thus, national governments set stricter capital regulation, as compared to the supranational government, and hence, regulatory competition does not yield the maximum expected utility across the two countries.

3.3.2 Large Equity Issuance Cost

Lemma 3.2 shows that there exists a sufficiently small equity issuance cost such that UU^j is monotonically increasing in Θ for all $\Theta \in (0, \bar{\Theta})$. We now complete the analysis of one-dimensional regulatory competition by considering the case of sufficiently large equity issuance cost, such that there is an interval in $(0, \bar{\Theta})$ where UU^j is decreasing in Θ.

More specifically, from the proof of Lemma 3.2, we know that

$$\begin{aligned}\frac{\partial}{\partial\Theta}(UU^j) =\; & \left.-(1-\sigma)\frac{\partial k_R^j}{\partial\Theta}\cdot\left(\frac{\sigma\overline{R}}{\sigma+\Theta}-\underline{R}\right)\right\}\textit{Term 1}\\ & \left.+\; k_R^j\cdot(1-\sigma)\cdot\frac{\sigma\overline{R}}{(\sigma+\Theta)^2}\right\}\textit{Term 2}\\ & \left.-\;(K-k_F)\cdot(1-(1-\delta)\sigma)\cdot\frac{\sigma\overline{R}}{(\sigma+\Theta)^2}\right\}\textit{Term 3}\end{aligned} \tag{3.33}$$

with $k_R^j = 2(K-k_F) - \delta E^j$.

If *Term 3* dominates *Term 2*, and because *Term 1* approaches zero as Θ approaches $\bar{\Theta}$ from left, we know that there is a $\tilde{\Theta}$, with $UU^j(\tilde{\Theta}) > \mathbb{E}[U^j(\bar{\Theta})]$, $\partial UU^j(\tilde{\Theta})/\partial\Theta = 0$ and $\partial UU^j(\Theta)/\partial\Theta < 0$ for all Θ in the interval $(\tilde{\Theta}, \bar{\Theta})$. Although we cannot explicitly rule

[11] That can be better understood by combaring Term 3 of (B.1) against Term 3 of (3.32).

out the existence of a second maximum of UU^j in the interval $(0, \bar{\Theta})$ for all the forms of the FT production function, we assume for the sake of simplicity[12]

Assumption 3.1
UU^j is, at most, single-peaked at $\tilde{\Theta}$ in the interval $(0, \bar{\Theta})$.

From (3.21), and because $\mathbb{E}[T^j(\Theta)]$ is a continuous function that is monotonically decreasing in Θ and approaches zero as Θ approaches $\bar{\Theta}$ from left, we conclude that there exists a $\dot{\Theta} \in (\tilde{\Theta}, \bar{\Theta})$ such that

$$UU^j(\tilde{\Theta}) > FU^j(\Theta; \Theta \in (\dot{\Theta}, \bar{\Theta})) \tag{3.34}$$

$$UU^j(\tilde{\Theta}) = FU^j(\dot{\Theta}). \tag{3.35}$$

Therefore, and because of Lemma 3.1, we obtain the following reaction function of government in Country j:

$$\Theta^j_{\text{reg}} \begin{cases} > \Theta^k_{\text{reg}} & \text{if } \Theta^k_{\text{reg}} \in (0, \dot{\Theta}] \\ = \tilde{\Theta} & \text{if } \Theta^k_{\text{reg}} \in (\dot{\Theta}, +\infty). \end{cases} \tag{3.36}$$

From Lemma 3.1 and (3.36), we obtain the equilibrium with large equity issuance cost according to

Proposition 3.4
Let $\vartheta < \bar{\Theta}$ and suppose a $\tilde{\Theta} \in (0, \bar{\Theta})$ with $\partial UU^j / \partial \Theta = 0$ at $\Theta = \tilde{\Theta}$. Then,

i) there exists a continuum of equilibria where one country, say Country j, sets $\Theta^j_{\text{reg}} = \tilde{\Theta}$ and Country k sets $\Theta^k_{\text{reg}} > \dot{\Theta}$, and

ii) the expected utility of households in Country j is smaller than the expected utility of households in Country k with

$$\mathbb{E}[U^j] = (K - k_F)\left(\frac{1 + (1-\delta)\tilde{\Theta}}{\sigma + \tilde{\Theta}} \sigma \overline{R} - 2(1-\sigma)\left(\frac{\sigma \overline{R}}{\sigma + \tilde{\Theta}} - \underline{R}\right)\right) + f(k_F) \tag{3.37}$$

$$\mathbb{E}[U^k] = \frac{1 + (1-\delta)\tilde{\Theta}}{\sigma + \tilde{\Theta}} \sigma \overline{R} \cdot (K - k_F) + f(k_F). \tag{3.38}$$

The proof of Proposition 3.4 is given in Appendix B. As in the case of small equity

[12] This is a reasonable assumption because as Θ decreases, *Term 1*—which is positive—increases, and observing further that the dependence of both *Term 2* and *Term 3* on Θ is similar, we infer that if $\partial UU^j / \partial \Theta$ becomes positive as Θ decreases, then it is unlikely that *Term 3* can again dominate the sum of *Term 1* and *Term 2* for even smaller Θ.

issuance cost, a national government that hosts banks in an environment of regulatory competition without tax revenues perceives economies on equity issuance cost at national scale, while bears bailout costs at global scale. That is a different problem from the one faced by a supranational government which can economize on equity issuance cost at global scale. We thus infer that regulatory competition yields an inefficient outcome regardless of the level of equity issuance cost.

3.3.3 Discussion of One-dimensional Regulatory Competition

In this section, bank resolution and tax policy have been assumed to be the same across countries, and thus, competition takes place only in one dimension, namely, with regard to capital regulation.[13] Yet, only the special case with $P^j = 0$ and $\tau^j = 0$ has been considered so far. Other cases of one-dimensional regulatory competition are discussed now.

Fiscal Union with Competition in Capital Regulation

The discussion begins assuming that a bail-in provision is exogenously set as the bank resolution mechanism across countries, i.e., $P^j = P^k = 1$. In that case, bailout costs remain at zero, which, in turn, implies that hosting banking activities entails no risks.[14] In an environment of a fiscal union, i.e., with a tax rate imposed at supranational level, governments competing with regard to capital regulation would set capital requirements at the minimum level in order to allow banks operating within their jurisdiction to economize on equity issuance costs and thus, to be internationally competitive. That is, for any given tax rate that is imposed at supranational level, regulatory competition in capital regulation yields the efficient outcome,[15] provided that a bail-in provision has been exogenously imposed at supranational level.

We now focus again on the case of a bailout provision at supranational level, and we consider the case of a fiscal union with a strictly positive tax rate. Depending on the level of tax rate, two classes of outcomes can arise. As long as the supranational tax rate lies below the optimal level, $\bar{\tau}$, as defined by (2.67), national governments cannot counteract bailout costs by tax revenues. Thus, the incentive to avoid hosting banks—by setting sufficiently strict capital regulation—still exists, which yields an inefficient outcome due

[13] It has already been shown by Corollary 3.1 that as long as both countries can control at least two policy tools, regulatory competition can yield the efficient allocation of resources.

[14] Note that this is the case if the cost of a banking crisis is limited to the cost incurred by depositors, without spillovers to the real economy. Banking crisis repercussions are considered in Section 3.5.

[15] The outcome is considered efficient as the outcome that could arise if a supranational government decided on capital regulation, provided that the tax rate is set exogenously, and neither a supranational nor national governments can change it. Of course, social welfare would be maximized if the tax rate is equal to zero.

to excessive equity issuance costs. The opposing mechanism arises if the supranational tax rate is set equal to or above the optimal level, $\bar{\tau}$. In such a case, the expected tax revenues exceed the expected bailout costs, which, in turn, implies that governments can benefit from attracting banking activities. Regulatory competition would then result in the minimum level of capital regulation—in order to economize on equity issuance costs—that is the efficient outcome.[16]

Banking Union with Competition in Taxation

The discussion on one-dimensional regulatory competition closes by considering the case of common banking rules across countries, and competition with regard to taxation. The analysis in Chapter 2 and Section 3.2 points out that such an institutional framework yields the efficient outcome. In particular, if a bail-in provision is imposed at supranational level, then regulatory competition with regard to taxation would result in a zero tax rate. If the banking sector functions under a bailout provision at supranational level, then regulatory competition would induce the optimal level of tax rate, $\bar{\tau}$, according to the reaction pattern (2.77), provided that the supranational level of capital regulation allows bank failures, namely, $\Theta^j_{\text{reg}} = \Theta^k_{\text{reg}} < \bar{\Theta}$. Otherwise, in line with Lemma 2.8, competing governments would set a zero tax rate, irrespective of the bank resolution mechanism.

Policy Implications

Given the efforts for the development of a single rulebook in the EU banking sector and the provisions in TEU and TFEU that render fiscal policy a national prerogative, the institutional setting of a banking union with national tax policies approximates the current institutional framework within the European Union. Taking the preceding paragraph into consideration, one could conclude that the current EU framework moves into the right direction. However, some form of taxation has also been shifted to the supranational level. For example, as described in Subsection 1.1.2, banks pay annual contributions to the Single Resolution Fund that is managed at supranational level.[17] In view of the preceding paragraph, and especially of Footnote 16, the calculation of the level of bank contributions is of crucial importance. Furthermore, given the co-existence of tax policies at the national level and bank contributions at the supranational level within the EU, a downwards bias of the level of contributions—as compared to the optimal level of tax

[16] The remark of Footnote 15 applies again, with the social welfare being maximized under a bailout provision if the tax rate is equal to the optimal level, $\bar{\tau}$.

[17] Section 3.4 investigates a form of taxation in the spirit of the contributions of banks operating within the EU to the Single Resolution Fund. Note that these contributions are distinct from contributions to the Deposit Guarantee Schemes that are currently managed at the national level.

rate—is less harmful, since it can be complemented by the taxation set by the competing governments at the national level.

More generally, and because an inefficient outcome may arise when certain tools are fixed at supranational level whereas other tools are managed at national level, proposals for shifting certain aspects of banking regulation to the supranational level need to pay special attention as to whether the incentives that will arise due to regulatory competition with regard to other aspects of banking regulation move in the right direction, or not.

3.4 Systemic Risk Tax

In the base model in Chapter 2, we considered tax policy in the form of a tax rate, τ^j, that is imposed in period $t = 2$ on RT returns. In this section, we consider an alternative form of taxation. Namely, taxation on RT returns will be replaced by taxation on bank balance sheets in advance of loan grants to RT firms. Such a taxation has been discussed in the aftermath of the financial crisis of 2007-2008 in a proposal of the International Monetary Fund (2010) at the request of the G-20 leaders. Besides the accumulation of funds for covering the fiscal cost of a banking crisis (ex post effect), the proposed tools also aimed to affect risk-taking and thus preventing banking crises in the future (ex ante effect). Although a taxation on bank balance sheets has not been agreed by G-20, provisions such as the contribution of banks to resolution funds[18] move in the same direction.

More specifically, in this section, we consider that the taxation takes place in period $t = 1$ and is imposed on banks' balance sheet—on both deposits and equity.[19] The model setup presented in Section 2.2 remains unchanged except for the amount of capital that is available for bank loans.[20] In particular, the banking sector in Country j raises funds equal to $D^j + (1-\delta)E^j$ in period $t = 1$. Before loans are granted by banks to firms running RT, the government in Country j imposes a tax rate τ^j on the funds raised by banks. The funds that remain available after taxation, i.e., $(1 - \tau^j) \cdot (D^j + (1 - \delta)E^j)$, can be invested by the banking sector in RT. At the same time, the amount of $k_G^j = b^j \cdot \tau^j \cdot (D^j + (1 - \delta)E^j)$ is available to the government in period $t = 1$. In the next, we study the cases with k_G^j being invested either in RT or FT.

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[18] As described in Subsection 1.1.2, Regulation (EU) 806/2014 contains provisions on banks' contributions to the Single Resolution Fund.

[19] Indeed, the correction of the tax bias against equity and in favor of debt—that can be observed in several jurisdictions worldwide—is explicitly mentioned in the proposal of the International Monetary Fund (2010) as one of its objectives.

[20] Note that the equity-to-debt ratio, Θ^j, and the resilience boundary, $\bar{\Theta}$, also remain unchanged exactly because the tax rate is imposed on both deposits and equity.

3.4.1 Government Investment in RT

If government in Country j invests k_G^j in RT in period $t = 1$, in period $t = 2$ the government receives $\overline{\Phi}^j = k_G^j \cdot \overline{R}$ and $\underline{\Phi}^j = k_G^j \cdot \underline{R}$ in the bad state and the good state of the world, respectively. These returns are distributed to, and consumed by, households. The expected returns on government investments in RT read as follows:

$$\mathbb{E}[\Phi^j] = k_G^j \cdot \mathbb{E}[\widetilde{R}]. \tag{3.39}$$

We observe that the total amount invested in RT by both the banking sector and the government, when banks' balance sheets are taxed, is equal to the amount invested in RT by the banking sector only, when banks' balance sheets are not taxed. Further, the returns on government's investment in RT when tax revenues are raised by taxing bank balance sheets in period $t = 1$ are identical with the tax revenues raised by government when RT returns are taxed in period $t = 2$. Thus, the government problems at both national and supranational level remain unchanged and we obtain

Lemma 3.3
Imposing a tax rate, τ^j, on bank balance sheets in period $t = 1$ and investing tax revenues in RT is equivalent of imposing a tax rate, τ^j, on RT output in period $t = 2$, with $j = 1, 2$.

3.4.2 Government Investment in FT

We now study the case when government in Country j invests its tax revenues in FT, yielding in period $t = 2$

$$\mathbb{E}[\Phi_{FT}^j] = \tau^j \cdot \Big(D^j + (1-\delta)E^j\Big) \cdot R_D(\tau^j), \tag{3.40}$$

as opposed to the case of tax revenues invested in RT,[21] when the invested tax revenues yield in period $t = 2$

$$\mathbb{E}[\Phi_{RT}^j] = \tau^j \cdot \Big(D^j + (1-\delta)E^j\Big) \cdot \mathbb{E}[\widetilde{R}]. \tag{3.41}$$

Lemma 2.8 still holds for all $\vartheta \in [\bar{\Theta}, +\infty)$. Thus, we focus on the case with $\vartheta < \bar{\Theta}$. The difference between the returns on the invested tax revenues and the expected bailout costs

[21] When we make a distinction between variables that refer to the case of investing tax revenues in RT, as presented in Subsection 3.4.1, and variables that refer to the case of investing tax revenues in FT, as presented in Subsection 3.4.2, we index the former with RT and the latter with FT. In the absence of this indexing in this subsection, we always refer to the case of tax revenues invested in FT.

in the interval $(0, \bar{\Theta})$ read as

$$\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] = \Big(D^j + (1-\delta)E^j\Big) \cdot \phi^j, \tag{3.42}$$

where

$$\phi^j = \tau^j \left(R_D + (1-\sigma)\left(\frac{\sigma\overline{R}}{\sigma+\Theta} - \underline{R}\right)\right) - (1-\sigma)\left(\frac{\sigma\overline{R}}{\sigma+\Theta} - \underline{R}\right) \tag{3.43}$$

and

$$R_D = (1-\tau^j)\frac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j}\sigma\overline{R}. \tag{3.44}$$

Solving for $\phi^j = 0$ with respect to τ^j, we find the policy space dichotomy as follows:[22]

$$\text{Solution 1: } \bar{\tau} = 1 \tag{3.46}$$

$$\text{Solution 2: } \bar{\tau} = \frac{1-\sigma}{1+(1-\delta)\Theta^j} \cdot \left(1 - \frac{\underline{R}(\sigma+\Theta^j)}{\sigma\overline{R}}\right). \tag{3.47}$$

Solution 1 is not accepted because it yields $R_D^j = 0$. By comparing (2.67) with (3.47), and taking Lemma 3.3 into account, we conclude that a higher tax rate is required for the expected bailout cost to be balanced out by the returns on tax revenues when these revenues are invested in FT, as opposed to the case of being invested in RT.

If $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j]$ is negative, the expected utility of Country j, assuming that $b^j = 1$ and $b^k = 0$,[23] reads as

$$\mathbb{E}[U^j] = R_D \cdot (K - k_F) + f(k_F) + k_G^j \cdot \phi^j \tag{3.48}$$

with $k_G^j = 2(K - k_F) - \delta E^j$. FOC with respect to τ^j read as follows:

$$\frac{\partial \mathbb{E}[U^j]}{\partial \tau^j} = (K - k_F)\frac{\partial R_D}{\partial \tau^j} + \frac{\partial k_G^j}{\partial \tau^j}\phi^j + k_G^j\frac{\partial \phi^j}{\partial \tau^j} = 0, \tag{3.49}$$

---

[22] The solution can be found by denoting $A \equiv (1-\sigma)\left(\frac{\sigma\overline{R}}{\sigma+\Theta^j} - \underline{R}\right)$ and rewriting the equation $\phi^j = 0$ in the form of

$$\bar{\tau} = \frac{A}{(1-\bar{\tau})\frac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j}\sigma\overline{R} + A}. \tag{3.45}$$

[23] We know from Lemma 2.6 that if $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] < 0$, then a country can be strictly better off by avoiding to host banks within its jurisdiction.

where

$$\frac{\partial R_D}{\partial \tau^j} = -\frac{1+(1-\delta)\Theta}{\sigma+\Theta}\sigma\overline{R} \tag{3.50}$$

$$\frac{\partial \phi^j}{\partial \tau^j} = R_D + (1-\sigma)\left(\frac{\sigma\overline{R}}{\sigma+\Theta} - \underline{R}\right) + \tau^j \cdot \frac{\partial R_D}{\partial \tau^j}. \tag{3.51}$$

We can infer whether Country j is better off by increasing its tax rate for all $\tau^j < \bar{\tau}$, or not, by investigating the sign of (3.49) at $\bar{\tau}$. By substituting for $\tau^j = \bar{\tau}$ and $\phi^j = 0$ into (3.49), we obtain

$$\begin{aligned} \frac{\partial \mathbb{E}[U^j]}{\partial \tau^j} = &- \left.\frac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j}\cdot\sigma\overline{R}\cdot(K-k_F)\right\}\textit{Term 1} \\ &+ \left.\left(\frac{\sigma+(1-\delta)\Theta^j}{\sigma+\Theta^j}\sigma\overline{R} + (1-\sigma)\underline{R}\right)\left(2(K-k_F) - \delta E^j\right).\right\}\textit{Term 2} \end{aligned} \tag{3.52}$$

As opposed to (A.80), where *Term 2* always dominates *Term 1*, in the case of (3.52) *Term 1*, which is negative, might dominate *Term 2*, especially for too low $\underline{R}$ and large δ. In that case, the country that hosts a banking sector, chooses a τ^j smaller than $\bar{\tau}$.
FOC of the supranational government's problem read as

$$\frac{\partial \mathbb{E}[U^s]}{\partial \tau^s} = 2(K-k_F)\frac{\partial R_D}{\partial \tau^s} + \frac{\partial k_G^s}{\partial \tau^s}\phi^s + k_G^s\frac{\partial \phi^s}{\partial \tau^j} = 0, \tag{3.53}$$

where $k_G^s = 2(K-k_F) - \delta E^s$.
Comparing (3.49) and (3.53), we conclude that the equilibrium tax rate under regulatory competition is different, as compared to the case of supranational government, at least for specifications that yield $\partial \mathbb{E}[U^j]/\partial \tau^j < 0$ for $\tau^j = \bar{\tau}$,[24] and therefore, we obtain

Lemma 3.4
Suppose governments impose a tax rate, τ^j, on banks' balance sheets in period $t = 1$ and invest tax revenues in FT. Then, regulatory competition does not always yield an efficient outcome.

3.5 Banking Crisis Repercussions

Theorem 2.1 states that governments, setting capital requirements at efficient levels, allow the likelihood of a banking crisis to be strictly positive, provided that the *a priori*

[24] In that case, countries do not compete for attracting banks in the spirit of Proposition 2.2. Instead, they compete for avoiding banks in the spirit of Proposition 3.4. Since one country will free-ride on bailout costs, the other country simply maximizes (3.48), which is a different problem than the maximization of global social welfare by a supranational government.

capital regulation allows a positive likelihood of a banking crisis as well. This result is obtained under the assumption of no further adverse repercussions of a banking crisis on the economy. As the financial crisis of 2007-2008 proved however, the cost of a banking crisis can extend well beyond the cost for direct financial support in the form of bailouts. In order to capture this more general case, we assume in this section that a banking crisis is not fully contained and we model banking crisis spillovers by assuming a reduction of the productivity in RT. In particular, we assume that an investment of one unit in RT in period $t = 1$ returns $\overline{R}$, $\underline{R}$ and $(1-\kappa)\underline{R}$ with $\kappa \geq 0$[25] in the good state of the world, the bad state of the world with resilient banks and the bad state of the world with fragile banks, respectively.

The problem faced by the government in Country j remains unchanged, as compared to Chapter 2,apart from the expected bailout expenditures which read as follows:

$$\mathbb{E}[T^j] = \begin{cases} k_R^j \cdot (1-\sigma) \cdot (1-\tau^j) \left(\frac{\sigma \overline{R}}{\sigma + \Theta^j} - (1-\kappa)\underline{R} \right) & \forall \Theta^j \in (0, \bar{\Theta}) \\ 0 & \forall \Theta^j \in [\bar{\Theta}, +\infty) \end{cases} \tag{3.54}$$

with k_R^j given according to Lemma 2.4.

The bailout expenditures remain unchanged for all $\Theta^j_{\text{reg}} \geq \bar{\Theta}$, i.e., $\mathbb{E}[T^j] = 0$, and because of Lemma 2.8 we conclude that the government in Country j chooses $\left(\Theta^j_{\text{reg}}, \tau^j\right) = (\vartheta, 0)$ for all $\vartheta \geq \bar{\Theta}$. We thus focus on the case of $\vartheta < \bar{\Theta}$, and we obtain

$$\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] = k_R^j \cdot \phi^j \qquad \forall \Theta^j \in (0, \bar{\Theta}) \tag{3.55}$$

with

$$\phi^j = \frac{1+\Theta^j}{\sigma + \Theta^j} \cdot \sigma \overline{R} \tau^j - (1-\sigma) \cdot \left(\frac{\sigma \overline{R}}{\sigma + \Theta^j} - (1-\kappa)\underline{R} \right). \tag{3.56}$$

Therefore, the policy space dichotomy is adjusted upwards, as compared to Chapter 2,according to

$$\bar{\tau}(\Theta^j) = \frac{1-\sigma}{1+\Theta^j} \cdot \left(1 - \frac{\sigma + \Theta^j}{\sigma \overline{R}} \cdot (1-\kappa)\underline{R} \right). \tag{3.57}$$

Comparing with (2.67), where κ is assumed to be zero, we see that in case of a positive κ, a higher tax rate is required for achieving expected tax revenues to be equal to the expected cost of a banking crisis.

The incentives to deviate as long as the expected tax revenues are either strictly smaller or strictly greater than the expected cost of a banking crisis, as described by Lemma 2.6, still hold. Thus, it remains to investigate the behavior of the expected utility along the policy space dichotomy, i.e., when $\tau^j = \bar{\tau}$.

[25] The base model in Chapter 2 corresponds to the special case of $\kappa = 0$.

Plugging (3.57) into (2.33), we obtain

$$R_D(\Theta^j, \bar{\tau}^j) = \frac{1 + (1-\delta)\Theta^j}{1+\Theta^j} \cdot \left(\mathbb{E}[\widetilde{R}] - \kappa(1-\sigma)\underline{R}\right) \qquad \forall \Theta^j \in (0, \bar{\Theta}) \tag{3.58}$$

and because $\mathbb{E}[\Phi^j(\Theta^j, \bar{\tau})] - \mathbb{E}[T^j(\Theta^j, \bar{\tau})] = 0$, we also obtain

$$\mathbb{E}[U^j(\Theta^j, \bar{\tau}^j)] = R_D(\Theta^j, \bar{\tau}^j) \cdot (K - k_F) + f(k_F) \qquad \forall \Theta^j \in (0, \bar{\Theta}) \tag{3.59}$$

with

$$\frac{\partial \mathbb{E}[U^j(\Theta^j, \bar{\tau}^j)]}{\partial \Theta^j} = -\frac{\delta}{(1+\Theta^j)^2}\left(\mathbb{E}[\widetilde{R}] - \kappa(1-\sigma)\underline{R}\right)(K - k_F) \quad \forall \Theta^j \in (0, \bar{\Theta}). \tag{3.60}$$

Solving the problem from the supranational government's perspective, we obtain the result of Lemma 2.9 by replacing $\underline{R}$ with $(1-\kappa)\underline{R}$. Therefore,

$$\mathbb{E}[U^s(\Theta^s, \bar{\tau})] = R_D(\Theta^s, \bar{\tau}) \cdot 2(K - k_F) + 2f(k_F) \qquad \forall \Theta^s \in (0, \bar{\Theta}) \tag{3.61}$$

and

$$\frac{\partial \mathbb{E}[U^s(\Theta^s, \bar{\tau})]}{\partial \Theta^s} = -\frac{\delta}{(1+\Theta^s)^2}\left(\mathbb{E}[\widetilde{R}] - \kappa(1-\sigma)\underline{R}\right) 2(K - k_F) \qquad \forall \Theta^s \in (0, \bar{\Theta}). \tag{3.62}$$

Comparing (3.60) against (3.62), we obtain

Lemma 3.5
Suppose a competitive equilibrium where governments bail out failed banks and can also raise tax revenues from activities financed by banks with $\vartheta < \bar{\Theta}$. If $\kappa \geq \frac{\mathbb{E}[\widetilde{R}]}{(1-\sigma)\underline{R}}$, then the government in Country j sets $(\Theta^j_{\text{reg}}, \tau^j) = (\bar{\Theta}, 0)$ for $j = 1, 2$ and banks are resilient. This is an efficient outcome.

If (3.60) and (3.62) are negative, then governments choose ϑ for all $\Theta^j \in (0, \bar{\Theta})$. Note that it remains unclear whether they prefer ϑ to $\bar{\Theta}$. That cannot be concluded from (3.60) and (3.62) because neither of them is defined at $\bar{\Theta}$. Yet, assuming that ϑ is close to zero, we see that $R_D(\vartheta \approx 0) < R_D(\bar{\Theta})$ for all $\kappa > \frac{\delta\sigma(\overline{R}-\underline{R})}{(1-\sigma)\underline{R}}$. Therefore, one can infer that if banks in Country j had market power, namely, they could influence R_D, they may not choose $\Theta^j = \Theta^j_{\text{reg}}$ for all values of κ.

3.6 Conclusions

In this chapter, the base model of Chapter 2 has been extended in four dimensions. First, the base model has been generalized by endogenizing bank resolution mechanism. Second, regulatory competition when governments have only capital regulation at their disposal, i.e., tax policy and bank resolution are set exogenously, has been studied. Third, tax policy in the form of taxation on production after banks granted loans to the risky sector has been replaced by a systemic risk tax on bank's balance sheets in advance of bank lending. Fourth, losses beyond mere bailout expenditures have been considered in the form of unexpected productivity reduction in the case of a banking crisis.

It has been shown that the efficient outcome is sustained when competing governments set capital regulation, tax policy and the bank resolution mechanism. In particular, they set capital requirements such that the playing field with regard to capital regulation is even, and they then choose between two approaches: Either they induce a reduction on equilibrium returns via taxation in order to offer safety to depositors in the form of bailouts, or they shift the risk of banking crisis costs to depositors, i.e., choosing bail-in as a resolution mechanism, at the benefit of renouncing taxation. The efficient outcome is not sustained if competing governments have only capital regulation at their disposal. More specifically, regulatory competition under a bailout mechanism can yield an efficient allocation of resources only if competing governments can complement capital regulation with a policy tool, e.g. taxation, that can counteract potential bailout costs.

Further, it has been shown that taxation on the risky production can be replaced by taxation on bank balance sheets in advance of loan grants to risky firms, provided that government invests the tax revenues appropriately. Finally, in the presence of banking crisis repercussions besides the bailout expenditures, it has been shown that there exists a threshold of such repercussions, above of which competing governments prefer to render their banking sector resilient instead of economizing on equity issuance costs.

4 Regulatory Competition with Risk-averse Households

4.1 Introduction

The analysis in Chapters 2 and 3 has been done under the assumption that households are risk-neutral. This assumption simplified the analysis and allowed the explicit characterization of the equilibrium returns, shedding light upon the impact of banking regulation and tax policy on resource allocation. Risk-neutrality, however, is only a special case and thus, in this chapter, the robustness of the base model with regard to households' risk-aversion is checked.

4.1.1 Model Features and Main Results

The optimal allocation of resources in a one-country model with risk-averse households, and without banks, is firstly characterized. We then introduce banks, while allowing governments to decide on capital regulation and tax policy. Characterizing the equilibrium with financial intermediation, we show that there exists a combination of capital regulation and tax policy that yields the optimal allocation of resources in the presence of banks. The results are finally generalized in a two-country setting, showing that the mechanism described in the preceding chapters with risk-neutral households still exists when households are risk-averse. It is shown that risk-aversion does not change the mechanism at work when competing governments set capital regulation and tax policy.

The analysis in this chapter also reveals the impact of the interaction between the level of capital regulation and risk-aversion on the equilibrium returns, which in turn affects the optimal tax rate. In particular, lax capital regulation implies higher returns on deposits and thus higher potential bailout costs. These costs can only be outweighed by tax revenues that need to be larger for higher levels of risk-aversion. As capital regulation becomes stricter, the effect of capital regulation on potential bailout costs fades, allowing for the effect of risk-aversion on the returns to dominate. That is, higher levels of risk-aversion require lower tax rate because risk-aversion depresses returns on deposits and thus reducing the potential bailout costs.

4.1.2 Organization of the Chapter

The rest of the chapter is organized as follows. The model setup without financial intermediation is presented in Section 4.2 and the associated equilibrium is obtained in Section 4.3. Banks are then introduced and the equilibrium with financial intermediation is investigated in Section 4.4. In Section 4.5, the socially optimal combination of capital regulation and tax policy is obtained. The equilibrium under regulatory competition is investigated in Section 4.6. Conclusions are drawn in Section 4.7.

4.2 Model Setup without Financial Intermediation

We consider a two period economy ($t = 1, 2$). At $t = 1$, there is a total endowment K ($K > 0$) of an investment good that can neither be consumed nor be stored. The investment good can be transformed into a consumption good in period $t = 2$ by two different technologies; a technology that is free-of-risk (FT) and a risky technology (RT). In the simplest setup of the model, i.e., without financial intermediation, we assume two different types of agents; households and technology managers (henceforth, entrepreneurs), who live for two periods.[1] We assume that households are risk-averse whereas entrepreneurs are risk-neutral. Perfect competition prevails in all markets, implying that all agents are price-takers.

4.2.1 Entrepreneurs

The technologies are run by representative entrepreneurs that stand for a continuum of risk-neutral entrepreneurs who behave competitively. Details on the two technologies are given below.[2]

An investment of the amount of capital k_F in FT in period $t = 1$ yields the amount of $f(k_F)$ of the consumption good in period $t = 2$. The production function $f(\,\cdot\,)$ satisfies $f'(\,\cdot\,) > 0$, $f''(\,\cdot\,) < 0$, and the Inada conditions $\lim_{k_F \to 0} f'(k_F) = +\infty$ and $f'(K) = 0$. FT raises capital by issuing bonds B_F to households. In order for the FT bond market to clear,

$$B_F \equiv k_F. \tag{4.1}$$

Since the FT output is deterministic, the returns on the capital invested in FT, i.e., the returns on B_F, are free of risk. The profits generated by FT are also deterministic and are

[1] In Section 4.4, banks and government are also introduced in order to allow the investigation of equilibrium with financial intermediation.

[2] Although the setup of the two technologies is identical with the technologies in Chapter 2, the basic attributes of the two technologies are also presented here for the convenience of the reader.

denoted by Π_F where

$$\Pi_F = f(k_F) - R_F \cdot k_F. \tag{4.2}$$

The output in RT is contingent on two states of the world, namely, *good state* and *bad state*, that are realized at the beginning of $t = 2$. If the good state occurs, then an investment of the amount of capital k_R in RT in period $t = 1$ yields $k_R \cdot \overline{R}$ units of consumption good in period $t = 2$. If the bad state occurs, then an investment of the amount of capital k_R in RT in period $t = 1$ yields $k_R \cdot \underline{R}$ units of consumption good in period $t = 2$. We assume that the good state and the bad state of the world occur with probability σ $(0 < \sigma < 1)$ and $1 - \sigma$, respectively. We also assume $0 < \underline{R} < \overline{R}$.

RT raises capital by issuing bonds B_R to households. In order for the RT bond market to clear,

$$B_R \equiv k_R. \tag{4.3}$$

Since the RT output is state-contingent, the returns on B_R are state-contingent as well and are denoted by $\overline{R}_R$ and $\underline{R}_R$ in the good state and the bad state of the world, respectively. The expected profits of RT are denoted by $\mathbb{E}[\Pi_R]$ where

$$\mathbb{E}[\Pi_R] = k_R \cdot \left[\sigma \cdot \left(\overline{R} - \overline{R}_R\right) + (1 - \sigma) \cdot \left(\underline{R} - \underline{R}_R\right)\right]. \tag{4.4}$$

4.2.2 Households

We assume a continuum of identical risk-averse households and thus, we consider a representative household, initially endowed with capital K. Households also own the property rights of the two technologies. In period $t = 1$, households invest the amount of $\beta \cdot K$ in RT bonds, B_R, and the amount of $(1 - \beta) \cdot K$ in FT bonds, B_F.

In period $t = 2$, households exchange the returns on B_F and B_R, and the profits from FT and RT, against the consumption good that is produced by the two technologies. Due to the state-contingent output and returns from RT, households' consumption is also state-contingent. In particular, they consume $\overline{c}$ and $\underline{c}$ in the good state and the bad state of the world, respectively.

We assume an utility function with constant risk-aversion in the tradition of Pratt (1964). Taking the work of von Neumann and Morgenstern (1944) into consideration, we express the expected utility of the risk-averse households as follows:

$$\mathbb{E}[U] = \begin{cases} 1 - \sigma \cdot e^{-A \cdot \overline{c}} - (1 - \sigma) \cdot e^{-A \cdot \underline{c}} & \text{if } A \neq 0 \\ \sigma \cdot \overline{c} + (1 - \sigma) \cdot \underline{c} & \text{if } A = 0, \end{cases} \tag{4.5}$$

where A is a positive parameter and is called the risk-aversion parameter since the higher

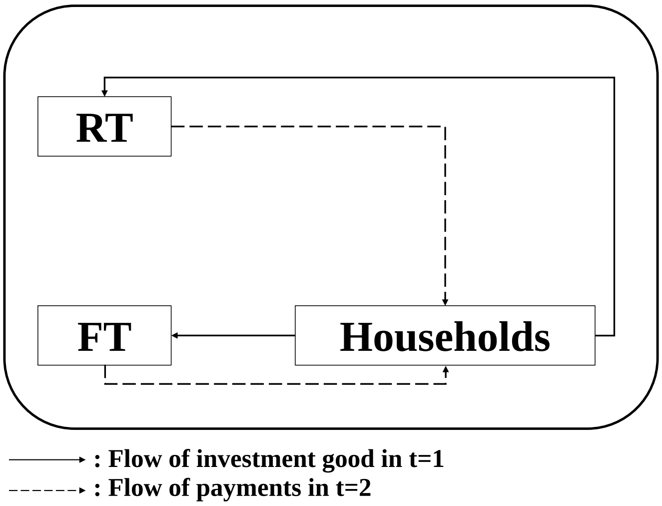

Figure 4.1: Model setup without financial intermediation

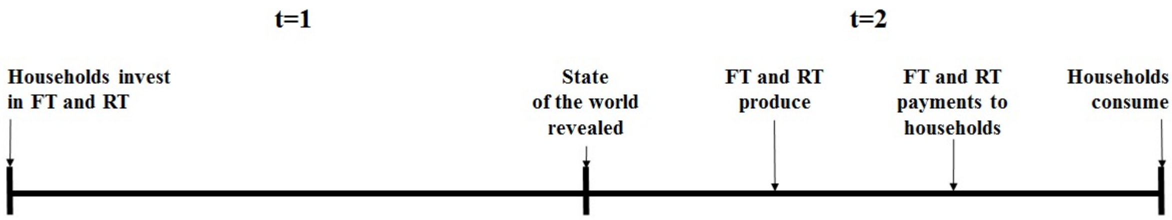

Figure 4.2: Timeline without financial intermediation

A is, the more risk-averse households are.[3] $A = 0$ yields the special case of risk-neutral households, which has been studied in Chapters 2 and 3. Hence, in this chapter we assume that A is strictly positive.
The setup of the model is graphically presented in Figure 4.1. The timeline of the model is depicted by Figure 4.2.

4.2.3 Markets

The excess demand functions of the capital market, the consumption good market in the good state and the consumption good market in the bad state are determined as follows:

$$z_K = (k_F + k_R) - K \tag{4.6}$$

$$\overline{z_c} = \overline{c} - \left(f(k_F) + k_R \cdot \overline{R}\right) \tag{4.7}$$

$$\underline{z_c} = \underline{c} - (f(k_F) + k_R \cdot \underline{R}) \tag{4.8}$$

[3] Negative values of A imply risk-seeking attitude, which is unlikely to be the case for unsophisticated households.

We say that a market clears if its excess demand equals zero. The FT bond market and the RT bond market clear, as shown in Subsection 4.2.1.

4.3 Equilibrium without Financial Intermediation

We now investigate the equilibrium without financial intermediation by solving the problems of all the agents in the above described economy.

4.3.1 Problem of Entrepreneurs

FT entrepreneur solves the following problem:

$$\max_{B_F=k_F} \left\{\Pi_F = f(k_F) - R_F \cdot k_F\right\}.$$

First Order Condition (henceforth FOC) yields

$$R_F = f'\left(k_F\right). \tag{4.9}$$

Because of the Inada conditions, if $k_F = 0$, then R_F becomes infinitely large, whereas $R_F = 0$ for $k_F = K$.

RT entrepreneur solves the following problem:

$$\max_{B_R=k_R} \left\{\mathbb{E}[\Pi_R] = k_R \cdot \left[\sigma \cdot \left(\overline{R} - \overline{R}_R\right) + (1-\sigma) \cdot \left(\underline{R} - \underline{R}_R\right)\right]\right\} \tag{4.10}$$

$$\text{s.t. } k_R \cdot \left(\overline{R} - \overline{R}_R\right) \geq 0 \tag{4.11}$$

$$k_R \cdot \left(\underline{R} - \underline{R}_R\right) \geq 0. \tag{4.12}$$

Conditions (4.11) and (4.12) imply that RT entrepreneurs always repay their bondholders, although those repayments are state-contingent. Conditions (4.11) and (4.12) also imply that $\mathbb{E}[\Pi_R] \geq 0$. We note however, that due to the linearity of $\mathbb{E}[\Pi_R]$ with regard to k_R, if $\mathbb{E}[\Pi_R]$ is strictly positive, then RT entrepreneur would demand an infinite amount of capital. That would imply zero investments in FT, which in turn, due to Inada conditions, would yield infinite FT returns, which cannot hold in equilibrium. Thus, we conclude that in equilibrium, $\mathbb{E}[\Pi_R] = 0$ and therefore,

$$\overline{R}_R = \overline{R} \tag{4.13}$$

$$\underline{R}_R = \underline{R}. \tag{4.14}$$

4.3.2 Problem of Households

Risk-averse households aim to maximize their expected utility. Formally, households' optimal consumption in the good state and the bad state of the world is derived from solving the following problem:[4]

$$\max_{\beta} \left\{ \mathbb{E}[U] = 1 - \sigma \cdot e^{-A \cdot \overline{c}} - (1-\sigma) \cdot e^{-A \cdot \underline{c}} \right\} \tag{4.15}$$

$$\text{s.t. } \overline{c} = \beta \cdot K \cdot \overline{R} + (1-\beta) \cdot K \cdot R_F + \Pi_F \tag{4.16}$$

$$\underline{c} = \beta \cdot K \cdot \underline{R} + (1-\beta) \cdot K \cdot R_F + \Pi_F. \tag{4.17}$$

FOC yield

$$\overline{c} - \underline{c} = \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R} - R_F}{R_F - \underline{R}} \right). \tag{4.18}$$

Solving for β, we obtain

$$\beta = \frac{1}{K \cdot (\overline{R} - \underline{R})} \cdot \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R} - R_F}{R_F - \underline{R}} \right). \tag{4.19}$$

From (4.18) we note that for an infinitely high value of the risk-aversion parameter, A, households would optimally demand the consumption in the bad state to be equal to the consumption in the good state. Indeed, as it is shown by (4.19), infinitely risk-averse households would make no investments in RT, namely, $\beta = 0$.

4.3.3 Equilibrium and Welfare Analysis

In equilibrium, we require that all agents optimize their objective functions and markets clear. That is,

Definition 4.1
An equilibrium without financial intermediation is a tuple $(\overline{c}^*, \underline{c}^*, k_F^*, k_R^*, R_F^*)$ *which satisfies the following system of equations:*

$$\overline{c} - \underline{c} = \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R} - R_F}{R_F - \underline{R}} \right) \tag{4.20}$$

$$R_F = f'(k_F) \tag{4.21}$$

$$k_R = K - k_F \tag{4.22}$$

$$\overline{c} = f(k_F) + k_R \cdot \overline{R} \tag{4.23}$$

$$\underline{c} = f(k_F) + k_R \cdot \underline{R}. \tag{4.24}$$

[4] Note that $\overline{\Pi}_R = \underline{\Pi}_R = 0$ because of (4.13) and (4.14).

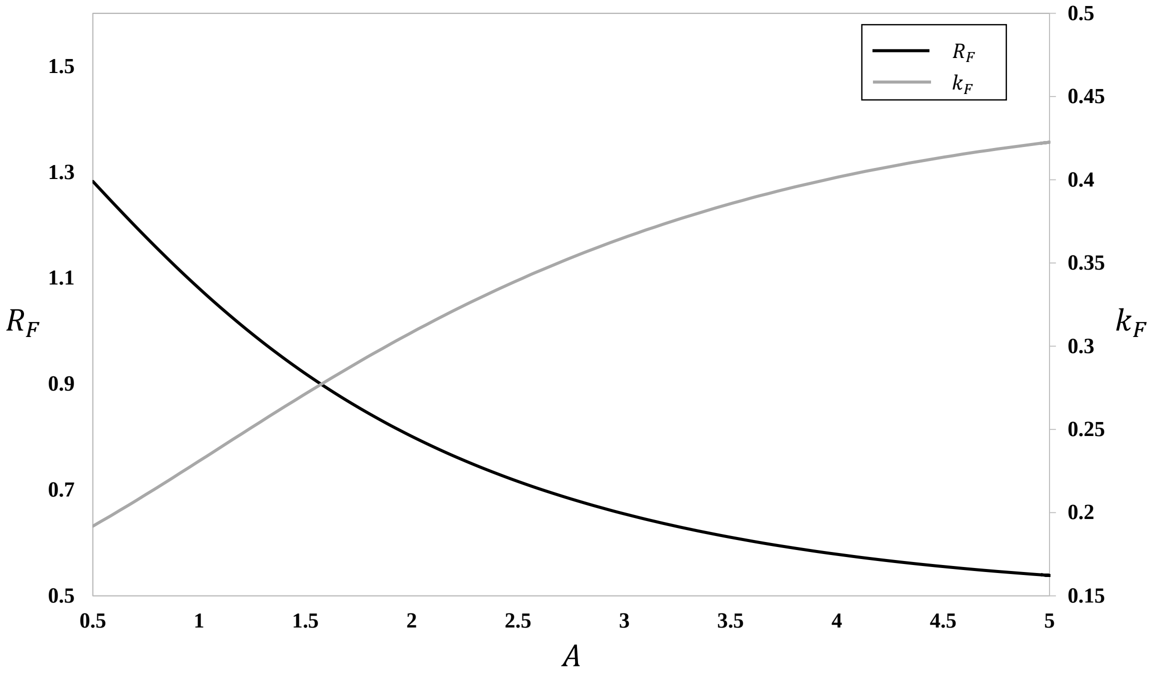

Figure 4.3: Impact of risk-aversion on returns and allocations without financial intermediation

We obtain,

Proposition 4.1
There exists a tuple $(\overline{c}^*, \underline{c}^*, k_F^*, k_R^*, R_F^*)$ *which is a unique equilibrium without financial intermediation with* $\beta^* = \frac{1}{K \cdot (\overline{R} - \underline{R})} \cdot \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R} - R_F}{R_F - \underline{R}}\right)$.

The proof of Proposition 4.1 is given in Appendix C. Figure 4.3 illustrates the impact of risk aversion on the returns, and consequently, on the allocation of resources, for a given parameterization.[5] We observe that the equilibrium returns on risk-free assets decline in the risk-aversion parameter. That is the case because the more risk-averse households are, the higher the risk premium they demand for investing in the risky sector, thus, depressing risk-free returns in equilibrium. Indeed, as shown in Figure 4.3, the allocation of resources to FT is increasing in the risk-aversion parameter. That is, the higher A is, the lower β^* is.

We now define the optimal allocation and we investigate whether the equilibrium under Proposition 4.1 yields an optimal allocation of resources, or not.

Definition 4.2
The allocation $(\hat{k}_F, K - \hat{k}_F)$ *is optimal if it maximizes the households' expected utility.*

[5] $\overline{R} = 2$, $\underline{R} = 1/2$, $\sigma = 2/3$, $K = 1$ and $f(k_F) = 2\sqrt{k_F} - k_F$.

The optimal allocation is thus determined by solving the following problem:

$$\max_{k_F} \left\{1 - \sigma \cdot e^{-A \cdot \overline{c}(k_F)} - (1-\sigma) \cdot e^{-A \cdot \underline{c}(k_F)}\right\} \tag{4.25}$$

$$\text{s.t. } \overline{c}(k_F) = f(k_F) + (K - k_F) \cdot \overline{R} \tag{4.26}$$

$$\underline{c}(k_F) = f(k_F) + (K - k_F) \cdot \underline{R}. \tag{4.27}$$

FOC yield

$$\overline{c} - \underline{c} = \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R} - f'}{f' - \underline{R}}\right). \tag{4.28}$$

Taking (4.21) into account, we observe that (4.20) and (4.28) coincide. Thus, we obtain,

Proposition 4.2
An equilibrium without financial intermediation yields the optimal allocation.

4.4 Equilibrium with Financial Intermediation

We now consider a friction in the form of moral hazard in RT, as in Subsection 2.2.2. Thus, resources can be allocated to RT only via banks which, having access to monitoring technology, act as financial intermediaries between households and RT. We also introduce a government that provides deposit guarantees, regulates banks and sets tax policy. Finally, we revise the setup with regard to households because they face different asset choices in the presence of banks, as compared to the case without financial intermediation.

4.4.1 Banks

A continuum of identical banks, which have access to monitoring technology and are operated by bank managers, can invest in RT, acting as intermediaries between households and the risky sector. We assume that there are no monitoring costs and no moral hazard associated with bank managers. Since banks are identical and perfectly competitive, it is sufficient to consider a representative bank.
The bank can be funded by deposits, D, and equity, E. Banks are contractually bound to repay their depositors with R_D per unit of deposit in period $t = 2$. In period $t = 2$, bank profits are distributed proportionally among shareholders. We assume limited liability of shareholders. Thus, in case of negative profits, shareholders receive zero returns, but are not expected to inject new equity into the banks. Further, we assume the existence of a legal requirement for a strictly positive amount of equity for banks to be licensed.[6] That

[6] An example of such a requirement can be found in Directive 2013/36/EU, as described in Subsection 1.1.2.

is, the case of $E = 0$ automatically implies the absence of banks.

The entire amount of funds received by banks in the form of deposits, D, and equity, E, is invested in RT. Namely, bank assets are equal to $B_R = k_R \equiv D + E$.[7] Thus, taking into consideration that the returns on B_R are state-contingent, we conclude that bank revenues and returns on equity are state-contingent as well. Note that, because RT returns can be taxed according to the tax policy that is described in Subsection 4.4.2, (4.13) and (4.14) become

$$\overline{R}_R = (1 - \tau) \cdot \overline{R} \tag{4.29}$$

$$\underline{R}_R = (1 - \tau) \cdot \underline{R}, \tag{4.30}$$

respectively,[8] where τ is the tax rate imposed on RT output.

Bank managers aim at maximizing the bank's expected returns on equity which read as follows:

$$\mathbb{E}[R_E] = \sigma \cdot \overline{R}_E + (1 - \sigma) \cdot \underline{R}_E, \tag{4.31}$$

where $\overline{R}_E$ and $\underline{R}_E$ are the returns on equity in the good state and the bad state of the world, respectively.

The capital structure of the bank is depicted by the equity-to-debt ratio,

$$\Theta = \frac{E}{D}. \tag{4.32}$$

Banks do not default as long as they are able to fulfill their repayment obligations to their depositors. That requires non-negative profits, even if the bad state of the world occurs.[9] That is,

$$k_R \cdot (1 - \tau) \cdot \underline{R} - D \cdot R_D \geq 0. \tag{4.33}$$

The non-defaulting condition (4.33) can also be expressed as

$$\Theta \geq \bar{\Theta}, \tag{4.34}$$

[7] In this chapter we assume no equity issuance cost. In terms of Chapters 2 and 3, no equity issuance cost means $\delta = 0$. That simplifies the analysis and allows us to focus on the impact of households' risk-aversion on the results.

[8] This is the solution of the following problem:

$$\max_{B_R = k_R} \left\{ \mathbb{E}[\Pi_R] = k_R \cdot \left[\sigma \cdot \left((1 - \tau) \cdot \overline{R} - \overline{R}_R \right) + (1 - \sigma) \cdot ((1 - \tau) \cdot \underline{R} - \underline{R}_R) \right] \right\}$$
$$\text{s.t. } k_R \cdot \left((1 - \tau) \cdot \overline{R} - \overline{R}_R \right) \geq 0$$
$$k_R \cdot ((1 - \tau) \cdot \underline{R} - \underline{R}_R) \geq 0.$$

[9] It turns out that in equilibrium, banks do no default if the good state of the world occurs.

where

$$\bar{\Theta} = \frac{R_D - (1-\tau)\underline{R}}{(1-\tau)\underline{R}}. \tag{4.35}$$

We call $\bar{\Theta}$ the *"resilience boundary"*. A bank that satisfies $\Theta \geq \bar{\Theta}$ is a resilient bank. Otherwise, the bank is a fragile bank.

4.4.2 Government

We now turn our focus to the threefold role of government with respect to capital regulation, tax policy, and deposit guarantee.

Capital Regulation

At the beginning of period $t = 1$, the government sets capital regulation, in the form of a minimal equity-to-debt ratio, denoted by Θ_{reg}. Banks equity-to-debt ratio, Θ, must fulfill

$$\Theta \geq \Theta_{\text{reg}}. \tag{4.36}$$

Θ_{reg} itself fulfills

$$\Theta_{\text{reg}} \geq \vartheta, \tag{4.37}$$

where ϑ ($\vartheta > 0$) is an *a priori* minimal capital requirement.[10] (4.36) along with (4.37) ensure that banks always hold a strictly positive amount of equity.

Tax Policy

At the beginning of period $t = 1$, the government sets the tax policy in the form of a tax rate that is imposed on the RT output, namely, on the output of the sector that is financed by banks.

The tax rate is denoted by τ. Once the consumption good has been produced in period $t = 2$, the government raises tax revenues that are equal to $\overline{\Phi} = \tau \cdot k_R \cdot \overline{R}$ and $\underline{\Phi} = \tau \cdot k_R \cdot \underline{R}$ in the good state and the bad state of the world, respectively. The tax revenues—in the form of consumption good—are either distributed to, and consumed by, households, or are spent to cover potential bailout expenditures, as described below.

Deposit Guarantee

We assume that the government guarantees deposits by bailing out failed banks. Bailout expenditures are financed by tax revenues. If bailout expenditures exceed tax revenues,

[10] An interpretation of ϑ can be found in Section 2.2.

the government covers the difference by imposing a lump sum taxation on households. Bailout expenditures are denoted by T and read as follows:

$$T = \max\left\{0, D \cdot R_D - (1-\tau) \cdot k_R \cdot \underline{R}\right\}. \tag{4.38}$$

4.4.3 Households with Financial Intermediation

Since investments in RT can now only take place via banks, households' asset choices differ as compared to the economy without banks. In particular, households, in the presence of banks, allocate the amount of $\gamma \cdot K$ in bank equity, which is a risky asset, and the amount of $(1-\gamma) \cdot K$ in bank deposits and FT bonds, which are free of risk assets. Formally, we say that

$$E = \gamma \cdot K \tag{4.39}$$

$$D + k_F = (1-\gamma) \cdot K. \tag{4.40}$$

We assume no arbitrage and thus, the returns in deposits and FT bonds are equal since both assets are safe. We denote *"safe returns"* with R_S and the following always holds:

$$R_S \equiv R_D = R_F. \tag{4.41}$$

The returns on equity in the good state and the bad state of the world read as follows:

$$\overline{R}_E = \frac{(1-\tau) \cdot k_R \cdot \overline{R} - D \cdot R_S}{E} \tag{4.42}$$

$$\underline{R}_E = \max\left\{0, \frac{(1-\tau) \cdot k_R \cdot \underline{R} - D \cdot R_S}{E}\right\}. \tag{4.43}$$

The representative household aims at maximizing its expected utility taking the equilibrium returns and allocations as given. That is, the representative household solves the following problem:

$$\max_{\gamma} \left\{\mathbb{E}[U] = 1 - \sigma \cdot e^{-A \cdot \overline{c}} - (1-\sigma) \cdot e^{-A \cdot \underline{c}}\right\} \tag{4.44}$$

$$\text{s.t. } \overline{c} = \gamma \cdot K \cdot \overline{R}_E + (1-\gamma) \cdot K \cdot R_S + \Pi_F + \overline{\Phi} \tag{4.45}$$

$$\underline{c} = \gamma \cdot K \cdot \underline{R}_E + (1-\gamma) \cdot K \cdot R_S + \Pi_F + \underline{\Phi} - T. \tag{4.46}$$

FOC yield

$$\overline{c} - \underline{c} = \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R}_E - R_F}{R_F - \underline{R}_E}\right). \tag{4.47}$$

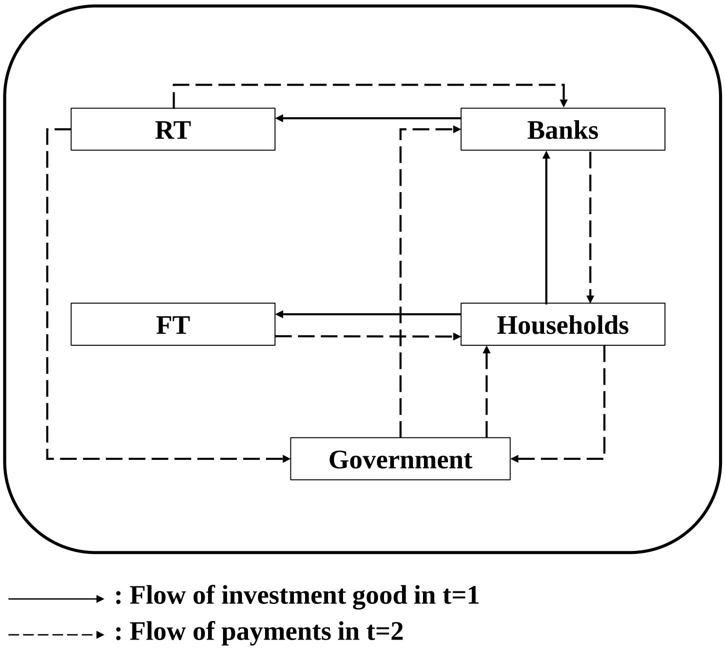

Figure 4.4: Model setup with financial intermediation

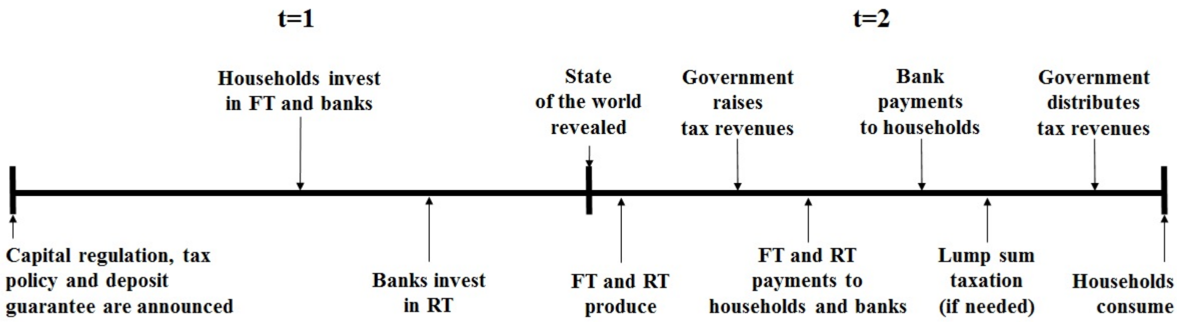

Figure 4.5: Timeline with financial intermediation

Solving for γ, we obtain

$$\gamma = \frac{1}{K \cdot (\overline{R}_E - \underline{R}_E)} \cdot \left[\frac{1}{A} \cdot \ln \left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R}_E - R_S}{R_S - \underline{R}_E} \right) - \left(\overline{\Phi} - \underline{\Phi} + T \right) \right]. \tag{4.48}$$

The setup of the model with financial intermediation is graphically presented in Figure 4.4. The timeline of the model with financial intermediation is depicted by Figure 4.5.

4.4.4 Problem of Banks

The banks' problem is solved in two steps. In the first step, banks aim to raise an initial amount of equity, and obtain an amount say E', in order to be licensed and start operating.

In the second step, the initial shareholders appoint a bank manager who is acting on their behalf.[11] The bank manager decides on the bank's capital structure, Θ,[12] aiming to maximize the expected returns on equity, $\mathbb{E}[R_E]$, under the capital regulation as described by (4.36). Thus, the bank manager of the representative bank faces the following problem:

$$\max_{E,D} \{\mathbb{E}[R_E]\} \tag{4.49}$$

$$\text{s.t. } \Theta \geq \Theta_{\text{reg}}. \tag{4.50}$$

FOC with regard to E and D show that if banks are resilient, i.e., $(1-\tau) \cdot k_R \cdot \underline{R} - D \cdot R_D \geq 0$, then the expected returns on equity are independent of E and D. For the sake of simplicity, we make the following assumption:[13]

Assumption 4.1
If the bank manager is indifferent between E and D, he always chooses a capital structure such that $\Theta = \Theta_{\text{reg}}$.

From FOC we also obtain that if banks are fragile, i.e., $(1-\tau) \cdot k_R \cdot \underline{R} - D \cdot R_D < 0$, then the expected returns on equity are monotonically decreasing in E, whereas they are monotonically increasing in D. Thus, and taking Assumption 4.1 into account, we obtain

Lemma 4.1
The manager of the representative bank sets $\Theta = \Theta_{\text{reg}}$.

That is, in the second step, the manager of the representative bank keeps $E = E'$ and demands deposits such that $\Theta = \Theta_{\text{reg}}$.

4.4.5 Equilibrium

We can now define the equilibrium with financial intermediation as follows:

Definition 4.3
An equilibrium with financial intermediation is a tuple $(\overline{c}^*, \underline{c}^*, k_F^*, k_R^*, R_F^*, \overline{R}_E^*, \underline{R}_E^*, \Theta^*, E^*, T^*)$

[11] The bank manager's interests are considered to be fully aligned with the shareholders' interests.
[12] Because of (4.32), the bank manager chooses the capital structure by choosing E and D.
[13] The assumption would become redundant with strictly positive equity issuance costs.

which satisfies the following system of equations:

$$\bar{c} - \underline{c} = \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R}_E - R_F}{R_F - \underline{R}_E}\right) \tag{4.51}$$

$$R_F = f'(k_F) \tag{4.52}$$

$$\overline{R}_E = \frac{(1-\tau) \cdot k_R \cdot \overline{R} - D \cdot R_S}{E} \tag{4.53}$$

$$\underline{R}_E = \max\left\{0, \frac{(1-\tau) \cdot k_R \cdot \underline{R} - D \cdot R_S}{E}\right\} \tag{4.54}$$

$$k_R = K - k_F \tag{4.55}$$

$$\bar{c} = f(k_F) + k_R \cdot \overline{R} \tag{4.56}$$

$$\underline{c} = f(k_F) + k_R \cdot \underline{R} \tag{4.57}$$

$$\frac{E}{D} = \Theta_{\text{reg}} \tag{4.58}$$

$$k_R = E + D \tag{4.59}$$

$$T = \max\left\{0, D \cdot R_D - (1-\tau) \cdot k_R \cdot \underline{R}\right\}. \tag{4.60}$$

We obtain,

Proposition 4.3
Suppose Θ_{reg} and τ are given with $\Theta_{\text{reg}} \geq \vartheta$ and $\tau \in [0,1)$. There exists an equilibrium with financial intermediation with

$$\gamma^* = \frac{1}{K \cdot (\overline{R}_E - \underline{R}_E)} \cdot \left[\frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R}_E - R_S}{R_S - \underline{R}_E}\right) - \left(\overline{\Phi} - \underline{\Phi} + T\right)\right].$$

The proof of Proposition 4.3 is given in Appendix C. From γ^* we observe that the higher the risk-aversion, as measured by A, the lower the investments in the risky sector are. That implies shift of resources to the free-of-risk sector, which in turn, depresses the risk-free returns. Essentially, that reflects households' need to smooth consumption by investing more in the sector the outcome of which is not uncertain.

Figure 4.6 illustrates the impact of risk aversion on the returns, and consequently, on the allocation of resources, for a given parameterization and fixed τ and Θ_{reg}.[14] Note that risk aversion also affects the resilience boundary.[15] In particular, we know from (4.35) that the resilience boundary, $\bar{\Theta}$, is increasing in the risk-free returns. Thus, for sufficiently high A, the risk-free returns decline such that banks become resilient for a given capital regulation. For example, in Figure 4.6, $\Theta_{\text{reg}} = 1/2$ yields fragile banks if risk-aversion

[14] $\theta = 0.05$, $\overline{R} = 2$, $\underline{R} = 1/2$, $\sigma = 2/3$, $K = 1$, $f(k_F) = 2\sqrt{k_F} - k_F$, and $\tau = 0$ and $\Theta_{\text{reg}} = 1/2$.

[15] That distinguishes Figure 4.6 from Figure 4.3 that corresponds to an economy without financial intermediation and thus, without bank failures.

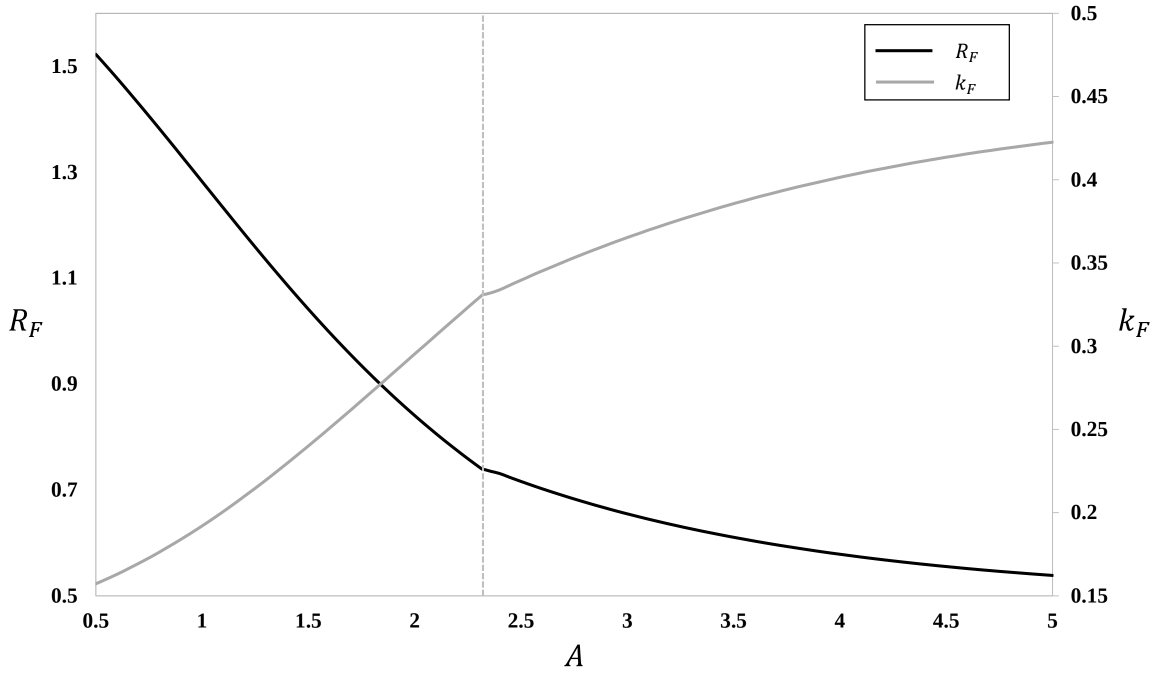

Figure 4.6: Impact of risk-aversion on returns and allocations with financial intermediation

parameter, A, lies left to the dotted line, whereas $\Theta_{\text{reg}} = 1/2$ results in resilient banks for risk-aversion levels that lie right to the dotted line.

4.5 Social Planner

We now investigate the optimal legislative scheme $(\Theta_{\text{reg}}, \tau)$ which is defined as follows:

Definition 4.4
An optimal legislative scheme is the legislative scheme that yields the efficient allocation $(\hat{k}_F, 1 - \hat{k}_F)$.

We initially restrict our investigation by focusing on the case with resilient banks. That is, $\Theta_{\text{reg}} \geq \bar{\Theta}$ which, in turn, implies $\underline{R}_E \geq 0$ and $T = 0$. We obtain,

Proposition 4.4
Let $\Theta_{\text{reg}} \geq \bar{\Theta}$. *An equilibrium with financial intermediation yields an optimal allocation* $(\hat{k}_F, 1 - \hat{k}_F)$ *if and only if* $\tau = 0$.

The proof of Proposition 4.4 is given in Appendix C. Proposition 4.4 implies that a strictly positive tax rate would reduce risk-free returns below the optimal level, resulting in over-investment in safe assets and under-investment in the risky sector.

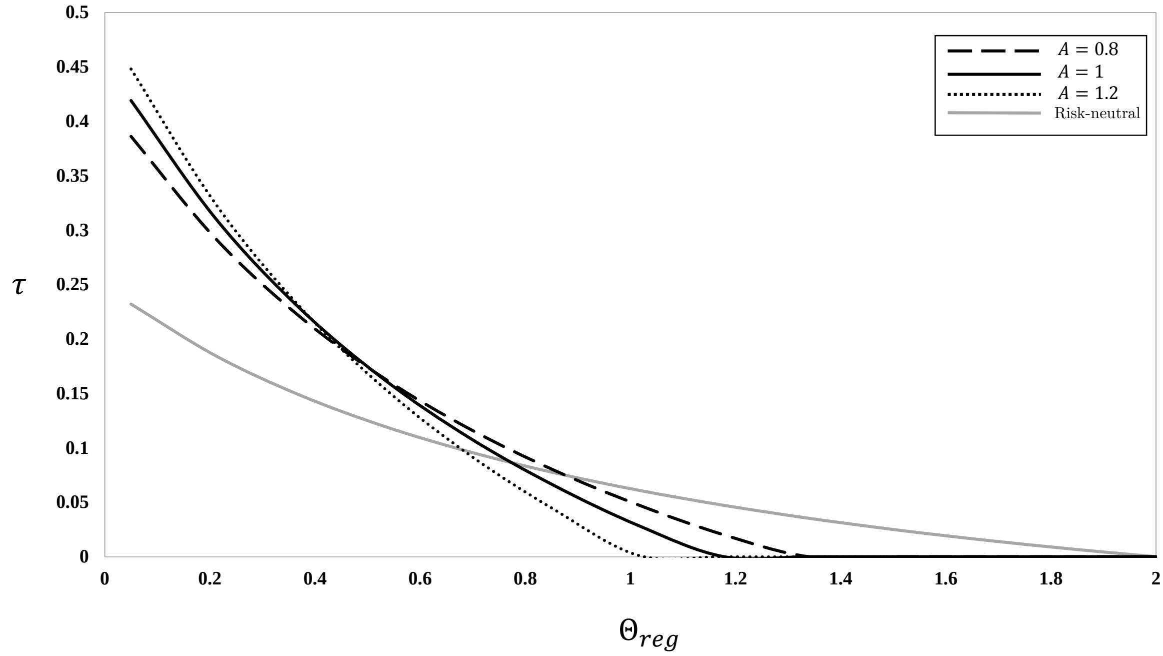

Figure 4.7: Optimal tax policy for different levels of risk-aversion

Extending our investigation to the case of fragile banks, i.e., $\Theta_{\text{reg}} < \bar{\Theta}$, we obtain,

Proposition 4.5

Let $\Theta_{\text{reg}} < \bar{\Theta}$ with $\Theta_{\text{reg}} \geq \vartheta$. There exists a τ^*, with $0 < \tau^* < 1$, that supports an equilibrium with financial intermediation yielding the optimal allocation. τ^* satisfies

$$\frac{1+\Theta}{\Theta} \cdot \frac{(1-\tau^*) \cdot \overline{R} - R_s}{R_s} = \frac{\overline{R} - R_s}{R_s - \underline{R}} \tag{4.61}$$

where $\Theta = \Theta_{\text{reg}}$ and R_s is determined in equilibrium.

The proof of Proposition 4.5 is given in Appendix C. Figure 4.7 illustrates the optimal tax policy as a function of capital regulation, for a given parameterization[16] and different levels of risk-aversion. We observe that for relatively lax capital regulation, the optimal tax rate is increasing in risk-aversion, whereas for relatively strict capital regulation, the optimal tax rate is decreasing in risk-aversion.

In order to understand the mechanism in place, we take into consideration that the optimal tax rate depends on the amount of tax revenues that risk-averse households require in order to outweigh potential bailout costs, and thus, to optimally smooth their consumption according to (4.28). The amount of tax revenues depends on the tax rate and the amount

[16] $\theta = 0.05$, $\overline{R} = 2$, $\underline{R} = 1/2$, $\sigma = 2/3$, $K = 1$ and $f(k_F) = 2\sqrt{k_F} - k_F$.

invested in RT, which, in turn, is determined by the risk-free returns. The amount of bailout cost depends on the absolute amount of deposits and the risk-free returns that have been promised on these deposits. We also know that the risk-free returns are *ceteris paribus* decreasing in capital regulation, tax rate and risk-aversion.

For low values of Θ_{reg} in Figure 4.7, the effect of lax capital regulation, which increases bailout costs by increasing risk-free returns, dominates the effect of risk-aversion, which increases safe investments by depressing risk-free returns. Thus, risk-averse households, aiming to smooth their consumption, require higher tax rate which has two effects in equilibrium. First, a high tax rate reduces risk-free returns and consequently, shifts resources to FT. Second, a high tax rate increases tax revenues.

As capital regulation increases, the effect of capital regulation on risk-free returns fades, and thus, the effect of risk-aversion dominates. That is, the promised returns to deposits, that need to be covered in the form of bailout costs, are smaller for higher levels of risk-aversion because the risk-free returns, promised on deposits, are depressed. Thus, for higher levels of risk-aversion, smaller amounts of tax revenues are required for smoothing households' consumption, yielding a lower optimal tax rate.

Finally, we observe that in line with Proposition 4.4, the optimal tax rate for capital regulation that renders banks resilient is zero. Figure 4.7 also shows that the resilience boundary, $\bar{\Theta}$,[17] which is increasing in risk-free returns, declines in risk-aversion parameter, A. That is the result of the decreasing risk-free returns in risk-aversion parameter (see also Figure 4.6).

4.6 Regulatory Competition in Capital Regulation and Tax Policy

We now obtain the equilibrium legislation in a two country setting. A generic country is denoted by j $(j = 1, 2)$ or k $(k = 1, 2)$ with $j \neq k$ if both labels are used concurrently.

Proposition 4.6

There exists a continuum of equilibria with endogenously determined legislative schemes where the government in Country j sets $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta, \tau^*(\Theta))$ for all $\Theta < \bar{\Theta}$, and $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta, 0)$ for all $\Theta \geq \bar{\Theta}$.

The proof of Proposition 4.6 is analogous to the proof of Proposition 2.2.[18] Proposition 4.6 implies that competing governments always choose a legislative scheme along the

[17] In Figure 4.7, the resilience boundary, $\bar{\Theta}$, for different A corresponds to the value of Θ_{reg} for which the optimal tax rate becomes zero from positive.

[18] Note that for the interval $\Theta \geq \bar{\Theta}$, we use Assumption 4.1.

optimal tax rate, τ^*, for any value of Θ. The intuition runs as follows. Governments need to set a tax rate at least equal to τ^* because otherwise, the raised tax revenues are not enough to cover potential bailout costs. Note that τ^* depends on the level of risk aversion, as discussed in the previous section. In a two-country setting, a government would ideally aim to host the entire banking sector, while at the same time, setting tax rate greater than τ^*. That would result in excessive tax revenues, more than what is required in order to outweigh potential bailout costs. Any upwards deviation of Country j from τ^* however, would leave space to Country k to set indeed, a tax rate greater than τ^* but still smaller than the tax rate in the competing country. Since the returns are *ceteris paribus* decreasing in tax rate, Country k would be able to attract all the banking activities while still enjoying excessive tax revenues. Hence, incentives to deviate only vanish when countries set policy along the optimal tax rate. Note that our analysis in this chapter assumes no equity issuance cost, i.e., $\delta = 0$. In the case of positive equity issuance cost, we infer that the countries would still set $\tau^j = \tau^*$, but capital regulation would be set at the lowest possible level, i.e., $\Theta^j_{\text{reg}} = \vartheta$ in order to economize on equity issuance costs.

4.7 Conclusions

In this chapter, the robustness of the results of Chapter 2 in regard to risk-aversion has been checked. The equilibrium in an one-country setting with risk-averse households has been first investigated. It has been shown that risk-aversion depresses risk-free returns and shifts resources to the free-of-risk sector. It has been also shown that for any level of capital regulation, there exists a tax rate that yields the optimal allocation of resources. This rate is zero for capital regulation that renders banks resilient, whereas it is strictly positive for capital regulation that results in fragile banks.

We then investigate the legislative outcome in a two-country setting and we conclude that risk-aversion does not change the mechanism of competition between countries in banking regulation and tax policy, as described in Chapter 2. Yet, risk aversion does induce different optimal tax rate for any given level of capital regulation.

In particular, optimal tax rate depends on the interaction between the effects of capital regulation and risk-aversion. Lax capital regulation implies higher returns on deposits and thus higher potential bailout costs. These costs can only be outweighed by tax revenues that need to be larger for higher levels of risk-aversion. As capital regulation becomes stricter, the effect of regulation on potential bailout costs fades, allowing for the effect of risk-aversion on the returns to dominate. That is, higher levels of risk-aversion require lower tax rate because risk-aversion depresses returns on deposits and thus reducing the potential bailout costs.

Chapters 3 and 4 present a series of extensions and generalizations of the base model. Yet, there is a number of scenarios in which parameters that are symmetric in the presented models can be considered as country-specific. RT productivity, probability that the good state of the world occurs and issuance cost per unit of equity are such parameters. Although these scenarios have not been exhaustively presented, the preceding analysis clearly points out that one may understand the impact of different specifications by capturing their impact on the trade-off between accentuating benefits over costs from banking on the one hand, and enhancing bank competitiveness on the other hand. For example, a country that features higher σ enjoys an advantageous position in regulatory competition because a higher σ increases benefits and decreases costs, in the form of expected tax revenues and bailout costs, respectively, and raises banks' competitiveness through higher returns.

This important intuition can explain why regulatory provisions in some jurisdictions are stricter than international minimum standards. For example, Switzerland sets capital requirements above the internationally agreed minimum level. Our analysis suggests that such a policy can occur only if Switzerland deviates from other jurisdictions with regard to some parameters. Indeed, one can observe that Switzerland features above the average productivity, which, in our model terms, corresponds to RT productivity above $\overline{R}$ and $\underline{R}$. At the same time, Swiss economy heavily depends on the banking sector, which implies that a potential banking crisis may result in above the average repercussions, and which—in our model terms—corresponds to higher κ. These two features are reflected into the aforementioned trade-off. Namely, higher productivity enhances Swiss banks' competitiveness, while higher crisis repercussions raise potential costs from banking activities. While the latter entails that Swiss authorities *must* set high capital requirements, the former implies that Swiss economy *can* indeed afford capital requirements above the internationally agreed minimum standards, thus resulting in the publicly-known "Swiss finish".

5 On Banking Regulation and Lobbying

5.1 Introduction

Studying aspects of international political economy of banking regulation so far, the benevolence of national governments with regard to households' welfare within their jurisdiction has not been questioned. Namely, in the preceding chapters we considered that national governments—free of considerations in regard to global welfare maximization—compete internationally, aiming to affect the allocation of resources via their legislation in favor of their jurisdiction.

However, since government intervention in the form of banking regulation affects the allocation of resources within the domestic economy as well, one can expect that banking regulation is also shaped by domestic political forces.[1] Indeed, a number of empirical studies suggest the existence of an interaction between lobbyists and legislators with regard to banking regulation. For example, Kroszner and Stratmann (1998) and Kroszner and Strahan (1999) highlight the impact of special interest groups on banking regulation, but also on the organization of relevant legislative bodies. Moreover, Igan et al. (2011) argue that lobbying contributed to the financial crisis of 2007-2008 since active lobbying is found to be related to excessive risk-taking in the US, while Claessens et al. (2008) find the same association in Brazil. Finally, in a more recent study, Lambert (forthcoming) shows that lobbying bankers undertake riskier decisions, while he also shows that regulators are less likely to take enforcement actions against a bank that is actively lobbying.

In this chapter, an explanatory theory on the mechanism through which politicians and bankers exchange favorable regulation for lobbying contributions is offered. The impact of this exchange on resource allocation and consequently, on financial stability and social welfare is analyzed as well.

[1] Note that the interaction between interest groups and legislators in the EU is allowed by Article 11 TEU, while in the United States, lobbying activities are protected by the right to petition of the First Amendment of the U.S. Constitution. In fact, lobbying in the US is considered an integral part of the political process and is currently regulated by the Honest Leadership and Open Government Act of 2007.

5.1.1 Relation to the Literature

The work of Stigler (1971), Peltzman (1976) and Becker (1983) share the underlying assumption that special interest groups aim to capture the power to legally coerce other agents, which originally belongs to the government. We adopt this assumption and we consider that, in the "supply side" of regulation, politicians running the government hold the monopoly of imposing certain regulations and policies. In the "demand side" of regulation, we consider bankers as the only special interest group.[2] Alternatively, in line with Becker (1983), one could also say that bankers form the sole politically active group, as opposed to other groups that remain politically passive because their marginal costs for being informed and organized exceed their marginal gains from favorable regulations.

Hardy (2006) examines a mechanism by which regulators, that set capital requirements, are captured by bankers in a partial equilibrium setting. Boyer and Ponce (2012) also developed a theoretical model that examines regulatory capture in banking. They focus, however, on supervision and on whether centralized or decentralized supervision can be more immune to bankers' efforts to capture supervisors.

This chapter contributes to the literature on the theory of regulatory capture in banking by adopting a general equilibrium approach and thus, offering a macro-perspective on the impact of lobbying. The lobbying mechanism in the presence of a second banking regulatory tool, namely, bank resolution in the form of either bailout or bail-in, is also formally examined. In particular, the contribution of this chapter to the literature is threefold. First, a theoretical model that links the theories of regulatory capture and banking regulation is developed. Second, the general equilibrium approach allows the study of the effect of lobbying on resource allocation and consequently, on social welfare and financial stability. Third, a normative analysis is presented and certain policies that could improve or restore efficiency are discussed.

5.1.2 Model Features and Main Results

To study lobbying on banking regulation, political activities need to be integrated into a model where banks and banking regulation have a role. We build on Gersbach et al. (2015) who develop a general equilibrium model with banks acting as financial intermediaries between households and a risky production sector, and show that inefficient outcomes can be eliminated by capital regulation. Their model is extended in various ways that are detailed in the subsequent sections of this chapter. Three important deviations from Gersbach et al. (2015) are mentioned here. First, we motivate bankers' lobbying activities by allowing them to actively decide on banks' capital structure. Second, we consider

[2] Note that the demand for regulation of a special interest group might be negative.

that a fraction of households are also politicians. Third, we motivate politicians' role by explicitly modeling a government with certain regulatory tools at its disposal.

In particular, a two-period general equilibrium model with three types of agents, namely, households, entrepreneurs and bankers, is developed. A fraction of households are also politicians. Households are initially endowed with capital and property rights of two different technologies that transform capital into consumption good in the second period. Bankers run banks acting as financial intermediaries between households and entrepreneurs operating a risky technology. Politicians run the government and can raise funds in the form of lobbying contributions.

Bankers raise equity and deposits and thus, decide on banks' capital structure that must comply with capital regulation set by government. Capital regulation itself must comply with *a priori* capital requirements, that are set exogenously. The standards set by Basel III can be an example of such an exogenously determined regulation that must be satisfied by domestic regulators. In the base model, the government also guarantees deposits by bailing out failed banks.[3] Politicians and bankers engage into bargaining, where the former can offer favorable regulation to the latter in exchange for lobbying contributions.

Three main results are obtained. First, bankers and politicians can reach an agreement on capital regulation and lobbying contributions, providing that politicians are not bound by a sufficiently high *a priori* capital regulation. The agreement between bankers and politicians yields strictly positive lobbying contributions and a capital regulation that exposes banks to a strictly positive likelihood of a banking crisis. This outcome undermines financial stability and reduces social welfare. Second, an agreement can be reached when bank resolution is also in the bargaining agenda. In that case, strictly positive lobbying contributions from bankers to politicians are exchanged for low capital regulation level and a bailout resolution mechanism. That also implies that if a bail-in provision is exogenously imposed, then bankers and politicians cannot reach an agreement, which results in a socially optimal outcome. Third, a non-cooperative game yields zero lobbying contributions and capital regulation that renders banks resilient.

Normative implications towards improving social welfare result from the analysis. In particular, market-based tools, namely, bail-in provisions or equity funding, can eliminate lobbying incentives and restore the socially optimal equilibrium. It is also shown that a non-cooperative game between bankers and politicians yields the socially optimal outcome. Finally, broadening the participation in the political system can enhance social welfare.

[3] In an extension in Section 5.5, bank resolution is endogenized allowing government to decide whether failed banks will be bailed out or bailed in.

5.1.3 Organization of the Chapter

The rest of the chapter is organized as follows. The model setup is outlined in Section 5.2. In Section 5.3, the equilibrium for given capital regulation and lobbying intensity is investigated. In Section 5.4, we investigate the result of bargaining between bankers and politicians on capital regulation and lobbying intensity. Extensions are presented in Section 5.5. Four normative implications of the analysis are discussed in Section 5.6, and we conclude in Section 5.7. The proofs are given in Appendix D.

5.2 Model Setup

We consider a two-period ($t = 1, 2$) economy with three types of agents: households, technology managers (henceforth entrepreneurs) and executives. Households are initially endowed with capital K. A fraction of households are also politicians running the government that is conferred regulatory authorities. Entrepreneurs possess management skills of technologies that transform capital into consumption good in the second period. Executives run legal entities acting as financial intermediaries between households and entrepreneurs running a risky technology. These entities are called banks and their executives are called bankers. All agents are risk-neutral and perfect competition prevails in all markets. Further details on the model setup are outlined below.

5.2.1 Entrepreneurs

There is a continuum of entrepreneurs that operate a free-of-risk technology (FT) and a risky technology (RT).[4] FT can be interpreted as a well-established representative firm which produces a free-of-risk output, employing capital, denoted by k_F, in period $t = 1$. In the second period, the amount of $f(k_F)$ is produced with $f'(k_F) > 0$, $f''(k_F) < 0$, and the Inada conditions $\lim_{k_F \to 0} f'(k_F) = +\infty$ and $f'(K) = 0$ being satisfied.
FT entrepreneurs raise capital k_F by issuing bonds B_F to households in the first period at cost R_F, where R_F denotes the returns per unit of capital invested in FT. By construction, and in order for the bond market to clear, $k_F \equiv B_F$ must hold with $0 \leq k_F \leq K$. FT profits read as follows:

$$\Pi_F = f(k_F) - R_F \cdot k_F. \tag{5.1}$$

As opposed to the output of FT, the output of RT depends on the state of the world. In particular, at the beginning of $t = 2$, either the *good state* or the *bad state* of the world occurs with probability σ and $1 - \sigma$ ($0 < \sigma < 1$), respectively. The returns per unit

[4] Although the setup of the two technologies is identical with the technologies in Chapter 2, the basic attributes of the two technologies are also presented here for the convenience of the reader.

of investment are $\overline{R}$ in the good state and $\underline{R}$ in the bad state of the world. We assume $0 < \underline{R} < \overline{R}$. The expected returns of investing one unit of capital in RT are thus

$$\mathbb{E}[\tilde{R}] = \sigma\overline{R} + (1-\sigma)\underline{R}. \tag{5.2}$$

RT production can only be financed by banks[5] that grant loans, L_R, to RT entrepreneurs with state-contingent returns $\overline{R}_R$ and $\underline{R}_R$ in the good state and the bad state of the world, respectively. By construction, and in order for the loan market to clear, the amount of capital invested in RT, denoted by k_R, needs to satisfy $k_R \equiv L_R$. RT expected profits read as follows:

$$\mathbb{E}[\Pi_R] = \sigma \cdot \overline{\Pi}_R + (1-\sigma) \cdot \underline{\Pi}_R\ , \tag{5.3}$$

where $\overline{\Pi}_R$ and $\underline{\Pi}_R$ are the RT profits in the good state and the bad state of the world, respectively, and read as follows:

$$\overline{\Pi}_R = \left(\overline{R} - \overline{R}_R\right) \cdot k_R \tag{5.4}$$

$$\underline{\Pi}_R = \left(\underline{R} - \underline{R}_R\right) \cdot k_R. \tag{5.5}$$

5.2.2 Bankers

As in Subsection 2.2.2, we assume a friction in the form of moral hazard in RT, which, in turn, gives rise to the role of banks that, having access to monitoring technology, can lend to RT, as opposed to households. That is, banks act as financial intermediaries between households and RT.

Assets and Liabilities

We assume a continuum of identical banks and thus, it suffices to consider a representative bank that raises funds by issuing deposits, D, and equity, E, to households. The equity-to-debt ratio represents the capital structure of banks and is denoted by

$$\Theta \equiv \frac{E}{D}. \tag{5.6}$$

As bank equity-holders, households are the bank owners who hand over the management of the representative bank to a representative banker with the mandate *"to maximize the expected returns on equity"*, denoted by $\mathbb{E}[R_E]$.[6] We assume no moral hazard associated

[5] The rationale of this assumption is detailed in Gersbach et al. (2015).

[6] It is *a priori* unclear whether bankers' mandate will maximize households' welfare from a general equilibrium perspective. However, giving a reasonable mandate, i.e., to maximize the returns on its investment, is the best choice for the representative household, who lacks the knowledge of the economy from a general equilibrium perspective.

with bankers.[7] The entire amount of raised funds is invested in RT. Namely, bank assets are equal to

$$k_R \equiv D + E. \tag{5.7}$$

Bankers try to fulfill their mandate by deciding on bank's capital structure, Θ.

Assumption 5.1
If the representative banker is indifferent among a continuum of capital structures $[\Theta_1, \Theta_2]$, *then he chooses* $\Theta = \Theta_1$.

Assumption 5.1 reflects bankers' preference for deposits over equity.[8]

Lobbying Activities

As we will see in the next subsection, the banker's decision on the capital structure is constrained by capital regulation. Yet, they are able to influence this regulation. More specifically, there exists a Bank Association that can lobby on behalf of bankers who contribute a fraction λ ($\lambda \in [0, 1]$) of bank revenues to it. Therefore, the Bank Association has the amounts of

$$\overline{\Lambda} = \lambda \cdot (D + E) \cdot \overline{R}_R, \text{ and} \tag{5.8}$$

$$\underline{\Lambda} = \lambda \cdot (D + E) \cdot \underline{R}_R \tag{5.9}$$

in the good state and the bad state of the world, respectively, at its disposal for lobbying in exchange for regulatory provisions that better serve bankers' mandate. We call λ the *"lobbying intensity"*, whereas we call $\overline{\Lambda}$ and $\underline{\Lambda}$ the *"lobbying contributions"* in the good state and the bad state of the world, respectively. We will see in Section 5.4 that lobbying intensity, λ, is a decision variable, whereas lobbying contributions, $\overline{\Lambda}$ and $\underline{\Lambda}$, are determined in equilibrium.

Resolution Mechanism

In period $t = 2$, bank profits, i.e., bank revenues net of lobbying contributions and returns on deposits, are distributed proportionally among equity-holders. Banks are contractually obliged to repay their depositors with R_D per unit of deposit in period $t = 2$. We say that banks default if they are not able to fulfill their repayment obligations to depositors in period $t = 2$. In other words, banks with non-negative profits in the bad state of the

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[7] Alternatively, we could assume that the banker decides aiming to maximize his salary, where banker's salary depends on bank revenues. The direction of the results would remain unchanged.

[8] Equity issuance costs, that are not formally modeled in this chapter, could justify such a preference.

world do not default. That is,[9]

$$(1-\lambda)\cdot k_R\cdot \underline{R}_R - D\cdot R_D \geq 0. \tag{5.10}$$

The non-defaulting condition (5.10) can also be expressed as

$$\Theta \geq \bar{\Theta}, \tag{5.11}$$

where

$$\bar{\Theta} = \frac{R_D-(1-\lambda)\cdot \underline{R}_R}{(1-\lambda)\cdot \underline{R}_R}. \tag{5.12}$$

Banks fulfilling (5.11) are called *"resilient banks"*. Banks that do not fulfill (5.11) are called *"fragile banks"* because they are not capitalized enough in order to withstand the adverse macroeconomic shock that takes place in the bad state of the world. In that case, the following resolution mechanism applies: equity, E, wipes out and the liquidation value of the bank, i.e., $(1-\lambda)\cdot k_R\cdot \underline{R}_R$, is distributed proportionally among depositors. The rest of the promised returns on deposits is covered by the government. This resolution mechanism is called *"bailout"* and the cost faced by the government is called *"bailout cost"* and is denoted by T, given by

$$T = \max\left\{0, R_D\cdot D-(1-\lambda)\cdot k_R\cdot \underline{R}_R\right\}. \tag{5.13}$$

$T=0$ means that banks do not fail. This can be the case either because the good state of the world has been materialized or because banks are resilient and therefore, they can repay their depositors even if the bad state of the world has been materialized, i.e., (5.10) is fulfilled.

5.2.3 Households

We assume a continuum of risk-neutral households. An initial amount of capital K and technology property rights are evenly distributed among households. It thus suffices to consider a representative household. A fraction η are also *"politicians"*. We call η the *"factor of political participation"*. For the sake of distinction from politicians, we call the fraction $1-\eta$ *"ordinary households"*. The term *"households"* refers to the sum of *"politicians"* and *"ordinary households"*.

Both politicians and ordinary households can invest in a portfolio that is composed of three assets: k_F, D and E. That is, both have a source of consumption in their capacity

[9] In equilibrium, bank profits are non-negative in the good state of the world. Therefore, the respective condition, i.e., $(1-\lambda)\cdot k_R\cdot \overline{R}_R - D\cdot R_D \geq 0$, is satisfied irrespectively of bank's capital structure.

as investors. As opposed to ordinary households, politicians may have a second source of consumption from lobbying contributions. Finally, both politicians and ordinary households may incur losses in their capacity as taxpayers. The attributes of households in their capacity as taxpayers, investors and politicians are now outlined.

Taxpayers

In the base model, in line with the resolution mechanism as described in Subsection 5.2.2, we assume that failed banks are bailed out by government. Bailout cost, which is given by (5.13), is financed by a lump sum taxation imposed on households, i.e., on both ordinary households and politicians.

Investors

Households, in their capacity as investors, invest in period $t = 1$ by choosing among FT capital, k_F, deposits, D, and equity, E, with expected returns $\mathbb{E}[R_F]$, $\mathbb{E}[R_D]$ and $\mathbb{E}[R_E]$, respectively. In particular, they decide on the values of the variables γ and ν in period $t = 1$ with the amounts of $\gamma\nu \cdot K$, $\gamma(1-\nu) \cdot K$ and $(1-\gamma) \cdot K$ being invested in FT, deposits and equity, respectively. The returns on equity are state-contingent whereas the returns on FT capital and deposits are free of risk.[10] Thus, the expected returns, per unit of invested capital, on each asset are the following:

$$\mathbb{E}[R_F] = R_F \tag{5.14}$$

$$\mathbb{E}[R_D] = R_D \tag{5.15}$$

$$\mathbb{E}[R_E] = \sigma \cdot \overline{R}_E + (1-\sigma) \cdot \underline{R}_E \tag{5.16}$$

$\overline{R}_E$ and $\underline{R}_E$ are the returns on equity in the good state and the bad state of the world, respectively, with

$$\overline{R}_E = \frac{\big((1-\lambda)\cdot(1+\Theta)\,\overline{R}_R - R_D\big)}{\Theta} \tag{5.17}$$

$$\underline{R}_E = \max\left\{0, \frac{((1-\lambda)\cdot(1+\Theta)\,\underline{R}_R - R_D)}{\Theta}\right\}. \tag{5.18}$$

The non-negativity of $\underline{R}_E$ denotes equity-holders' protection by limited liability.[11]

In period $t = 2$, the representative household in its capacity as investor exchanges the returns on their investment plus the profits from FT and RT, net of any bailout cost, against the consumption good that has been produced by the two technologies, and they consume

[10] Deposits are free of risk because of the bailout resolution mechanism as outlined in Subsection 5.2.2.

[11] Since in equilibrium banks never default in the good state of the world, $\overline{R}_E$ is also non-negative.

$\overline{c}^i$ and $\underline{c}^i$ in the good state and the bad state of the world, respectively, which read as follows:

$$\overline{c}^i = \Big(\gamma\nu \cdot R_F + \gamma(1-\nu) \cdot R_D + (1-\gamma) \cdot \overline{R}_E\Big) \cdot K + \Pi_F + \overline{\Pi}_R \tag{5.19}$$

$$\underline{c}^i = (\gamma\nu \cdot R_F + \gamma(1-\nu) \cdot R_D + (1-\gamma) \cdot \underline{R}_E) \cdot K + \Pi_F + \underline{\Pi}_R - T. \tag{5.20}$$

Ordinary Households

The aggregate amounts of the consumption good allocated to ordinary households in the good state and the bad state of the world, which are denoted by $\overline{C}^{\text{oh}}$ and $\underline{C}^{\text{oh}}$, respectively, satisfy

$$\overline{C}^{\text{oh}} = (1-\eta) \cdot \overline{c}^i; \tag{5.21}$$

$$\underline{C}^{\text{oh}} = (1-\eta) \cdot \underline{c}^i. \tag{5.22}$$

Politicians

Politicians run the government which is endowed with the right to coerce other agents to comply with certain regulations. In this model, the government sets regulation with regard to two policy areas: capital regulation and bank resolution. If politicians appropriate their regulatory power, they can raise funds by renting their power to other agents.

Politicians as Fund-raisers

Politicians can rent their regulatory authorities in exchange for lobbying contributions, which, in turn, are consumed by politicians.[12] In this model, the Bank Association is the only interest group engaging into lobbying. In particular, at the beginning of period $t = 1$—and provided that bankers and politicians reach an agreement—bankers write a contract $(\Theta_{\text{reg}}, \lambda)$ with politicians. This contract implies that in period $t = 2$ bankers will contribute to politicians a fraction λ of their revenues, if politicians set regulation Θ_{reg} in period $t = 1$.[13] Lobbying contributions in the good state and the bad state of the world, i.e., $\overline{\Lambda}$ and $\underline{\Lambda}$, are given by (5.8) and (5.9), respectively.[14] Therefore, the aggregate

[12] Lobbying contributions can be consumed by politicians either for personal purposes or in order to organize their election campaigns. In the former case, lobbying contributions resemble bribes and the transaction between bankers and politicians is probably informal and secret. In the latter case, lobbying contributions resemble campaign contributions and the transaction might be formal and disclosed.

[13] One could argue that bankers can cheat by not paying the agreed contribution in the second period. Although that is a valid argument, especially in a two-period economy, we assume that the contract $(\Theta_{\text{reg}}, \lambda)$ is fully enforceable because in reality, bankers and politicians play a repeated game, which reduces cheating incentives.

[14] Administrative costs incurred by bankers in order to be politically active could also be taken into consideration. That would reduce lobbying contributions. However, that would not change the direction of the results, especially in the absence of a competing special interest group. Therefore, and for the sake of simplicity, we assume no administrative costs for lobbying.

amounts of politicians' consumption in the good state and the bad state of the world, denoted by $\overline{C}^{\pi}$ and $\underline{C}^{\pi}$, respectively, are given by:

$$\overline{C}^{\pi} = \eta \cdot \overline{c}^{i} + \overline{\Lambda}\,; \tag{5.23}$$

$$\underline{C}^{\pi} = \eta \cdot \underline{c}^{i} + \underline{\Lambda}. \tag{5.24}$$

Note that the aggregate consumption of households, namely, ordinary households and politicians, in the good state, denoted by $\overline{C}^{\text{h}}$, and in the bad state, denoted by $\underline{C}^{\text{h}}$, satisfy

$$\overline{C}^{\text{h}} = \overline{C}^{\text{oh}} + \overline{C}^{\pi}; \tag{5.25}$$

$$\underline{C}^{\text{h}} = \underline{C}^{\text{oh}} + \underline{C}^{\pi}. \tag{5.26}$$

Politicians as Policy-makers

At the beginning of period $t = 1$, the government decides on capital regulation in the form of minimum equity-to-debt ratio. Capital regulation is described by Θ_{reg}. That is, bankers can only choose a capital structure Θ that satisfies

$$\Theta \geq \Theta_{\text{reg}}. \tag{5.27}$$

Capital regulation, Θ_{reg}, itself fulfills

$$\Theta_{\text{reg}} \geq \vartheta, \tag{5.28}$$

where ϑ is an *a priori* minimal equity-to-debt ratio with ϑ being a strictly positive parameter.[15]

Besides capital regulation, the government also intervenes by bailing out failed banks in line with the resolution mechanism described in Subsection 5.2.2. In an extension in Section 5.5, we will endogenize bank resolution by allowing government to decide whether failed banks will be bailed out or bailed in. In the latter case, T is zero.

Consistent with the focus of this thesis on the design of banking regulation (ex ante), as opposed to the implementation of banking regulation (ex post), it is assumed that the decisions of politicians regarding banking regulation are announced at the beginning of period $t = 1$, and are implemented afterwards without time inconsistency problems.

[15] This assumption ensures that equity, E, is also strictly positive, which in turn, serves both conceptual and technical purposes. Conceptually, and in line with the existing banking legislation in the EU as described in Subsection 1.1.2, it ensures that banks fulfill the legal requirement of holding a strictly positive amount of equity for operating. Technically, it ensures that $\mathbb{E}[R_E]$ never goes to infinity and thus, bankers' mandate is meaningful.

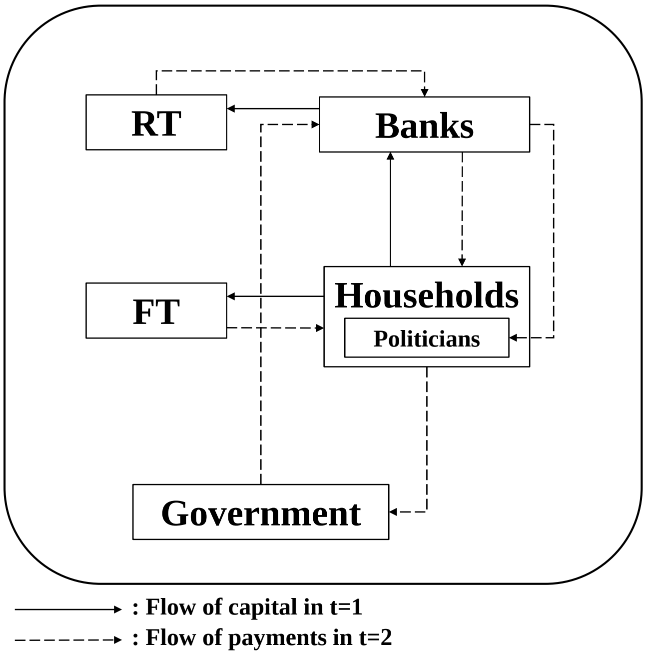

Figure 5.1: Setup of the model on banking regulation and lobbying

5.2.4 Markets

There are three markets: capital market, consumption good market in the good state and consumption good market in the bad state. The excess demand functions of the three markets are determined as follows:

$$z_K = k_F + E + D - K \tag{5.29}$$
$$\overline{z_c} = \overline{C}^{\mathrm{h}} - \left(f(k_F) + k_R \cdot \overline{R}\right) \tag{5.30}$$
$$\underline{z_c} = \underline{C}^{\mathrm{h}} - \left(f(k_F) + k_R \cdot \underline{R}\right). \tag{5.31}$$

A market clears if the respective excess demand function is zero.[16] The setup of the model is graphically presented in Figure 5.1.

5.3 Competitive Equilibrium

In this section, the competitive equilibrium for any given lobbying intensity, λ, and capital regulation, Θ_{reg}, is characterized. Lobbying intensity and capital regulation will be endogenized in the next section where the bargaining between bankers and politicians will be investigated in detail. In equilibrium, the returns, R_D, R_F and $\mathbb{E}[R_E]$, the capital

[16] As explained in Subsection 5.2.1, bond market and loan market clear by construction.

allocations, k_F and k_R, and the bank capital structure, Θ, are such that households maximize their expected utility in their capacity as investors, entrepreneurs maximize their expected profits, bankers maximize the expected returns on equity, and all markets clear, i.e., $z_k = \overline{z_c} = \underline{z_c} = 0$.

For the ease of notation, we define:

$$H \equiv \frac{1-\eta}{\eta} \tag{5.32}$$

$$\mathcal{J}(\Theta) \equiv \frac{1+\Theta}{\sigma+\Theta}. \tag{5.33}$$

We now solve the problems of households in their capacity as investors,[17] entrepreneurs and bankers in order to characterize the equilibrium outcome.

5.3.1 Problem of Households as Investors

Households in their capacity as investors decide on the values of the variables γ and ν in period $t = 1$ with the amounts of $\gamma\nu \cdot K$, $\gamma(1-\nu)\cdot K$ and $(1-\gamma)\cdot K$ being invested in FT, deposits and equity, respectively. Thus, they solve the following problem:

$$\max_{\gamma,\nu} \left\{\sigma \cdot \overline{c}^i + (1-\sigma)\cdot \underline{c}^i\right\}. \tag{5.34}$$

By showing that the objective function is linear with respect to the expected returns on household's investment choices, we obtain

Lemma 5.1

The representative household, in its capacity as investor, invests in the asset with the highest expected returns. If multiple assets are associated with the highest expected returns, the representative household is indifferent among them.

The proof of Lemma 5.1 is given in Appendix D. From Lemma 5.1, and because investments in FT, deposits and equity need to be strictly positive in equilibrium, we obtain

Lemma 5.2

In a competitive equilibrium, the returns satisfy

$$R_D = R_F = \mathbb{E}[R_E] \tag{5.35}$$

[17] The solution of the problem faced by politicians is postponed to Section 5.4, where lobbying intensity and capital regulation are endogenized.

with

$$R_D(\Theta,\lambda) = \begin{cases} R_D^{\text{frg}} = (1-\lambda)\cdot \mathcal{J}(\Theta)\cdot \sigma\overline{R} & \forall\Theta \in \left(0,\bar{\Theta}\right) \\ R_D^{\text{rsl}} = (1-\lambda)\cdot \mathbb{E}[\widetilde{R}] & \forall\Theta \in \left[\bar{\Theta},+\infty\right) \end{cases} \tag{5.36}$$

and

$$\bar{\Theta} = \frac{\sigma\left(\overline{R}-\mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}. \tag{5.37}$$

The proof of Lemma 5.2 is given in Appendix D. We call R_D the *"equilibrium returns"*. R_D^{frg} stands for the equilibrium returns when banks are fragile, whereas R_D^{rsl} stands for the equilibrium returns when banks are resilient. Because $\partial R_D^{\text{frg}}/\partial\Theta < 0$, $\partial R_D^{\text{rsl}}/\partial\Theta = 0$ and $R_D^{\text{frg}}(\bar{\Theta}) = R_D^{\text{rsl}}(\bar{\Theta})$, we obtain

Corollary 5.1
Equilibrium returns are continuous, monotonically decreasing in Θ for all $\Theta < \bar{\Theta}$, and independent of Θ for all $\Theta \geq \bar{\Theta}$.

5.3.2 Problem of Entrepreneurs

FT entrepreneur solves the following problem:

$$\max_{k_F}\left\{\Pi_F = f(k_F) - R_F\cdot k_F\right\}.$$

FOC yields

$$R_F = f'\left(k_F\right). \tag{5.38}$$

Note that because of the Inada conditions, if $k_F = 0$, then R_F becomes infinitely large, whereas $R_F = 0$ for $k_F = K$.
RT entrepreneur solves the following problem:

$$\max_{k_R}\left\{\mathbb{E}[\Pi_R] = k_R\cdot\left[\sigma\cdot\left(\overline{R}-\overline{R}_R\right)+(1-\sigma)\cdot\left(\underline{R}-\underline{R}_R\right)\right]\right\} \tag{5.39}$$

$$\text{s.t. } k_R\cdot\left(\overline{R}-\overline{R}_R\right)\geq 0 \tag{5.40}$$

$$k_R\cdot\left(\underline{R}-\underline{R}_R\right)\geq 0. \tag{5.41}$$

Conditions (5.40) and (5.41) imply that RT entrepreneurs always repay their loans—although those repayments are state-contingent—and thus, $\mathbb{E}[\Pi_R] \geq 0$. We note however, that due to the linearity of $\mathbb{E}[\Pi_R]$ with regard to k_R, if $\mathbb{E}[\Pi_R]$ is strictly positive, then RT entrepreneur would demand an infinite amount of capital. Given that the total amount of initial capital is finite, an infinite demand of RT entrepreneur would result in zero investments in FT, which in turn, due to (5.38) and Inada conditions, would yield infinite returns, which cannot hold in equilibrium. Thus, we conclude that in equilibrium, $\mathbb{E}[\Pi_R] = 0$ and therefore,

$$\overline{R}_R = \overline{R}, \text{ and} \tag{5.42}$$

$$\underline{R}_R = \underline{R}. \tag{5.43}$$

5.3.3 Problem of Bankers

The bankers' problem is solved in two steps. In the first step, they raise an initial amount of equity, E', in order to be granted a license for bank activities.[18] Note that, because of Lemma 5.2, risk-neutral households are indifferent between equity and deposits, and thus, banks can raise equity.

In the second step, bankers, acting under their mandate, aim at maximizing the expected returns on equity, $\mathbb{E}[R_E]$, as given by (5.16). Formally, bankers solve

$$\max_{\lambda,E,D} \{\mathbb{E}[R_E]\} \tag{5.44}$$

$$\text{s.t. } \Theta \geq \Theta_{\text{reg}}. \tag{5.45}$$

In this section, we consider lobbying intensity as given and thus, bankers only decide on their capital structure.[19] We obtain

Lemma 5.3
Suppose that the representative banker is subject to capital requirements Θ_{reg}. Then he demands deposits such that $\Theta = \Theta_{\text{reg}}$.

The proof of Lemma 5.3 is given in Appendix D. Lemma 5.3 points out that bankers aim to leverage their balance sheet as much as possible. That is, capital regulation is binding which in turn, raises bankers' incentives for lobbying.

5.3.4 Equilibrium and Welfare Analysis

Having characterized the optimal solution of all the agents, we obtain

[18] The requirement for a strictly positive amount of equity in order for a bank to be licensed is in line with the EU legislation as described in Subsection 1.1.2.

[19] Bankers decide on their capital structure by deciding on the amount of equity, E, and deposits, D, that they raise. Since in the first step they already raised equity E', in the second step they essentially decide whether E will be less, equal, or greater than E'. The rest of the raised capital is covered by deposits, D.

Proposition 5.1
Let λ and Θ_{reg} be exogenously given. There exists a unique competitive equilibrium where

$$k_R = K - k_F \tag{5.46}$$
$$k_F = f'^{-1}(R_D) \tag{5.47}$$
$$R_D = \begin{cases} (1-\lambda)\cdot\mathcal{J}(\Theta)\cdot\sigma\overline{R} & \forall\Theta\in\left(0,\bar{\Theta}\right); \\ (1-\lambda)\cdot\mathbb{E}[\widetilde{R}] & \forall\Theta\in\left[\bar{\Theta},+\infty\right) \end{cases} \tag{5.48}$$

with $\Theta = \Theta_{\text{reg}}$ and $\bar{\Theta} = \frac{\sigma\left(\overline{R}-\mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}$.

The proof of Proposition 5.1 is given in Appendix D. We now define the optimal allocation and we investigate whether the equilibrium under Proposition 5.1 yields an optimal allocation of resources, or not.

Definition 5.1
The allocation $(\hat{k}_F, K-\hat{k}_F)$ is optimal if it maximizes social welfare.

That is, the social planner solves the following problem:

$$\max_{k_F}\left\{\sigma\cdot\overline{C}^{\text{h}} + (1-\sigma)\cdot\underline{C}^{\text{h}}\right\}, \tag{5.49}$$

where, $\overline{C}^{\text{h}}$ and $\underline{C}^{\text{h}}$, according to market clearing conditions (5.30) and (5.31), read

$$\overline{C}^{\text{h}} = f(k_F) + (K-k_F)\cdot\overline{R} \tag{5.50}$$
$$\underline{C}^{\text{h}} = f(k_F) + (K-k_F)\cdot\underline{R}. \tag{5.51}$$

FOC of (5.49) with respect to k_F yields

$$R_D^{\text{SO}} \equiv R_D = \mathbb{E}[\widetilde{R}], \tag{5.52}$$

where R_D^{SO} stands for the *"socially optimal equilibrium returns"*. Taking (5.48) into account, and because of Corollary 5.1, we obtain

Proposition 5.2
An equilibrium yields the socially optimal allocation of resources if and only if $\lambda = \lambda^{\text{SO}}(\Theta)$, where $\Theta = \Theta_{\text{reg}}$ and

$$\lambda^{\text{SO}}(\Theta) = \begin{cases} \frac{\mathcal{J}(\Theta)\cdot\sigma\overline{R}-\mathbb{E}[\widetilde{R}]}{\mathcal{J}(\Theta)\cdot\sigma\overline{R}} & \text{if } \Theta_{\text{reg}} < \bar{\Theta} \\ 0 & \text{if } \Theta_{\text{reg}} \geq \bar{\Theta}. \end{cases} \tag{5.53}$$

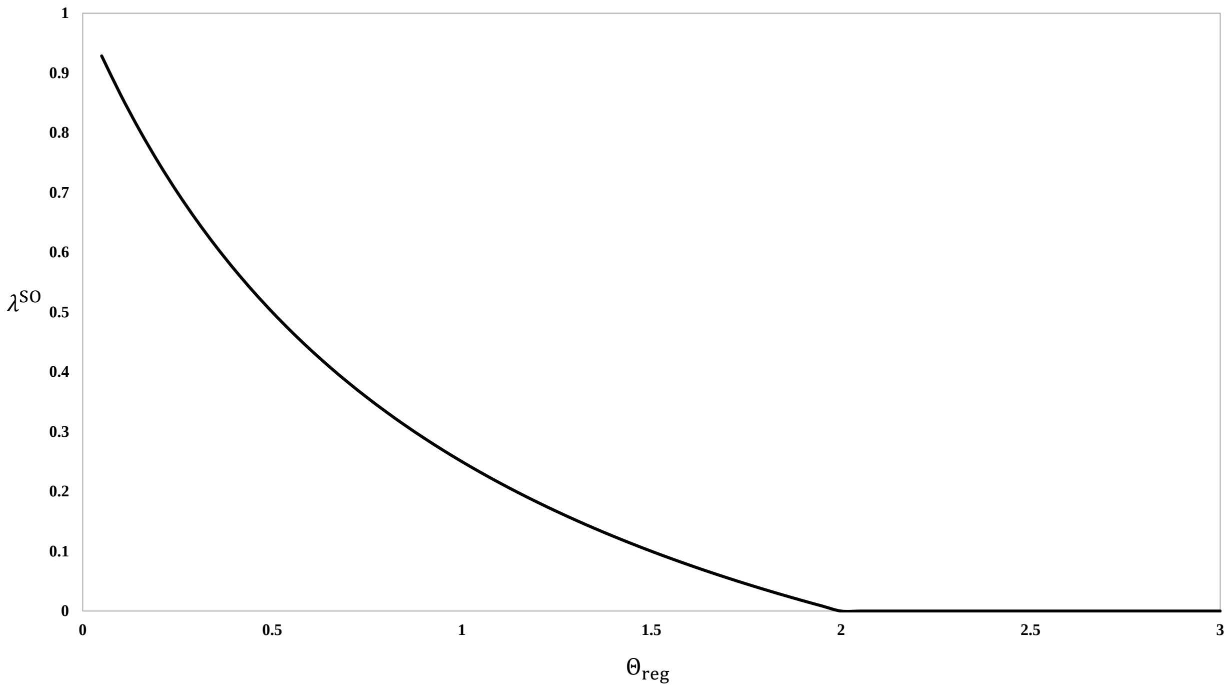

Figure 5.2: Socially optimal lobbying intensity

We call λ^{SO} the *"socially optimal lobbying intensity"*. Figure 5.2 illustrates λ^{SO} for a given parameterization.[20] The intuition runs as follows. The optimal allocation of resources between FT and RT requires $R_D = R_D^{SO}$. If Θ_{reg} is sufficiently high that renders banks resilient, i.e., $\Theta_{reg} \geq \bar{\Theta}$, then the optimal allocation can be achieved if and only if $\lambda = 0$. Any strictly positive λ reduces equilibrium returns and thus, shifts capital to FT above the optimal level.

If $\Theta_{reg} < \bar{\Theta}$, then the socially optimal allocation requires a strictly positive λ, i.e., $\lambda = \lambda^{SO}$, in order for the increase of equilibrium returns due to laxer capital regulation to be canceled out by a decrease of equilibrium returns due to shift of revenues from bankers to politicians. In general, any $\lambda > \lambda^{SO}$ yields $R_D < R_D^{SO}$ and thus, an over-investment in FT, whereas any $\lambda < \lambda^{SO}$ results in $R_D > R_D^{SO}$ and thus, in over-investment in RT. Note that, although there exists a λ yielding the optimal allocation of resources for all $\Theta_{reg} \in (0, \infty)$, the allocation of the consumption good benefits politicians at the expense of the ordinary households for all $\Theta_{reg} < \bar{\Theta}$.

[20] $\vartheta = 0.05$, $\sigma = 2/3$, $\underline{R} = 1/2$, $\overline{R} = 2$, $K = 1$ and $f(k_F) = 2\sqrt{k_F} - k_F$.

5.4 Bargaining on Capital Regulation and Lobbying Intensity

Capital regulation, Θ_{reg}, and lobbying intensity, λ, are now endogenized by considering a bargaining setting where bankers aim at maximizing the expected returns on equity, as given by

$$\mathbb{E}[R_E] = \begin{cases} R_D^{\text{frg}} = (1-\lambda)\cdot\mathcal{J}(\Theta)\cdot\sigma\overline{R} & \forall\Theta\in(0,\bar{\Theta}); \\ R_D^{\text{rsl}} = (1-\lambda)\cdot\mathbb{E}[\widetilde{R}] & \forall\Theta\in[\bar{\Theta},+\infty), \end{cases} \tag{5.54}$$

and politicians aim at maximizing their expected utility which reads as follows:

$$\eta\cdot\Big(f(k_F)+(1-\lambda)\cdot(K-k_F)\cdot\mathbb{E}[\widetilde{R}]\Big)+\lambda\cdot(K-k_F)\cdot\mathbb{E}[\widetilde{R}]. \tag{5.55}$$

Both bankers and politicians face a trade-off in regard to the capital regulation level and the lobbying intensity. On the one hand, bankers can only agree on a λ that is low enough such that gains from laxer capital regulation exceed the cost of lobbying contributions. On the other hand, politicians would only agree on a λ that is high enough to outweigh any losses that might be incurred in the form of bailout expenditures. Note that although politicians benefit from lobbying contributions because $\overline{\Lambda}$ and $\underline{\Lambda}$ are only shared among the fraction η of households, they are still partly aligned with the interests of the ordinary households in their capacity as investors and taxpayers.

The bargaining setting is now specified by considering a *take-it-or-leave-it* bargaining game that takes place in period $t = 1$, once the *a priori* capital regulation and the bank resolution mechanism have been announced. Bargaining itself occurs in two sub-periods. In the first sub-period, bankers offer a contract $(\Theta_{\text{reg}}, \lambda)$ to politicians. In the second sub-period, politicians decide whether they accept bankers' offer, or not.

If politicians reject the proposed contract, we assume that bankers set $\lambda = 0$ and politicians set Θ_{reg} such that the socially optimal allocation arises. According to Proposition 5.2, that implies $\Theta_{\text{reg}} \geq \bar{\Theta}$. For the sake of simplicity, we assume however, that politicians choose to satisfy the socially optimal condition for capital regulation with equality.[21] Taking (5.27) and (5.28) into account, the disagreement outcome is formally defined as follows:

Axiom 5.1

If bargaining between politicians and bankers collapses due to disagreement, then

(i) bankers set $\lambda = 0$,

[21] Equity issuance costs in an environment of regulatory competition, as described in Chapter 2, can indeed induce the government to set $\Theta_{\text{reg}} = \bar{\Theta}$ in the case of indifference in the interval $[\bar{\Theta}, +\infty)$.

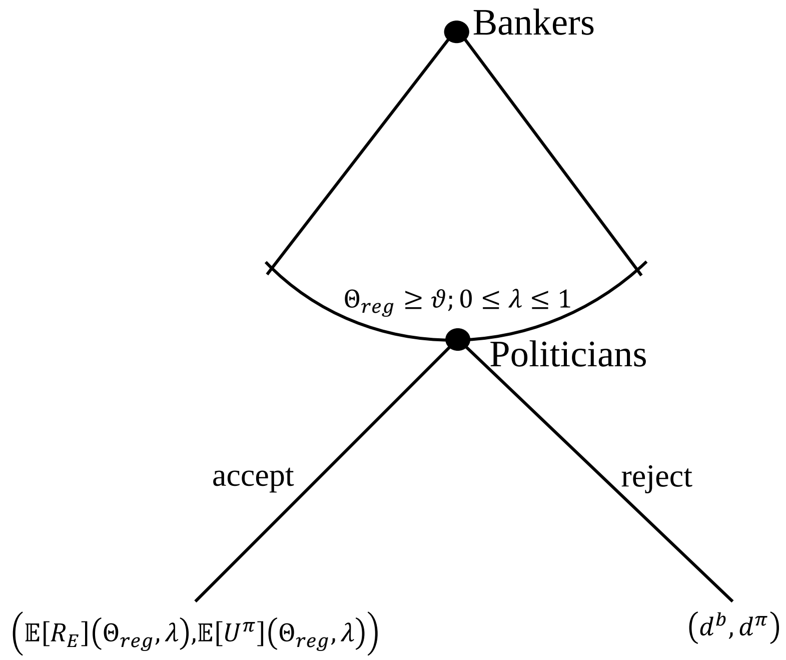

Figure 5.3: Bargaining game between bankers and politicians

(ii) politicians set $\Theta_{\text{reg}} = \bar{\Theta}$ *for all* $\vartheta \leq \bar{\Theta}$*, and they set* $\Theta_{\text{reg}} = \vartheta$ *for all* $\vartheta > \bar{\Theta}$*.*

Substituting for $\lambda = 0$ and $\Theta = \bar{\Theta}$[22] as given by (5.12), into (5.54) and (5.55), we obtain

$$(d^b, d^\pi) = \left(\mathbb{E}[\widetilde{R}], \eta \cdot \left(f(\hat{k}_F) + (K - \hat{k}_F) \cdot \mathbb{E}[\widetilde{R}]\right)\right), \tag{5.56}$$

where d^b and d^π denote the expected returns on equity achieved by bankers and the expected utility of politicians, respectively, in the case of disagreement.
The bargaining game between bankers and politicians is shown in its extensive form in Figure 5.3. Bankers choose the capital regulation level, Θ_{reg}, from a continuum $\Theta_{\text{reg}} \geq \vartheta$ and the lobbying intensity, λ, from a continuum $0 \leq \lambda \leq 1$.
Formally, bankers, who move first, solve the following problem:

$$\max_{(\Theta_{\text{reg}},\lambda)} \{\mathbb{E}[R_E]\} \tag{5.57}$$

$$\text{s.t. } \mathbb{E}[R_E] \geq d^b \tag{5.58}$$

$$\mathbb{E}[U^\pi] \geq d^\pi. \tag{5.59}$$

Bankers would only offer a contract that satisfies constraint (5.58). Further, it becomes clear from Figure 5.3 that politicians can only accept an offer that satisfies constraint

[22] We know from Lemma 5.3 that $\Theta = \Theta_{\text{reg}}$.

(5.59). As derived in the proof of Proposition 5.3 in Appendix D, constraints (5.58) and (5.59) can be simultaneously satisfied for

$$\lambda^E \leq \lambda \leq \lambda^{\text{SO}}, \tag{5.60}$$

where

$$\lambda^E(\Theta) \equiv \frac{\mathcal{J}(\Theta) \cdot \sigma \overline{R} - \mathbb{E}[\widetilde{R}]}{\mathcal{J}(\Theta) \cdot \sigma \overline{R} + H \cdot \mathbb{E}[\widetilde{R}]}, \tag{5.61}$$

with H and $\mathcal{J}(\Theta)$ being given by (5.32) and (5.33), respectively.
Showing that once bankers offer a lobbying intensity λ^E, politicians become indifferent among capital regulation levels, we obtain

Proposition 5.3
Suppose bankers enter into bargaining with politicians by offering a contract $(\Theta_{\text{reg}}, \lambda)$*.*

(i) If $\vartheta \geq \bar{\Theta}$*, then bankers offer* $\lambda = 0$ *and bargaining collapses, yielding the disagreement outcome.*

(ii) If $\vartheta < \bar{\Theta}$*, bankers offer* $\lambda = \lambda^E$ *in exchange of capital regulation such that* $\Theta_{\text{reg}} = \vartheta$*. Politicians accept this offer.*

The proof of Proposition 5.3 is given in Appendix D. We call λ^E the *"equilibrium lobbying intensity"*. Figure 5.4 depicts the equilibrium lobbying intensity, λ^E, as well as the socially optimal lobbying intensity, λ^{SO}, as a function of Θ_{reg}, for a given parameterization.[23] Note that $\lambda^E < \lambda^{\text{SO}}$ for all $\eta < 1$, whereas $\mathbb{E}[R_E] = d^b = \mathbb{E}[\widetilde{R}]$ for $\lambda = \lambda^{\text{SO}}$. That is, even though $\mathbb{E}[R_E]$ is decreasing in λ, bankers still achieve $\mathbb{E}[R_E] > d^b$ by offering λ^E to politicians, provided that the *a priori* regulation level ϑ is sufficiently low. In fact, Claim (i) of Proposition 5.3 reveals that lobbying incentives exist only if banks are fragile. Otherwise, as shown by (5.54), the expected returns on equity are immune to capital regulation.[24]
Taking Proposition 5.2 into consideration, we can assess the equilibrium that arises as the result of bargaining from a social welfare perspective and thus, we obtain

Corollary 5.2
Suppose politicians and bankers enter into bargaining.

(i) If $\vartheta \geq \bar{\Theta}$*, then the socially optimal allocation of resources occurs.*

(ii) If $\vartheta < \bar{\Theta}$*, then the allocation of resources is not socially optimal.*

[23] $\vartheta = 0.05$, $\sigma = 2/3$, $\underline{R} = 1/2$, $\overline{R} = 2$, $K = 1$, $f(k_F) = 2\sqrt{k_F} - k_F$ and $\eta = 0.5$.
[24] That moves in the direction of the evidence presented by Gibson and Padovani (2011), who show that banks with more vulnerable balance sheets are more likely to engage in lobbying.

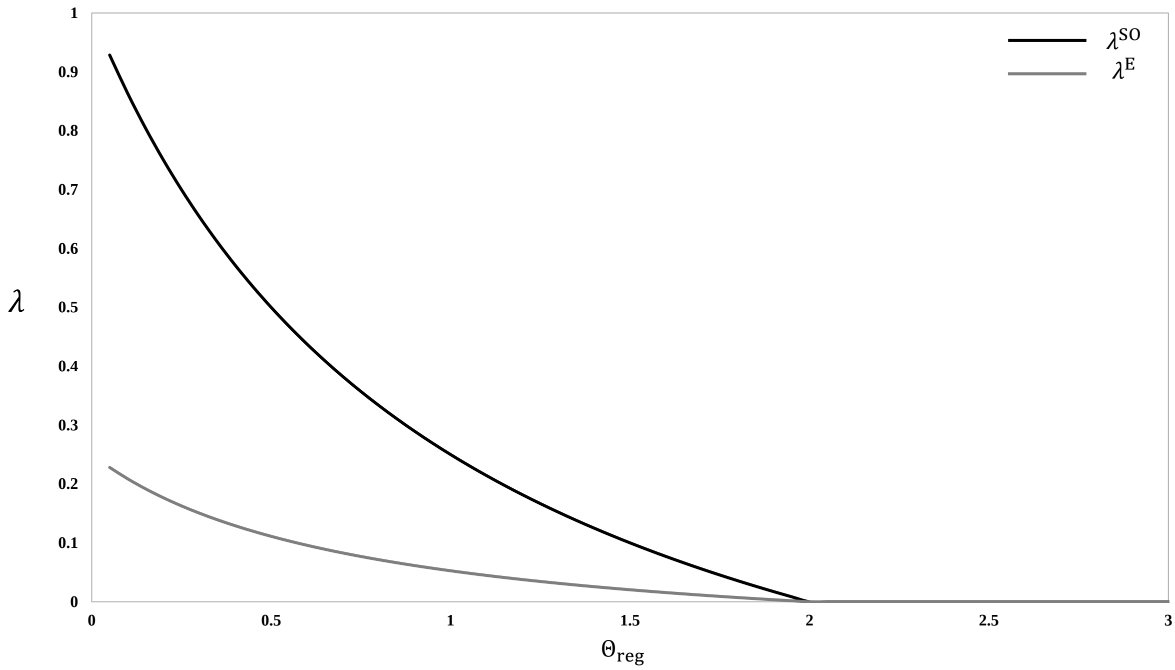

Figure 5.4: Equilibrium and socially optimal lobbying intensities

The allocation of resources is suboptimal because bargaining yields a laxer capital regulation level which, in turn, yields higher equilibrium returns compared to the socially optimal equilibrium returns, i.e., $R_D > R_D^{SO}$. This implies a shift of resources from the free-of-risk technology to the risky technology above the socially optimal level. Under the bargaining outcome with $\vartheta < \bar{\Theta}$, when the bad state of the world occurs, banks default, which imposes bailout costs on households. Because of the lobbying contributions received by politicians, the fraction η of bailout cost, incurred by politicians, is canceled out. That is, politicians' welfare remains intact, whereas ordinary households' welfare—in expected terms—declines.

5.5 Extensions

The base model is extended in two directions. First, the equilibrium when politicians and bankers cannot communicate is examined. Second, a scenario where failed banks are bailed in is investigated and thus, the equilibrium outcome when the bank resolution mechanism is also in the bargaining agenda is studied.

5.5.1 Non-cooperative Solution

In Section 5.4, politicians and bankers were allowed to bargain on the capital regulation level, Θ_{reg}, and on the lobbying intensity, λ. We now assume that although lobbying contributions are still possible, there is no bargaining process. Formally, politicians and bankers play a simultaneous game.
Politicians solve the following problem:

$$\max_{\Theta_{\text{reg}}} \left\{ \eta \cdot \left(f(k_F) + (1-\lambda) \cdot (K - k_F) \cdot \mathbb{E}[\widetilde{R}] \right) + \lambda \cdot (K - k_F) \cdot \mathbb{E}[\widetilde{R}] \right\}. \tag{5.62}$$

From the FOC with respect to Θ, and taking into account that $\Theta = \Theta_{\text{reg}}$, we obtain that the politicians' reaction function reads as follows:

$$\Theta_{\text{reg}} \begin{cases} \geq \bar{\Theta} & \forall \lambda < \lambda^E(\Theta) \\ = \vartheta & \forall \lambda \geq \lambda^E(\Theta). \end{cases} \tag{5.63}$$

Bankers solve the following problem:

$$\max_{\lambda} \left\{ \mathbb{E}[R_E] \right\}, \tag{5.64}$$

where

$$\mathbb{E}[R_E] = \begin{cases} R_D^{\text{frg}} = (1-\lambda) \cdot \mathcal{J}(\Theta) \cdot \sigma \overline{R} & \forall \Theta \in \left(0, \bar{\Theta}\right); \\ R_D^{\text{rsl}} = (1-\lambda) \cdot \mathbb{E}[\widetilde{R}] & \forall \Theta \in \left[\bar{\Theta}, +\infty\right). \end{cases} \tag{5.65}$$

The reaction function of bankers is thus

$$\lambda = 0 \qquad\qquad \forall \Theta_{\text{reg}} \in [\vartheta, +\infty). \tag{5.66}$$

From (5.63) and (5.66), we obtain

Proposition 5.4
Suppose politicians and bankers choose the capital regulation level and the lobbying intensity, respectively, in a simultaneous game. Then politicians set $\Theta_{\text{reg}} \geq \bar{\Theta}$ and bankers set $\lambda = 0$.

That is, if politicians and bankers play a simultaneous game, then bankers are better off by decreasing the lobbying intensity for any given capital regulation, resulting in $\lambda = 0$. If politicians set a capital regulation level that renders banks fragile, any losses incurred in their capacity as taxpayers cannot be offset in the absence of lobbying contributions. Thus, politicians set the capital regulation level such that banks become resilient, which results in the socially optimal outcome.

5.5.2 Lobbying on Capital Regulation and Bank Resolution

Assume now that failed banks are not bailed out. In that case, the returns on deposits are not free of risk anymore and (5.35) becomes

$$R_F = \mathbb{E}[R_D] = \mathbb{E}[R_E]. \tag{5.67}$$

The expected returns on deposits read as follows:

$$\mathbb{E}[R_D] = \begin{cases} \sigma R_D + (1-\lambda)(1+\Theta)(1-\sigma)\underline{R} & \forall \Theta \in (0, \bar{\Theta}); \\ (1-\lambda)\mathbb{E}[\widetilde{R}] & \forall \Theta \in [\bar{\Theta}, +\infty). \end{cases} \tag{5.68}$$

Substituting for (5.68) into (5.67), and taking (5.16)-(5.18) into account, we obtain

$$\mathbb{E}[R_E] = (1-\lambda) \cdot \mathbb{E}[\widetilde{R}] \qquad \forall \Theta \in (0, +\infty). \tag{5.69}$$

That is, if failed banks are bailed in, then $\mathbb{E}[R_E]$ does not depend on capital regulation. Consequently, a positive λ can only reduce $\mathbb{E}[R_E]$ and therefore, we obtain

Lemma 5.4
Suppose failed banks are resolved under bail-in provisions. Then, bargaining yields the disagreement outcome, which is socially optimal.

According to Lemma 5.4, as long as failed banks are bailed in, politicians receive no lobbying contributions and bankers can at most achieve $\mathbb{E}[R_E] = d^b$. Therefore, both have incentives to introduce bank resolution rules into the bargaining agenda—provided that $\vartheta < \bar{\Theta}$. In that case, and denoting the chosen bank resolution mechanism as follows:

$$P = \begin{cases} 0 & \text{if failed banks are bailed out;} \\ 1 & \text{if failed banks are bailed in,} \end{cases} \tag{5.70}$$

we obtain

Proposition 5.5
Suppose bankers enter into bargaining with politicians by offering a contract $(\Theta_{\text{reg}}, P, \lambda)$.

(i) If $\vartheta \geq \bar{\Theta}$, then bankers offer $\lambda = 0$ and bargaining collapses, yielding the disagreement outcome.

(ii) If $\vartheta < \bar{\Theta}$, bankers offer $\lambda = \lambda^E$ in exchange of capital regulation such that $\Theta_{\text{reg}} = \vartheta$ and bank resolution such that $P = 0$. Politicians accept this offer.

5.6 Normative Implications

The preceding analysis in this chapter shows that politicians and bankers can reach an agreement with strictly positive lobbying contributions and a capital regulation level that allows bank failures in the bad state of the world. This agreement implies a shift of resources to the risky sector compared to the socially optimal level, which harms social welfare and undermines financial stability. The analysis points out four normative implications to improve or restore social efficiency. Two of the implications are of political nature, and the other two refer to market-based tools.

5.6.1 Political Implications

The results suggest that broadening political participation can enhance social welfare, whereas breaking the communication channel between politicians and bankers could fully restore social efficiency.

Political Participation

According to Proposition 5.3, there exists a λ^E given by (5.61) that makes politicians indifferent among the capital regulation levels, since any loss incurred in the form of bail-out cost is compensated by gains in the form of lobbying contributions. Equilibrium lobbying intensity λ^E is increasing in η for any given Θ_{reg} and converges to the socially optimal lobbying intensity, λ^{SO}, as η converges to 1.[25] This relationship is illustrated in Figure 5.5. Taking Proposition 5.2 into consideration, the convergence of λ^E to λ^{SO} for large η implies that the larger the fraction of households that are also politicians, the higher the social welfare.[26]

The intuition runs as follows. As (5.55) indicates, a larger η implies that the interests of politicians are more aligned with the interests of ordinary households in their capacity as investors and taxpayers. In fact, although a larger η induces higher lobbying contributions, these contributions are distributed among a larger fraction of households, and thus, not only the allocation of capital approaches the socially optimal level, but the allocation of the consumption good is also more evenly distributed. This could also be used to explain reluctant attitudes to broaden political participation. That is, established politicians aim at keeping η as low as possible in order to keep the mass of politicians that benefits from

[25] $\eta = 1$ results in $H = 0$, which implies $\lambda^E = \lambda^{\text{SO}}$.

[26] It is worth mentioning evidence presented by Behn et al. (2015) who show that high political competition reduces the probability of a bailout. Although they measure political competition in terms of the margin between the first two parties, one could also argue that small margins are associated with broader participation because the stakes are higher.

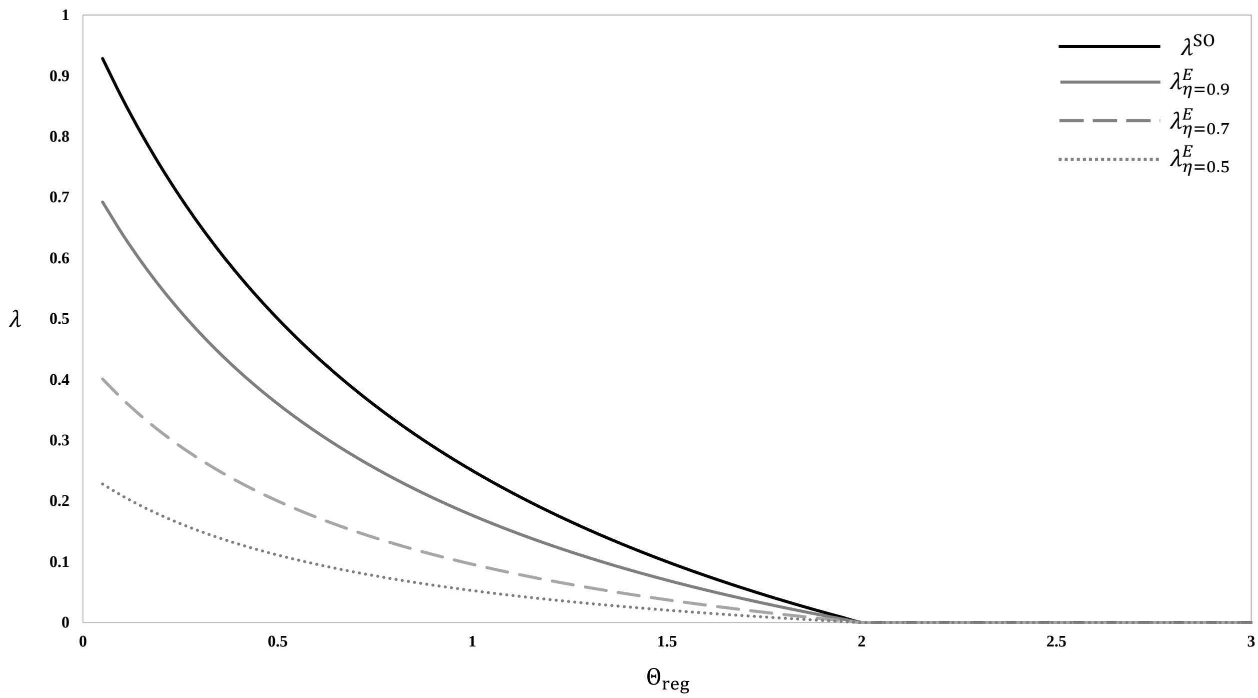

Figure 5.5: Equilibrium lobbying intensities for different factors of political participation

lobbying as small as possible.[27]

Communication Barriers

A comparison between Propositions 5.3 and 5.4 suggests that the equilibrium outcome strongly depends on whether politicians and bankers can bargain, or not. In particular, in the absence of communication between politicians and bankers, lobbying contributions are zero and the socially optimal allocation prevails. However, when politicians and bankers bargain, they set capital regulation at the lowest possible level in exchange for lobbying contributions, which results in resource misallocation in the form of over-investment in the risky sector.

This can be a justification for communication barriers between the financial and the political system. Yet, the cases of generously compensated speeches of prominent US politicians in Wall Street show that such barriers are hardly implemented. In fact, communication channels between politicians and lobbyists have been given an institutional status in some cases. For example, Article 11 TEU not only allows, but even encourages a regular dialogue between EU institutions and representative associations. This chapter's results suggest that such a provision moves into the wrong direction, especially in systems where the political power concentrates in a small fraction of the population.

[27] The interest of initial shareholders for reducing the number of new shareholders in order for the revenues to be distributed among fewer beneficiaries is an interesting analogy.

5.6.2 Market-based Implications

Bail-in and equity funding arise from the analysis as tools that restore social efficiency by eliminating lobbying incentives.

Bail-in as Resolution Mechanism

Lemma 5.4 shows that if failed banks are bailed in, then bankers have no incentive to offer lobbying contributions to politicians. Thus, bargaining collapses and the efficient outcome is restored. This happens because a bail-in mechanism eliminates the impact of politicians' decisions on resource allocation. In fact, equilibrium returns do not depend anymore on capital regulation and thus, politicians' regulatory authority worths nothing for bankers. In other words, politicians have no valuable power to rent.

Note that, as long as bank resolution can be in the bargaining agenda, lobbying incentives exist since bankers can benefit by shifting part of their revenues to politicians in order to choose bailout over bail-in and to reduce the capital regulation to the lowest possible level. Thus, the bail-in mechanism needs to be imposed exogenously on the political system. Two potential solutions are suggested. First, a provision can be introduced in the constitution prohibiting bailouts.[28] Second, the bank resolution authority could be conferred to an institution that does not depend on the political system, for example a supranational authority.[29] However, these suggestions are not free of caveats. In particular, although constitutions are usually more stable than regulations, they can still be subject to changes. Moreover, the second suggestion comes with the risk of shifting lobbying activities from the national to the supranational level.[30]

Capital Regulation

Sufficiently high *a priori* capital regulation can also eliminate lobbying incentives according to Corollary 5.2. This happens again as a result of eliminating the impact of

[28] Such a provision could be in the spirit of the no-bailout clause, as it is outlined in Article 125 TFEU, which prohibits bailouts of states.

[29] The Single Resolution Board which implements the Single Resolution Mechanism within the EU, as reviewed in Chapter 1, can be an example of such an authority.

[30] In that case, besides lobbyists representing private interests, national governments might also be involved in lobbying aiming to achieve favorable decisions for banks operating within their jurisdiction. Furthermore, as indicated by Gadinis (2013) international standard-setting bodies tend to adopt a more political character. For example, the composition of the Financial Stability Board, which is an international body established in the aftermath of the financial crisis of 2007-2008 and is involved in banking regulation, has a more political character due to the participation of elected politicians. On the other hand, one could not overlook the empirical evidence presented by Young (2012) arguing that the influence of lobbyists on another international standard-setting body, namely, the Basel Committee on Banking Supervision, has not been significant.

politicians' decisions on equilibrium returns, because such a strict *a priori* capital regulation, which would render banks resilient, suspends the effect of bailout mechanism on equilibrium returns. Internationally agreed capital requirements, e.g. the requirements agreed within the framework of the Basel Committee on Banking Supervision (BCBS), can play the role of such an *a priori* capital regulation that needs to be implemented by national legislators.[31]

The suggestion of imposing high capital requirements essentially implies a strong government intervention. In that sense, the statement that strict capital regulation could eliminate the role of politicians sounds contradicting. We have to keep in mind however, that the role of politicians exist due to the combination of two government interventions, namely, deposit guarantees and capital regulation. Thus, a government intervention with regard to capital regulation that renders banks resilient, would effectively suspend the first government intervention of deposit guarantee. In other words, a strong government intervention in regard to one tool cancels out the impact of a government intervention in regard to another tool. Inversely, a light intervention with regard to capital regulation would preserve the role of politicians in the system via deposit guarantees.

5.7 Conclusions

In this chapter, a two-period general equilibrium model with three types of agents, namely, households, entrepreneurs and bankers, has been developed. Households are initially endowed with capital and property rights of two different technologies that transform capital into a consumption good in the second period. Bankers run banks acting as financial intermediaries between households and entrepreneurs running a risky technology. A fraction of households are also politicians who run the government which possesses regulatory authorities.

Bankers raise equity and deposits and thus, decide on their banks' capital structure, which must comply with capital regulation that is set by the government which in turn, must comply with an *a priori* capital regulation in the form of exogenously set minimum standards. In the base model, the government also guarantees deposits by bailing out failed banks. Politicians and bankers bargain over more favorable regulation in exchange for lobbying contributions.

In this setting, bankers and politicians can reach an agreement on the capital regulation level and lobbying contributions, providing that politicians are not bound by a too strict *a priori* capital regulation. The agreement implies strictly positive lobbying contributions

[31] Although agreements within the BCBS framework do not have legal force, they are mostly respected as minimum standards by national legislators due to market discipline mechanisms. Otherwise, the participation of their countries in the global financial markets would be at risk.

and a capital regulation level that exposes the economy to a strictly positive likelihood of a banking crisis. This outcome reduces social welfare and undermines financial stability. In an extension of the base model, we show that the adoption of bail-in as a bank resolution mechanism yields a disagreement between bankers and politicians since politicians' decision on capital regulation would not affect returns on equity anymore.

The analysis points out normative implications towards improving social welfare. In particular, market-based tools, namely, bailing in failed banks or equity funding, can eliminate lobbying incentives and restore the socially optimal equilibrium. We also show that a non-cooperative game between bankers and politicians yields the socially optimal outcome, and that broadening the participation in the political system enhances social welfare.

6 Conclusions and Outlook

Besides purely economic considerations in terms of total welfare-maximization, banking regulation is shaped by political forces at both the domestic and international level. These forces exist because government intervention—in the form of banking regulation—affects the allocation of resources among interest groups within a national economy, as well as among states within the globe.

Aiming to contribute to the understanding of domestic and international political economy of banking regulation, formal mathematical models have been developed and analyzed in Chapters 2–5. The general equilibrium approach of these models allows a thorough understanding of the impact of banking regulation on the allocation of resources at the domestic and international level, and thus, the four research questions outlined in Chapter 1 have been addressed. Yet, the study of the political economy of banking regulation is far from being exhausted by this thesis. In this concluding chapter, the answers to the research questions are summarized, and an outlook of further research on the political economy of banking regulation is outlined.

6.1 Conclusions

What mechanisms are at work when competing governments set banking regulation?

A lax approach towards capital regulation indeed allows countries to attract banking activities to their jurisdiction. A trade-off between accentuating benefits over costs stemming from hosting banking activities on the one hand, and enhancing banks' competitiveness on the other hand, is the mechanism that determines the decisions of national governments when setting banking regulation within their jurisdiction. Costs arise from bailout expenditures if banks fail. Benefits take the form of tax revenues, if any, and higher returns on capital. If capital is mobile, as is assumed throughout the thesis because of the increasingly integrated international capital markets, households benefit from higher returns on capital, no matter where they reside. Thus, the governments' decision is eventually determined by the expected bailout costs and the expected tax revenues. Without a policy tool that can counteract potential bailout costs, e.g. in the absence of tax revenues, national governments aim at avoiding these costs by adopting strict capital regulation. If taxation belongs to governments' policy tools, national governments aiming to attract banks in order to benefit from tax revenues set capital regulation at a minimum level—allowing banks to economize on equity issuance costs—and internalize potential bailout expenditures by setting a strictly positive tax rate, either on risky output or on banks' balance-sheet.

What is the impact of regulatory competition in banking regulation on social welfare, in general, and financial stability, in particular?

Regulatory competition yields an inefficient outcome if national governments cannot counteract potential bailout costs. In particular, governments, aiming to avoid the cost of a banking crisis, set strict capital requirements rendering the banking sector more resilient, but also resulting in excessive equity issuance costs. Contrariwise, if governments can raise taxes, regulatory competition yields the efficient outcome because competing governments can economize on equity issuance costs by setting capital regulation at a minimum level, while bailout costs are offset by tax revenues. Regulatory competition prevents excessive taxation, and thus under-investment in risky projects, because that would harm their banks' capability to compete internationally. At the same time, governments avoid taxation below the optimal level, and thus over-investment in risky projects, because that would generate excessive bailout costs. We note that taxation not only generates tax revenues but also affects equilibrium returns on capital and bank risk-taking. We also note that the efficient combination of banking regulation and tax policies involves a positive likelihood of a banking crisis.

What is the mechanism through which special interest groups can affect banking regulation?

The misalignment of interests between ordinary households and politicians allows bankers to exchange lobbying contributions for favorable banking regulation. This misalignment happens because politicians not only obtain income in their capacity as investors, but can also receive lobbying contributions that are not shared by the rest of the households, i.e., by ordinary households.

What is the impact of lobbying on banking regulation on social welfare, in general, and financial stability, in particular?

Lobbying contributions from bankers to politicians result in lax capital regulation, which increases equilibrium returns. That results in over-investment in risky projects and undermines financial stability. Although the excessive shift of resources to risky projects benefits households in their capacity as investors, social welfare is harmed overall due to excessive losses—incurred by households in their capacity as taxpayers—in the form of bailout costs if a negative shock is materialized. Broader political participation would increase the politicians' bargaining power and consequently, raise lobbying contributions. In turn, that would reduce equilibrium returns and therefore, the excessive shift of resources to risky projects would be mitigated. Communication barriers between bankers and politicians, as well as market based-tools such as bail-in of failed banks and equity funding could restore socially optimal allocation.

6.2 Outlook

Three directions for future research on the political economy of banking regulation are presented now. First, the study of the behavior of the electorate with respect to proposed banking regulation is deemed important for further understanding the domestic political economy of banking regulation. Besides bankers and politicians, citizens-voters could also be taken into consideration. In such a model, citizens would be asked to cast their vote choosing among politicians that propose differing banking rules. The trade-off faced by citizens would arise because on the one hand, citizens in their capacity as investors would prefer laxer regulation in order to benefit from higher returns, whereas on the other hand, citizens in their capacity as taxpayers would prefer stricter regulation to avoid the burden of rescuing failed banks.

Second, the integration of lobbying in a model of regulatory competition could offer a broader perspective on the study of the political economy of banking regulation. Importantly, it would allow the comparison between the impact of domestic and international lobbyists on banking regulation, thus contributing to the policy question whether banking regulation should be exercised at national or international level—or supranational level in the case of the EU.

Finally, the integration of regulatory competition with respect to banking regulation into a monetary policy model deserves the attention of future researchers. That is particularly relevant in the case of a currency union with a fragmented—as to whether decisions are made at national or supranational level—banking rulebook (e.g. Eurozone). Such a model could contribute to the debate as to whether the European banking union should be completed with a deposit insurance scheme at the supranational level.

This thesis concludes with a remark from a methodological point of view: A general equilibrium approach contributes to the understanding of the impact of the studied aspects of banking regulation on the allocation of resources. Thus, a general equilibrium approach is worth the effort in order to obtain a broader perspective of the implications of banking regulation on financial stability and social welfare.

A Proofs for Chapter 2

A.1 Proof of Lemma 2.1

The representative household in Country j solves the following problem:

$$\max_{\overline{c}^j, \underline{c}^j} \left\{ \mathbb{E}[U^j] = \sigma \overline{c}^j + (1-\sigma)\underline{c}^j \right\} \tag{A.1}$$

s.t.

$$\Big((1-\lambda^j)\varepsilon^j\gamma^j + \lambda^j\varepsilon^j\gamma^j + \varepsilon^j(1-\gamma^j) + (1-\varepsilon^j)(1-\nu^j) + (1-\varepsilon^j)\nu^j \Big) \cdot K \leq K. \tag{A.2}$$

Because of the linearity of the utility function, the budget constraint (A.2) must be satisfied with equality. Taking into account the returns on the household's investment choices, as given by (2.22)-(2.26), we express the household's consumption in the good state and the bad state of the world as follows:

$$\begin{aligned} \overline{c}^j = & \Big((1-\lambda^j)\varepsilon^j\gamma^j R_F^j + \lambda^j\varepsilon^j\gamma^j R_D^j + (1-\varepsilon^j)(1-\nu^j) R_D^k \Big) \cdot K \\ & + \Big(\varepsilon^j(1-\gamma^j)\overline{R}_E^j + (1-\varepsilon^j)\nu^j \overline{R}_E^k \Big) \cdot K \\ & + \Pi_F^j + \overline{\Pi}_R^j + \overline{\Phi}^j, \end{aligned} \tag{A.3}$$

and

$$\begin{aligned} \underline{c}^j = & \Big((1-\lambda^j)\varepsilon^j\gamma^j R_F^j + \lambda^j\varepsilon^j\gamma^j R_D^j + (1-\varepsilon^j)(1-\nu^j) R_D^k \Big) \cdot K \\ & + \Big(\varepsilon^j(1-\gamma^j)\underline{R}_E^j + (1-\varepsilon^j)\nu^j \underline{R}_E^k \Big) \cdot K \\ & + \Pi_F^j + \underline{\Pi}_R^j + \underline{\Phi}^j - T^j. \end{aligned} \tag{A.4}$$

Substituting for $\overline{c}^j$ and $\underline{c}^j$ into (A.1), and taking (2.19), (2.21)-(2.26) into account, we can re-write the household's problem as follows:

$$\max_{\lambda^j, \varepsilon^j, \gamma^j, \nu^j} \left\{ \mathbb{E}[U^j \left(\lambda^j, \varepsilon^j, \gamma^j, \nu^j \right)] \right\} \tag{A.5}$$

s.t.

$$\Big((1-\lambda^j)\varepsilon^j\gamma^j + \lambda^j\varepsilon^j\gamma^j + \varepsilon^j(1-\gamma^j) + (1-\varepsilon^j)(1-\nu^j) + (1-\varepsilon^j)\nu^j\Big)\cdot K = K, \tag{A.6}$$

where

$$\begin{aligned}\mathbb{E}[U^j] = &\Big((1-\lambda^j)\varepsilon^j\gamma^j R_F^j + \lambda^j\varepsilon^j\gamma^j R_D^j + \varepsilon^j(1-\gamma^j)\mathbb{E}[R_E^j]\Big)\cdot K\\ &+\Big((1-\varepsilon^j)(1-\nu^j)R_D^k + (1-\varepsilon^j)\nu^j\mathbb{E}[R_E^k]\Big)\cdot K\\ &+\Pi_F^j + \mathbb{E}[\Pi_R^j] + \mathbb{E}[\Phi^j] - \mathbb{E}[T^j].\end{aligned} \tag{A.7}$$

Hence, the expected utility of the representative household in Country j depends linearly on the expected returns on its investment choices. Therefore, the representative household maximizes its expected utility by investing in the asset with the highest expected returns. Note that the representative household is price-taker and thus, cannot influence the aggregate variables of Π_F^j, $\mathbb{E}[\Pi_R^j]$, $\mathbb{E}[\Phi^j]$ and $\mathbb{E}[T^j]$. □

A.2 Proof of Lemma 2.2

We prove Lemma 2.2 by proving (2.32), (2.33) and (2.34). For the proof of Lemma 2.2, we use temporarily the following auxiliary assumptions:

Assumption A.1
If $b^j = 1$, then $\overline{R}_R^j = (1-\hat{\tau}^j)\overline{R}$ and $\underline{R}_R^j = (1-\hat{\tau}^j)\underline{R}$.

Assumption A.2
Banks choose to be financed by a strictly positive amount of deposits.

Assumption A.1 becomes redundant after the characterization of the RT optimal decision in equilibrium (see Subsection 2.3.2). Assumption A.2 becomes redundant after the characterization of the bank's optimal decision in equilibrium (see Subsection 2.3.3).

Proof of (2.32)*:*
We know from (2.16) that banks in Country j can operate only if $E^j > 0$. Thus, and taking Lemma 2.1 and (2.22)-(2.26) into account, we obtain

$$\max\Big\{R_F^j, R_D^j, R_D^k, \mathbb{E}[R_E^k]\Big\} \leq \mathbb{E}[R_E^j]. \tag{A.8}$$

Because of the Inada conditions in FT, we obtain that in equilibrium, k_F^j must be strictly greater than zero. Otherwise, due to (2.1), R_F^j will become infinitely large and (A.8) would be violated. Thus, and because of Lemma 2.1 and (2.22)-(2.26), we obtain

$$\max\left\{R_D^j, R_D^k, \mathbb{E}[R_E^j], \mathbb{E}[R_E^k]\right\} \leq R_F^j. \tag{A.9}$$

Finally, because of Assumption A.2 and Lemma 2.1, and taking (2.22)-(2.26) into account, we obtain

$$\max\left\{R_F^j, R_D^k, \mathbb{E}[R_E^j], \mathbb{E}[R_E^k]\right\} \leq R_D^j. \tag{A.10}$$

From (A.8) to (A.10), we conclude that

$$R_F^j = R_F^k = R_D^j = R_D^k = \mathbb{E}[R_E^j] = \mathbb{E}[R_E^k] \tag{A.11}$$

must hold in equilibrium if banks operate in both countries, i.e., if $b^j = b^k = 1$. If the equilibrium returns offered by the banks in the two countries are not equal, then, because of Lemma 2.1, households only invest in the banks of the country with the higher returns. Thus, if $R_D^j > R_D^k$, then banks operate only in Country j, i.e., $b^j = 1$ and $b^k = 0$, and R_D^k and $\mathbb{E}[R_E^k]$ do not exist.

Proof of (2.33)*:*
Taking (2.32) into account, we calculate the equilibrium returns in Country j in the case of a fragile banking sector, $R_D^{j,\text{frg}}$, and in the case of a resilient banking sector, $R_D^{j,\text{rsl}}$, by requiring $R_D^j = \mathbb{E}[R_E^j]$, where $\mathbb{E}[R_E^j]$ is given by substituting for (2.14) and (2.15) into (2.25).

We also use Assumption A.1 by replacing $\overline{R}_R^j$ and $\underline{R}_R^j$ with $(1-\hat{\tau}^j)\overline{R}$ and $(1-\hat{\tau}^j)\underline{R}$, respectively. Finally, we note that $\mathbb{E}[R_E^j]$ depends on X^j, which equals 0 or 1 according to (2.13).

Proof of (2.34)*:*
Taking Assumption A.1 into account, we re-write (2.12) as follows:

$$\bar{\Theta}^j = \frac{R_D^{j,\text{frg}}(\bar{\Theta}^j, \hat{\tau}^j) - (1-\hat{\tau}^j)\underline{R}}{(1-\delta)(1-\hat{\tau}^j)\underline{R}} = \frac{R_D^{j,\text{rsl}}(\bar{\Theta}^j, \hat{\tau}^j) - (1-\hat{\tau}^j)\underline{R}}{(1-\delta)(1-\hat{\tau}^j)\underline{R}}. \tag{A.12}$$

Substituting for $R_D^{j,\text{frg}}$ and $R_D^{j,\text{rsl}}$ according to (2.33), and solving for $\bar{\Theta}^j$, we obtain

$$\bar{\Theta}^j = \bar{\Theta}^k =: \bar{\Theta} = \frac{\sigma\left(\overline{R} - \mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}. \tag{A.13}$$

Proofs of (2.32), (2.33) and (2.34) establish Lemma 2.2. □

A.3 Proof of Lemma 2.5

The bank manager of the representative bank in Country j raised $E^{j\prime}$ in the first step. In the second step, he faces the following problem:

$$\max_{E^j,D^j}\left\{\mathbb{E}[R_E^j]\right\} \tag{A.14}$$

$$\text{s.t. } \Theta^j \geq \hat{\Theta}^j_{\text{reg}}, \tag{A.15}$$

where $\mathbb{E}[R_E^j]$ is given by substituting for (2.14) and (2.15) into (2.25), and $\Theta^j = \frac{E^j}{D^j}$. We also substitute for $\overline{R}_R^j$ and $\underline{R}_R^j$ according to (2.41) and (2.42), respectively. Note that, because of perfect competition, banks are price takers and therefore, cannot affect R_D^j.

We prove Lemma 2.5 in three steps.

Step 1: *Fragile Bank*
If the bank is fragile, i.e., $X^j = 1$, its manager faces the following problem:

$$\max_{E^j,D^j}\left\{\mathbb{E}[R_E^j]_{X^j=1} = \sigma \cdot \frac{(1-\hat{\tau}^j)\,(D^j + (1-\delta)E^j)\,\overline{R} - D^j R_D^{j,\text{frg}}}{E^j}\right\} \tag{A.16}$$

$$\text{s.t. } \Theta^j = \frac{E^j}{D^j} \geq \hat{\Theta}^j_{\text{reg}}. \tag{A.17}$$

FOC read as follows:

$$\frac{\partial \mathbb{E}[R_E^j]_{X^j=1}}{\partial E^j} = -\frac{\sigma D^j\left((1-\hat{\tau}^j)\overline{R} - R_D^{j,\text{frg}}\right)}{{E^j}^2} \tag{A.18}$$

$$\frac{\partial \mathbb{E}[R_E^j]_{X^j=1}}{\partial D^j} = \frac{\sigma\left((1-\hat{\tau}^j)\overline{R} - R_D^{j,\text{frg}}\right)}{E^j}. \tag{A.19}$$

We now show that $R_D^{j,\text{frg}} < (1-\hat{\tau}^j)\overline{R}$ for all $\Theta^j \in (0,\bar{\Theta})$. Substituting for $\Theta^j = 0$ into (2.33), we obtain $R_D^{j,\text{frg}}(\hat{\tau}^j;\Theta^j = 0) = (1-\hat{\tau}^j)\overline{R}$. Thus, and taking Corollary 2.1 into account, as well as that, because of (2.16), $\Theta^j > 0$, we conclude that $R_D^{j,\text{frg}} < (1-\hat{\tau}^j)\overline{R}$ for all $\Theta^j \in (0,\bar{\Theta})$. Hence, $\partial\mathbb{E}[R_E^j]_{X^j=1}/\partial E^j < 0$ and $\partial\mathbb{E}[R_E^j]_{X^j=1}/\partial D^j > 0$.

Step 2: *Resilient Bank*
If the bank is resilient, i.e., $X^j = 0$, its manager faces the following problem:

$$\max_{E^j,D^j}\left\{\mathbb{E}[R_E^j]_{X^j=0} = \frac{(1-\hat{\tau}^j)\,(D^j + (1-\delta)E^j)\,\mathbb{E}[\widetilde{R}] - D^j R_D^{j,\text{rsl}}}{E^j}\right\} \tag{A.20}$$

$$\text{s.t. } \Theta^j = \frac{E^j}{D^j} \geq \hat{\Theta}^j_{\text{reg}} \tag{A.21}$$

FOC read as follows:

$$\frac{\partial \mathbb{E}[R_E^j]_{X^j=0}}{\partial E^j} = -\frac{D^j \left((1-\hat{\tau}^j)\mathbb{E}[\widetilde{R}] - R_D^{j,\text{rsl}}\right)}{{E^j}^2} \tag{A.22}$$

$$\frac{\partial \mathbb{E}[R_E^j]_{X^j=0}}{\partial D^j} = \frac{(1-\hat{\tau}^j)\mathbb{E}[\widetilde{R}] - R_D^{j,\text{rsl}}}{E^j}. \tag{A.23}$$

We now show that $R_D^{j,\text{rsl}} < (1-\hat{\tau}^j)\mathbb{E}[\widetilde{R}]$ for all $\Theta^j \geq \bar{\Theta}$. Substituting for $\bar{\Theta}$ into (2.33), we obtain $R_D^{j,\text{rsl}}(\hat{\tau}^j; \Theta^j = \bar{\Theta}) = (1-\hat{\tau}^j)\left(\mathbb{E}[\widetilde{R}] - \delta\sigma(\overline{R} - \underline{R})\right) < (1-\hat{\tau}^j)\mathbb{E}[\widetilde{R}]$. Thus, and taking Corollary 2.1 into account, we obtain $R_D^{j,\text{rsl}} < (1-\tau^j)\mathbb{E}[\widetilde{R}]$ for all $\Theta^j \geq \bar{\Theta}$. Hence, $\partial \mathbb{E}[R_E^j]_{X^j=0}/\partial E^j < 0$ and $\partial \mathbb{E}[R_E^j]_{X^j=0}/\partial D^j > 0$.

Step 3:

From Steps 1 and 2, we obtain $\partial \mathbb{E}[R_E^j]/\partial E^j < 0$ and $\partial \mathbb{E}[R_E^j]/\partial D^j > 0$. That is, bank manager, aiming to maximize the expected returns on equity, raises no further equity, and raises deposits as long as constraint (A.17) is not satisfied with strict equality. □

A.4 Proof of Lemma 2.6

Proof of Claim (i)*:*

Assume first that $(\dot{\Theta}_{\text{reg}}^j, \dot{\tau}^j) = (\dot{\Theta}_{\text{reg}}^k, \dot{\tau}^k) = (\dot{\Theta}, \dot{\tau})$ with $\dot{\Theta} < \bar{\Theta}$ and $\dot{\tau} < \bar{\tau}(\dot{\Theta})$. Then the equilibrium returns are equal to $\dot{R}_D = \dot{R}_D^{j,\text{frg}}(\dot{\Theta}, \dot{\tau}) = \dot{R}_D^{k,\text{frg}}(\dot{\Theta}, \dot{\tau})$. Therefore, $\dot{k}_F = f'^{-1}(\dot{R}_D)$, $\dot{b}^j = \dot{b}^k = 1$, $\dot{\beta}^j = \dot{\beta}^k = 1$, and thus, $\mathbb{E}[\dot{\Phi}^j] - \mathbb{E}[\dot{T}^j] = \mathbb{E}[\dot{\Phi}^k] - \mathbb{E}[\dot{T}^k] < 0$ because $\dot{\tau} < \bar{\tau}(\dot{\Theta})$ with $\dot{\Theta} < \bar{\Theta}$. The expected utilities of households read as follows:

$$\mathbb{E}[\dot{U}^j] = \dot{R}_D(K - \dot{k}_F) + f(\dot{k}_F) + \mathbb{E}[\dot{\Phi}^j] - \mathbb{E}[\dot{T}^j] \tag{A.24}$$

$$\mathbb{E}[\dot{U}^k] = \dot{R}_D(K - \dot{k}_F) + f(\dot{k}_F) + \mathbb{E}[\dot{\Phi}^k] - \mathbb{E}[\dot{T}^k]. \tag{A.25}$$

Assume now that Country k keeps its initial choice, i.e., $(\ddot{\Theta}_{\text{reg}}^k, \ddot{\tau}^k) = (\dot{\Theta}, \dot{\tau})$, whereas Country j sets $(\ddot{\Theta}_{\text{reg}}^j, \ddot{\tau}^j) = (\ddot{\Theta}, \ddot{\tau})$ where $\ddot{\Theta} = \dot{\Theta}^+$ and $\ddot{\tau} = \dot{\tau}^+$ with $\dot{\Theta}^+$ and $\dot{\tau}^+$ denoting capital requirements and tax rate marginally higher than $\dot{\Theta}$ and $\dot{\tau}$, respectively. In that case, and taking Lemma 2.2 and Corollary 2.1 into account, we know that $\ddot{R}_D^{j,\text{frg}}(\ddot{\Theta}, \ddot{\tau}) < \ddot{R}_D^{k,\text{frg}}(\dot{\Theta}, \dot{\tau}) = \ddot{R}_D = \dot{R}_D$. Therefore, $\ddot{k}_F = f'^{-1}(\ddot{R}_D) = \dot{k}_F = f'^{-1}(\dot{R}_D)$, $\ddot{b}^j = 0$, $\ddot{b}^k = 1$, $\ddot{\beta}^j = 0$, $\ddot{\beta}^k = 2$, and thus, $\mathbb{E}[\ddot{\Phi}^j] - \mathbb{E}[\ddot{T}^j] = 0$ and $\mathbb{E}[\ddot{\Phi}^k] - \mathbb{E}[\ddot{T}^k] < 0$ because $\dot{\tau} < \bar{\tau}(\dot{\Theta})$ with $\dot{\Theta} < \bar{\Theta}$. The expected utilities of households read as follows:

$$\mathbb{E}[\ddot{U}^j] = \dot{R}_D(K - \dot{k}_F) + f(\dot{k}_F) + \mathbb{E}[\ddot{\Phi}^j] - \mathbb{E}[\ddot{T}^j] \tag{A.26}$$

$$\mathbb{E}[\ddot{U}^k] = \dot{R}_D(K - \dot{k}_F) + f(\dot{k}_F) + \mathbb{E}[\ddot{\Phi}^k] - \mathbb{E}[\ddot{T}^k]. \tag{A.27}$$

Because $\mathbb{E}[\ddot{\Phi}^j] - \mathbb{E}[\ddot{T}^j] = 0 > \mathbb{E}[\dot{\Phi}^j] - \mathbb{E}[\dot{T}^j]$, we obtain $\mathbb{E}[\ddot{U}^j] > \mathbb{E}[\dot{U}^j]$.

Proof of Claim (ii)*:*
Assume first that $(\dot{\Theta}^j_{\text{reg}}, \dot{\tau}^j) = (\dot{\Theta}^k_{\text{reg}}, \dot{\tau}^k) = (\dot{\Theta}, \dot{\tau})$ with $\dot{\Theta} < \bar{\Theta}$ and $\dot{\tau} > \bar{\tau}(\dot{\Theta})$. Then the equilibrium returns are equal to $\dot{R}_D = \dot{R}^{j,\text{frg}}_D(\dot{\Theta}, \dot{\tau}) = \dot{R}^{k,\text{frg}}_D(\dot{\Theta}, \dot{\tau})$. Therefore, $\dot{k}_F = f'^{-1}(\dot{R}_D)$, $\dot{b}^j = \dot{b}^k = 1$, $\dot{\beta}^j = \dot{\beta}^k = 1$, and thus, $\mathbb{E}[\dot{\Phi}^j] - \mathbb{E}[\dot{T}^j] = \mathbb{E}[\dot{\Phi}^k] - \mathbb{E}[\dot{T}^k] > 0$ because $\dot{\tau} > \bar{\tau}(\dot{\Theta})$. The expected utilities of households read as follows:

$$\mathbb{E}[\dot{U}^j] = \dot{R}_D(K - \dot{k}_F) + f(\dot{k}_F) + \mathbb{E}[\dot{\Phi}^j] - \mathbb{E}[\dot{T}^j] \tag{A.28}$$

$$\mathbb{E}[\dot{U}^k] = \dot{R}_D(K - \dot{k}_F) + f(\dot{k}_F) + \mathbb{E}[\dot{\Phi}^k] - \mathbb{E}[\dot{T}^k]. \tag{A.29}$$

Assume now that Country k keeps its initial choice, i.e., $(\ddot{\Theta}^k_{\text{reg}}, \ddot{\tau}^k) = (\dot{\Theta}, \dot{\tau})$, whereas Country j sets $(\ddot{\Theta}^j_{\text{reg}}, \ddot{\tau}^j) = (\ddot{\Theta}, \ddot{\tau})$ where $\ddot{\Theta} = \dot{\Theta}^-$ and $\ddot{\tau} = \dot{\tau}^-$ with $\dot{\Theta}^-$ and $\dot{\tau}^-$ denoting capital requirements and tax rate marginally lower than $\dot{\Theta}$ and $\dot{\tau}$, respectively. In that case, and taking Lemma 2.2 and Corollary 2.1 into account, we know that $\ddot{R}_D = \ddot{R}^{j,\text{frg}}_D(\ddot{\Theta}, \ddot{\tau}) > \dot{R}^{k,\text{frg}}_D(\dot{\Theta}, \dot{\tau})$. Therefore, $\ddot{k}_F = f'^{-1}(\ddot{R}_D)$, $\ddot{b}^j = 1$, $\ddot{b}^k = 0$, $\ddot{\beta}^j = 2$, $\ddot{\beta}^k = 0$, and thus, $\mathbb{E}[\ddot{\Phi}^j] - \mathbb{E}[\ddot{T}^j] = \left(\beta^j(K - \ddot{k}_F) - b^j\delta\ddot{E}^j\right) \cdot \ddot{\phi}^j$ and $\mathbb{E}[\ddot{\Phi}^k] - \mathbb{E}[\ddot{T}^k] = 0$ with $\mathbb{E}[\ddot{\Phi}^j] - \mathbb{E}[\ddot{T}^j] > \mathbb{E}[\dot{\Phi}^j] - \mathbb{E}[\dot{T}^j]$ because now $\ddot{\beta}^j = 2$, that is, the capital from both countries, net of FT allocations and equity issuance cost, is invested in Country j. Note that, in contrast with the drastic increase of β^j from 1 to 2, the continuous functions of the net expected tax revenues, the equilibrium returns and FT allocation, as well as the function ϕ^j, as given by (2.62), only marginally change because of the marginal reduction of capital requirements and tax policy—from $\dot{\Theta}$ and $\dot{\tau}$ to $\dot{\Theta}^-$ and $\dot{\tau}^-$, respectively. Further, the expected utilities of households read as follows:

$$\mathbb{E}[\ddot{U}^j] = \ddot{R}_D(K - \ddot{k}_F) + f(\ddot{k}_F) + \mathbb{E}[\ddot{\Phi}^j] - \mathbb{E}[\ddot{T}^j] \tag{A.30}$$

$$\mathbb{E}[\ddot{U}^k] = \ddot{R}_D(K - \ddot{k}_F) + f(\ddot{k}_F). \tag{A.31}$$

Because $\mathbb{E}[\ddot{\Phi}^j] - \mathbb{E}[\ddot{T}^j] > \mathbb{E}[\dot{\Phi}^j] - \mathbb{E}[\dot{T}^j]$, we obtain $\mathbb{E}[\ddot{U}^j] > \mathbb{E}[\dot{U}^j]$.
The same reasoning applies within the subspace characterized by $\Theta^j_{\text{reg}} \geq \bar{\Theta}$ and $0 \leq \tau^j \leq 1$, where banks are resilient and thus, $\mathbb{E}[T^j] = 0$. □

A.5 Proof of Lemma 2.7

Step 1:
Because $\mathbb{E}[T^j] = 0 \; \forall \Theta^j \geq \bar{\Theta}$, Corollary 2.1 suffices to prove that $R_D(\vartheta, 0)$ is the maximum equilibrium returns that satisfy $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \geq 0$ if $\vartheta \geq \bar{\Theta}$.
Step 2:
Corollary 2.1 also suffices to show that the maximum equilibrium returns that satisfy $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \geq 0$ require $\tau^j = \bar{\tau}(\Theta^j)$ for all $\Theta^j < \bar{\Theta}$.

Step 3:
It remains to show that the maximum equilibrium returns that satisfy $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \geq 0$ require $\Theta^j = \vartheta$ for all $\Theta^j \in \left(0, \bar{\Theta}\right]$. We first substitute for $\bar{\tau}$, as given by (2.67), into (2.33) and we obtain

$$R_D^{j,\text{frg}}(\Theta^j, \bar{\tau}(\Theta^j)) = \frac{1 + (1-\delta)\Theta^j}{1 + \Theta^j} \cdot \mathbb{E}[\widetilde{R}] \qquad \forall \Theta^j \in \left(0, \bar{\Theta}\right). \tag{A.32}$$

We also observe that $R_D^{j,\text{rsl}}(\Theta^j, \tau^j = 0) = \dfrac{1 + (1-\delta)\bar{\Theta}}{1 + \bar{\Theta}} \cdot \mathbb{E}[\widetilde{R}]$ and we define

$$R_{D,\mathbb{E}[\Phi^j]-\mathbb{E}[T^j]=0} = \frac{1 + (1-\delta)\Theta^j}{1 + \Theta^j} \cdot \mathbb{E}[\widetilde{R}] \qquad \forall \Theta^j \in \left(0, \bar{\Theta}\right]. \tag{A.33}$$

By showing that

$$\frac{\partial R_{D,\mathbb{E}[\Phi^j]-\mathbb{E}[T^j]=0}}{\partial \Theta^j} = -\frac{\delta}{(1 + \Theta^j)^2} \cdot \mathbb{E}[\widetilde{R}] < 0, \tag{A.34}$$

and because of Steps 1 and 2, we prove that $R_D(\vartheta, \bar{\tau}(\vartheta))$ is the maximum equilibrium returns that satisfy $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] \geq 0$ if $\vartheta < \bar{\Theta}$. □

A.6 Proof of Lemma 2.8

We consider the following three points on the policy space as described by Definition 2.5:

- Point i: (Θ_i, τ_i)
- Point ii: (Θ_{ii}, τ_{ii})
- Point iii: $(\Theta_{iii}, \tau_{iii})$

with

$$\bar{\Theta} \leq \vartheta = \Theta_i < \Theta_{ii} = \Theta_{iii} \tag{A.35}$$

and

$$0 = \tau_i = \tau_{ii} < \tau_{iii}. \tag{A.36}$$

Step 1:
We show that there is no deviation from *Point* i that can increase the expected utility of Country k's household, given that Country j sets $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta_i, \tau_i)$. That is, we show

$$\mathbb{E}[U_i^k] = \mathbb{E}[U_i^j] \geq \mathbb{E}[U_l^k] \qquad \text{with } l = \{ii, iii\}. \tag{A.37}$$

We note that when Country j and Country k set $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta^k_{\text{reg}}, \tau^k) = (\Theta_i, \tau_i)$, we obtain

$$R_D = R^j_{D,i} = R^k_{D,i} = \frac{1 + (1-\delta)\vartheta}{1+\vartheta} \cdot \mathbb{E}[\widetilde{R}] \tag{A.38}$$

and

$$\mathbb{E}[U^j_i] = \mathbb{E}[U^k_i] = R_D \cdot (K - k_{F,i}) + f(k_{F,i}) \tag{A.39}$$

with $k_{F,i} = f'^{-1}(R_D)$.

Deviation of Country k from Point i to Point ii:

The deviation from *Point* i to *Point* ii by Country k means that stricter capital requirements are imposed by County k. From Lemma 2.7, we know that

$$R^j_{D,i} > R^k_{D,ii}. \tag{A.40}$$

Taking Lemma 2.2 into account, we conclude that this deviation means Country k hosts no banking sector, i.e., $b^k = 0$. Thus,

$$R_D = R^j_{D,i} \tag{A.41}$$

$$\mathbb{E}[U^k_{ii}] = R^j_{D,i} \cdot (K - k_{F,i}) + f(k_{F,i}) = \mathbb{E}[U^j_i] = \mathbb{E}[U^k_i]. \tag{A.42}$$

Hence, the deviation is not profitable.

Deviation of Country k from Point i to Point iii:

The deviation from *Point* i to *Point* iii covers the case of seeking positive expected tax revenues. From Lemma 2.7, we know that

$$R^j_{D,i} > R^k_{D,iii}. \tag{A.43}$$

Together with Lemma 2.2, we conclude Country k hosts no banking sector when it deviates, i.e., $b^k = 0$. Thus,

$$R_D = R^j_{D,i} \tag{A.44}$$

$$\mathbb{E}[U^k_{iii}] = R^j_{D,i} \cdot (W - k_{F,i}) + f(k_{F,i}) = \mathbb{E}[U^j_i] = \mathbb{E}[U^k_i]. \tag{A.45}$$

The two properties (A.42) and (A.45) establish (A.37). To sum up, $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta^k_{\text{reg}}, \tau^k) = (\vartheta, 0)$ is an equilibrium.

Step 2:

Since we consider the case with $\vartheta \geq \bar{\Theta}$, and because of (2.16), we know from Claim (ii) of Lemma 2.6 that there is no equilibrium with $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta^k_{\text{reg}}, \tau^k)$ where $\Theta^j_{\text{reg}} \geq \bar{\Theta}$

and $\tau^j > 0$.

We also exclude from equilibrium the case with $\Theta^j_{\text{reg}} \geq \Theta^k_{\text{reg}}$ and $\tau^j \geq \tau^k$ with at least one strict inequality. The reasoning runs as follows. Assume first that $\dot{\Theta}^j_{\text{reg}} \geq \dot{\Theta}^k_{\text{reg}}$ and $\dot{\tau}^j \geq \dot{\tau}^k$ with at least one equality. Then $b^j = 0$ and $b^k = 1$, yielding $\mathbb{E}[\dot{U}^j] < \mathbb{E}[\dot{U}^k]$. Assume then that Country k keeps its initial choice, i.e., $\ddot{\Theta}^k_{\text{reg}} = \dot{\Theta}^k_{\text{reg}}$ and $\ddot{\tau}^k = \dot{\tau}^k$, whereas Country j sets $\ddot{\Theta}^j_{\text{reg}} = \dot{\Theta}^{k-}_{\text{reg}}$ and $\ddot{\tau}^j = \dot{\tau}^{k-}$ with $\dot{\Theta}^{k-}_{\text{reg}}$ and $\dot{\tau}^{k-}$ denoting capital requirements and tax rate marginally lower than $\dot{\Theta}^k_{\text{reg}}$ and $\dot{\tau}^k$, respectively. In that case, equilibrium returns only marginally decline, whereas Country j attracts all the banking activities and the consequent tax revenues because now $\ddot{b}^j = 1$ and $\ddot{b}^k = 0$. Thus, $\mathbb{E}[\ddot{U}^j] > \mathbb{E}[\ddot{U}^k]$, showing that there is always an incentive for Country j to deviate if $\Theta^j_{\text{reg}} \geq \Theta^k_{\text{reg}}$ and $\tau^j \geq \tau^k$ with at least one strict inequality.

That is, Step 2 shows that there is no equilibrium with $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] > 0$ and since $\mathbb{E}[T^j] = 0$ for all $\Theta^j \geq \bar{\Theta}$, we obtain that there is no equilibrium with $\mathbb{E}[\Phi^j] > 0$ for all $\Theta^j \geq \bar{\Theta}$.

Step 3:

We finally show that there is no equilibrium with $\Theta^j_{\text{reg}} > \vartheta$, and $\mathbb{E}[\Phi^j] = 0$. We assume first that $(\dot{\Theta}^j_{\text{reg}}, \dot{\tau}^j) = (\dot{\Theta}^k_{\text{reg}}, \dot{\tau}^k) = (\vartheta, 0)$. That means $\dot{R}_D = \dot{R}^j_D = \dot{R}^k_D$ and therefore, banks operate in both countries. Suppose now that Country j keeps its initial choice, i.e. $(\ddot{\Theta}^j_{\text{reg}}, \ddot{\tau}^j) = (\vartheta, 0)$, whereas Country k sets $(\ddot{\Theta}^k_{\text{reg}}, \ddot{\tau}^k) = (\ddot{\Theta}, \ddot{\tau})$ with $\ddot{\Theta} > \vartheta$ and $\ddot{\tau} = 0$. Because of Lemma 2.7, we know that $\ddot{R}_D = \ddot{R}^j_D > \ddot{R}^k_D$, and therefore, Country j attracts all banking activities. With $b^j = 1$ and $b^k = 0$, $\partial \mathbb{E}[U^j]/\partial \tau^j = k^j_R \cdot \Big((D^{jk} + E^{jk})/(D^j + E^j)\Big) \cdot \mathbb{E}[\widetilde{R}] > 0$ at $\tau^j = 0$. Hence, we can conclude that Country j can increase its expected utility—by achieving strictly positive net expected tax revenues through an, at least marginal, increase of the tax rate—while it still preserves $R^j_D > R^k_D$. That contradicts the conclusion of Step 2. Following the same reasoning, we finally exclude from equilibrium the case with $\tau^j = \tau^k = 0$ and $\vartheta < \Theta^j_{\text{reg}} < \Theta^k_{\text{reg}}$ because in that case Country k can be better off by setting capital requirements smaller than Θ^j_{reg} and at least marginally positive tax rate.

Steps 1-3 establish that $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta^k_{\text{reg}}, \tau^k) = (\vartheta, 0)$ is the unique equilibrium if $\vartheta \geq \bar{\Theta}$. □

A.7 Proof of Lemma 2.9

Step 1:

We show that a supranational government maximizing social welfare across countries sets $\tau^s = 0$ for all $\Theta^s_{\text{reg}} \in [\bar{\Theta}, +\infty)$.

FOC of (2.78) with respect to τ^s for all $\Theta \in [\bar{\Theta}, +\infty)$ yield

$$\tau^s = \frac{1}{\partial k_R^s / \partial \tau^s} \cdot \left(2(K - k_F) \frac{1 + (1-\delta)\Theta}{1 + \Theta} - k_R^s \right) \tag{A.46}$$

with $\Theta = \Theta^s_{\text{reg}}$.

By noting that $\Theta = \dfrac{E^s}{D^s}$, $1 + \Theta = \dfrac{E^s + D^s}{D^s} = \dfrac{2(K - k_F)}{D^s}$ and $1 + (1-\delta)\Theta = \dfrac{D^s + (1-\delta)E^s}{D^s} = \dfrac{k_R^s}{D^s}$, we calculate the term in parenthesis in (A.46) as follows:

$$2(K - k_F) \frac{1 + (1-\delta)\Theta}{1 + \Theta} - k_R^s = 0 \tag{A.47}$$

and therefore, $\tau^s = 0$.

Step 2:

FOC of (2.78) with respect to τ^s for all $\Theta \in [\vartheta, \bar{\Theta})$ yield

$$\begin{aligned} \tau^s = & \frac{1-\sigma}{1+\Theta} \left(1 - \frac{\underline{R}(\sigma + \Theta)}{\sigma \overline{R}} \right) \\ & + \frac{1}{\partial k_R^s / \partial \tau^s} \cdot \left(2(K - k_F) \frac{1 + (1-\delta)\Theta}{1 + \Theta} - k_R^s \right). \end{aligned} \tag{A.48}$$

We know from Step 1 that the second term of (A.48) equals zero.

Step 3:

From Steps 1 and 2, we conclude that a supranational government maximizing social welfare across countries sets

$$\tau^s = \begin{cases} \dfrac{1-\sigma}{1+\Theta} \left(1 - \dfrac{\underline{R}(\sigma + \Theta)}{\sigma \overline{R}} \right) & \forall \Theta \in [\vartheta, \bar{\Theta}) \\ 0 & \forall \Theta \in [\bar{\Theta}, +\infty) \end{cases} \tag{A.49}$$

with $\Theta = \Theta^s_{\text{reg}}$. □

A.8 Proof of Proposition 2.1

Households

Because of Lemmata 2.1 and 2.2, and Assumption 2.1, in equilibrium households in Country j are indifferent among domestic assets, whereas they do not invest in banks of Country k if $R_D^k \leq R_D^j$.

Returns

We know from Lemmata 2.2 and 2.5 that

$$R_D = \begin{cases} R_F^j = R_F^k = R_D^j = R_D^k = \mathbb{E}[R_E^j] = \mathbb{E}[R_E^k] & \text{if } b^j = b^k = 1 \\ R_F^j = R_F^k = R_D^j = \mathbb{E}[R_E^j] & \text{if } b^j = 1 \text{ and } b^k = 0, \end{cases} \tag{A.50}$$

with

$$R_D^j(\Theta^j, \tau^j) = \begin{cases} R_D^{j,\text{frg}} = (1-\hat{\tau}^j)\dfrac{1+(1-\delta)\Theta^j}{\sigma+\Theta^j} \cdot \sigma\overline{R} & \forall \Theta^j \in \left(0, \bar{\Theta}^j\right) \\ R_D^{j,\text{rsl}} = (1-\hat{\tau}^j)\dfrac{1+(1-\delta)\Theta^j}{1+\Theta^j} \cdot \mathbb{E}[\widetilde{R}] & \forall \Theta^j \in \left[\bar{\Theta}^j, +\infty\right) \end{cases} \tag{A.51}$$

where $\Theta^j = \hat{\Theta}^j_{\text{reg}}$ and

$$\bar{\Theta}^j = \bar{\Theta}^k = \bar{\Theta} = \frac{\sigma\left(\overline{R} - \mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}. \tag{A.52}$$

Entrepreneurs

We know from Lemma 2.3 that the same amount of resources is allocated to the free-of-risk sectors of the two countries according to

$$k_F = f'^{-1}(R_D), \tag{A.53}$$

with $(k_F \in (0, K))$.

If $R_D^j > R_D^k$, households do not invest in banks of Country k and consequently, RT in Country k cannot be financed. According to Lemma 2.4,

$$k_R^j = \beta^j \cdot (K - k_F) - b^j \delta E^j, \tag{A.54}$$

where $\beta^j \in \{0, 1, 2\}$ with $\sum_{j=1}^{2} \beta^j = 2$. That is an optimal allocation if $\mathbb{E}[\Pi_R^j] = 0$ which requires

$$\overline{R}_R^j = (1-\hat{\tau}^j)\overline{R} \tag{A.55}$$

$$\underline{R}_R^j = (1-\hat{\tau}^j)\underline{R}. \tag{A.56}$$

Expected Bailout Cost

If $X^j = 1$, i.e., $\Theta^j < \bar{\Theta}$, then

$$\mathbb{E}[T^j] = (1-\sigma) \cdot \left(D^j \cdot R_D^{j,\text{frg}} - \left(D^j + (1-\delta)E^j\right) \cdot \underline{R}_R^j\right). \tag{A.57}$$

By plugging (A.51) and (A.56) into (A.57), and taking into consideration that $\Theta^j = \frac{E^j}{D^j}$, we obtain

$$\mathbb{E}[T^j] = k_R^j \cdot (1-\sigma) \cdot (1-\hat{\tau}^j) \left(\frac{\sigma \overline{R}}{\sigma + \Theta^j} - \underline{R} \right). \tag{A.58}$$

It remains to show that all markets clear.

Capital Market Clearing

The capital market clears according to (2.27) by taking into account that $k_F = f'^{-1}(R_D)$, $\frac{E^j}{D^j} = \hat{\Theta}^j_{\text{reg}}$ and $\frac{E^k}{D^k} = \hat{\Theta}^k_{\text{reg}}$. In case $\hat{\tau}^j = \hat{\tau}^k$ and $\hat{\Theta}^j_{\text{reg}} = \hat{\Theta}^k_{\text{reg}}$, we know from Corollary 2.3 that $E^j = E^k$ and $D^j = D^k$.

Consumption Good Market Clearing in Good State

We need to show that

$$\overline{c}^j + \overline{c}^k = f(k_F) + f(k_F) + (k_R^j + k_R^k)\overline{R}. \tag{A.59}$$

Now

$$\begin{aligned}
\overline{c}^j + \overline{c}^k =& D^j R_D + E^j \left(\left(1 - \delta + (\Theta^j)^{-1}\right)(1-\tau^j)\overline{R} - (\Theta^j)^{-1} R_D \right) + k_F R_D \\
&+ f(k_F) - k_F R_D + \tau^j E^j \left(1 - \delta + (\Theta^j)^{-1}\right)\overline{R} \\
&+ D^k R_D + E^k \left(\left(1 - \delta + (\Theta^k)^{-1}\right)(1-\tau^k)\overline{R} - (\Theta^k)^{-1} R_D \right) + k_F R_D \\
&+ f(k_F) - k_F R_D + \tau^k E^k \left(1 - \delta + (\Theta^k)^{-1}\right)\overline{R} \\
=& E^j \left(1 - \delta + (\Theta^j)^{-1}\right)\overline{R} \\
&+ E^k \left(1 - \delta + (\Theta^k)^{-1}\right)\overline{R} \\
&+ 2f(k_F),
\end{aligned} \tag{A.60}$$

whereas

$$\begin{aligned}
f(k_F) + f(k_F) + (k_R^j + k_R^k)\overline{R} =& 2f(k_F) \\
&+ E^j \left(1 - \delta + (\Theta^j)^{-1}\right)\overline{R} \\
&+ E^k \left(1 - \delta + (\Theta^k)^{-1}\right)\overline{R}.
\end{aligned} \tag{A.61}$$

From (A.60) and (A.61), we establish equality (A.59).

Consumption Good Market Clearing in Bad State

We need to show that

$$\underline{c}^j + \underline{c}^k = f(k_F) + f(k_F) + (k_R^j + k_R^k)\underline{R}. \tag{A.62}$$

Now

$$\begin{aligned}
\underline{c}^j + \underline{c}^k =& D^j R_D + (1 - X^j) E^j \left(\left(1 - \delta + (\Theta^j)^{-1}\right)(1 - \tau^j)\underline{R} - (\Theta^j)^{-1} R_D \right) + k_F R_D \\
& + f(k_F) - k_F R_D + \tau^j E^j \left(1 - \delta + (\Theta^j)^{-1}\right) \underline{R} \\
& - X^j \cdot \left(D^j \cdot R_D - \left(D^j + (1-\delta) E^j \right) \cdot (1 - \tau^j) \underline{R} \right) \\
& + D^k R_D + (1 - X^k) E^k \left(\left(1 - \delta + (\Theta^k)^{-1}\right)(1 - \tau^k)\underline{R} - (\Theta^k)^{-1} R_D \right) + k_F R_D \\
& + f(k_F) - k_F R_D + \tau^k E^k \left(1 - \delta + (\Theta^k)^{-1}\right) \underline{R} \\
& - X^k \cdot \left(D^k \cdot R_D - \left(D^k + (1-\delta) E^k \right) \cdot (1 - \tau^k) \underline{R} \right) \\
=& E^j \left(1 - \delta + (\Theta^j)^{-1}\right) \underline{R} \\
& + E^k \left(1 - \delta + (\Theta^k)^{-1}\right) \underline{R} \\
& + 2 f(k_F),
\end{aligned} \tag{A.63}$$

for either $X^j = 0$ or $X^j = 1$. Further,

$$\begin{aligned}
f(k_F) + f(k_F) + (k_R^j + k_R^k)\underline{R} =& 2 f(k_F) \\
& + E^j \left(1 - \delta + (\Theta^j)^{-1}\right) \underline{R} \\
& + E^k \left(1 - \delta + (\Theta^k)^{-1}\right) \underline{R}.
\end{aligned} \tag{A.64}$$

From (A.63) and (A.64), we establish equality (A.62). □

A.9 Proof of Proposition 2.2

We consider the following four points on the policy space as described by Definition 2.5:

- Point i: (Θ_i, τ_i)
- Point ii: (Θ_{ii}, τ_{ii})
- Point iii: $(\Theta_{iii}, \tau_{iii})$
- Point iv: (Θ_{iv}, τ_{iv})

with

$$\vartheta = \Theta_i < \Theta_{ii} = \Theta_{iii} = \Theta_{iv} < \bar{\Theta} \tag{A.65}$$

and

$$\tau_{iv} < \tau_{ii} = \bar{\tau}(\Theta_{ii}) < \tau_i = \bar{\tau}(\Theta_i) < \tau_{iii}. \tag{A.66}$$

$\bar{\tau}$ is given by (2.67) and we know that $\tau_{ii} = \bar{\tau}(\Theta_{ii}) < \tau_i = \bar{\tau}(\Theta_i)$ because $\bar{\tau}(\Theta^j)$ is decreasing in Θ^j.

We note that when Country j and Country k set $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta^k_{\text{reg}}, \tau^k) = (\Theta_i, \tau_i)$, the following holds:

$$R_D = R^j_{D,i} = R^k_{D,i} = (1-\tau_i) \cdot \frac{1+(1-\delta)\vartheta}{\sigma+\vartheta} \cdot \sigma\overline{R} \tag{A.67}$$

and because $\mathbb{E}[\Phi^j(\Theta^j, \bar{\tau}(\Theta^j))] - \mathbb{E}[T^j(\Theta^j, \bar{\tau}(\Theta^j))] = 0$,

$$\mathbb{E}[U^j_i] = \mathbb{E}[U^k_i] = R_D \cdot (K - k_{F,i}) + f(k_{F,i}) \tag{A.68}$$

with $k_{F,i} = f'^{-1}(R_D)$.

Step 1:
We show that there is no deviation from *Point* i that can increase Country k's household expected utility, given that Country j sets $(\Theta^j_{\text{reg}}, \tau^j) = (\Theta_i, \tau_i)$. That is, we show

$$\mathbb{E}[U^k_i] = \mathbb{E}[U^j_i] \geq \mathbb{E}[U^k_l] \qquad \text{with } l = \{ii, iii, iv\}\,. \tag{A.69}$$

Deviation of Country k from Point i to Point ii:
The deviation from *Point* i to *Point* ii represents a move over the policy space dichotomy $\bar{\tau}$, including $(\Theta^k_{\text{reg}}, \tau^k) = (\bar{\Theta}, 0)$. From Lemma 2.7, we know that

$$R^j_{D,i} > R^k_{D,ii}. \tag{A.70}$$

Taking Lemma 2.2 into account, we conclude that Country k hosts no banking sector after its deviation, i.e., $b^k = 0$. Thus,

$$R_D = R^j_{D,i} \tag{A.71}$$

$$\mathbb{E}[U^k_{ii}] = R^j_{D,i} \cdot (K - k_{F,i}) + f(k_{F,i}) = \mathbb{E}[U^j_i] = \mathbb{E}[U^k_i]. \tag{A.72}$$

Deviation of Country k from Point i to Point iii:
The deviation from *Point* i to *Point* iii represents a move above the policy space dichotomy, $\bar{\tau}$, to seek positive net expected tax revenues. From Lemma 2.7, we know that

$$R^j_{D,i} > R^k_{D,iii}. \tag{A.73}$$

Thus, and because of Lemma 2.2, we conclude that Country k hosts no banking sector after this deviation, i.e., $b^k = 0$. Thus,

$$R_D = R^j_{D,i} \tag{A.74}$$
$$\mathbb{E}[U^k_{iii}] = R^j_{D,i} \cdot (K - k_{F,i}) + f(k_{F,i}) = \mathbb{E}[U^j_i] = \mathbb{E}[U^k_i]. \tag{A.75}$$

Deviation of Country k from Point i to Point iv:

The deviation from *Point* i to *Point* iv represents a move below the policy space dichotomy implying negative net expected tax revenues. The following two possible cases can exist:

- Case 1:
  If this deviation yields
  $$R^j_{D,i} > R^k_{D,iv}, \tag{A.76}$$
  then from Lemma 2.2, we conclude that Country k hosts no banking sector, i.e. $b^k = 0$. Thus,
  $$R_D = R^j_{D,i} \tag{A.77}$$
  $$\mathbb{E}[U^k_{iv}] = R^j_{D,i} \cdot (K - k_{F,i}) + f(k_{F,i}) = \mathbb{E}[U^j_i] = \mathbb{E}[U^k_i]. \tag{A.78}$$

- Case 2:
  If this deviation yields
  $$R^j_{D,i} < R^k_{D,iv}, \tag{A.79}$$
  then from Lemma 2.2, we conclude that Country j hosts no banking sector after Country k has deviated, i.e., $b^j = 0$ and $b^k = 1$. Since $R_D \dfrac{\partial k_F}{\partial \tau^k}$ is canceled out by $\dfrac{\partial f(k_F)}{\partial k_F} \cdot \dfrac{\partial k_F}{\partial \tau^k}$ because $R_D \equiv \dfrac{\partial f(k_F)}{\partial k_F}$, we obtain
  $$\begin{aligned} \frac{\partial \mathbb{E}[U^k]}{\partial \tau^k} = &- \frac{1 + (1-\delta)\Theta^k}{\sigma + \Theta^k} \cdot \sigma \overline{R} \cdot (K - k_F) \\ &+ \frac{1 + \Theta^k}{\sigma + \Theta^k} \cdot \sigma \overline{R} \cdot \Big(2(K - k_F) - \delta E^k\Big) \\ &+ \frac{\partial k^k_R}{\partial \tau^k} \cdot \phi^k. \end{aligned} \tag{A.80}$$
  The three lines on the right hand side of (A.80) are denoted by *Term 1*, *Term 2* and *Term 3*, respectively. Further, we note that $k^k_R = 2(K - k_F) - \delta E^k$ because $b^j = \beta^j = 0$.

  Term 2, which is positive, always dominates *Term 1* because $1+\Theta^k > 1+(1-\delta)\Theta^k$, and $2(K - k_F) - \delta E^k > K - k_F$. Further, $\phi^k < 0$ for all $\tau^k < \bar{\tau}$ and ϕ^k becomes zero at $\tau^k = \bar{\tau}$. Taking into account that $\partial R_D/\partial \tau^k < 0$, and because of the Inada conditions in FT, we know that $\partial k_F/\partial \tau^k > 0$. Because

$$k_R^k = \tfrac{1+(1-\delta)\Theta^k}{1+\Theta^k} 2\,(K - f'^{-1}(R_D)),$$

and taking into account that $\frac{\partial R_D}{\partial \tau^k} < 0$ and $f'' < 0$, we conclude that $\partial k_R^k/\partial \tau^k < 0$ and because $\phi^k < 0$ for all $\tau^k < \bar{\tau}$, *Term 3* is positive for all $\tau^k \leq \bar{\tau}$. We conclude thus,

$$\frac{\partial \mathbb{E}[U^k]}{\partial \tau^k} > 0 \qquad\qquad \forall \tau^k \leq \bar{\tau}. \tag{A.81}$$

The inequality (A.81) together with $\Theta_{ii} = \Theta_{iv}$ and $\tau_{iv} < \tau_{ii} = \bar{\tau}(\Theta_{ii})$ yield

$$\mathbb{E}[U_{ii}^k] > \mathbb{E}[U_{iv}^k]. \tag{A.82}$$

Combining (A.72) with (A.82), leads to

$$\mathbb{E}[U_i^j] > \mathbb{E}[U_{iv}^k]. \tag{A.83}$$

To sum up, equalities (A.72), (A.75), (A.78) and inequality (A.83) establish (A.69), which proves that $(\Theta_{\text{reg}}^j, \tau^j) = (\Theta_{\text{reg}}^k, \tau^k) = (\vartheta, \bar{\tau}(\vartheta))$ is an equilibrium.

Step 2:
We know from Claim (i) of Lemma 2.6 that there is no equilibrium with $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] < 0$. We know from Claim (ii) of Lemma 2.6 that there is no equilibrium with $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] > 0$. Step 2 proves that in equilibrium, $\tau^j = \bar{\tau}$ needs to be satisfied. That is, $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] = 0$.

Step 3:
We finally show that there is no equilibrium with $\Theta_{\text{reg}}^j > \vartheta$ and $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] = 0$. From Lemma 2.7, we know that *Point* i yields the maximum return in the area of the policy space that is characterized by $\vartheta \leq \Theta_{\text{reg}}^j < \bar{\Theta}$ and $\tau^j \geq \bar{\tau}$. Thus, any deviation of Country j from *Point* i will leave room to Country k to increase its tax rate—at least marginally—and still achieving $R_D^k > R_D^j$. Indeed, because (A.80) is positive for $\tau^j = \bar{\tau}$, Country k can increase its expected utility by increasing its tax rate such that $R_D^k > R_D^j$ still holds.

Steps 1-3 establish that $(\Theta_{\text{reg}}^j, \tau^j) = (\Theta_{\text{reg}}^k, \tau^k) = (\vartheta, \bar{\tau}(\vartheta))$ is the unique equilibrium. □

A.10 Proof of Corollary 2.1

$$\partial R_D^{j,\text{frg}}/\partial \Theta^j = -\,(1-\tau^j)\cdot\,(1-(1-\delta)\sigma)\,/\left((\sigma+\Theta^j)^2\right)\cdot\sigma\overline{R} < 0 \tag{A.84}$$

$$\partial R_D^{j,\text{rsl}}/\partial \Theta^j = -\,(1-\tau^j)\cdot\delta/(1+\Theta^j)^2\cdot\mathbb{E}[\widetilde{R}] < 0 \tag{A.85}$$

$$\partial R_D^{j,\text{frg}}/\partial \tau^j = -\,(1+(1-\delta)\Theta^j)/(\sigma+\Theta^j)\cdot\sigma\overline{R} < 0 \tag{A.86}$$

$$\partial R_D^{j,\text{rsl}}/\partial \tau^j = -\,(1+(1-\delta)\Theta^j)/(1+\Theta^j)\cdot\mathbb{E}[\widetilde{R}] < 0 \tag{A.87}$$

We complete the proof by observing that $R_D^{j,\text{frg}}(\bar{\Theta},\tau^j) = R_D^{j,\text{rsl}}(\bar{\Theta},\tau^j)$. □

B Proofs for Chapter 3

B.1 Proof of Lemma 3.2

$$
\begin{aligned}
\frac{\partial}{\partial \Theta}(UU^j) = & -(1-\sigma)\frac{\partial k_R^j}{\partial \Theta}\cdot\left(\frac{\sigma\overline{R}}{\sigma+\Theta}-\underline{R}\right)\Big\}\ \textit{Term 1} \\
& +\ k_R^j\cdot(1-\sigma)\cdot\frac{\sigma\overline{R}}{(\sigma+\Theta)^2}\Big\}\ \textit{Term 2} \\
& -\ (K-k_F)\cdot(1-(1-\delta)\sigma)\cdot\frac{\sigma\overline{R}}{(\sigma+\Theta)^2}\Big\}\ \textit{Term 3}
\end{aligned}
\tag{B.1}
$$

with $k_R^j = 2(K-k_F)-\delta E^j$. *Term 1* is positive, decreasing in Θ and becomes zero for $\Theta = \bar{\Theta}$. *Term 2* is also positive. *Term 3* is negative. Noting that $k_R^j = 2(K-k_F)-\delta E^j > (K-k_F)$, we infer that for small δ, *Term 2* dominates *Term 3*, yielding $\frac{\partial}{\partial \Theta}(UU^j) > 0$ in the interval $(0,\bar{\Theta})$. □

B.2 Proof of Proposition 3.1

We focus on the case with $0 < \vartheta < \bar{\Theta}$ and we consider the following two points on the policy space:

- Point i: (Θ_i, τ_i, P_i)
- Point ii: $(\Theta_{ii}, \tau_{ii}, P_{ii})$

with

$$\vartheta = \Theta_i = \Theta_{ii}, \tag{B.2}$$

$$\tau_i = \bar{\tau}\left(\Theta_i\right) > \tau_{ii} = 0 \tag{B.3}$$

and

$$P_i = 0 \neq P_{ii} = 1. \tag{B.4}$$

$\bar{\tau}\left(\Theta_i\right)$ is given by (2.67).

We initially assume that Country j sets $\left(\Theta^j_{\text{reg}}, \tau^j, P^j\right) = (\Theta_i, \tau_i, P_i)$, whereas Country k sets $\left(\Theta^k_{\text{reg}}, \tau^k, P^k\right) = (\Theta_{ii}, \tau_{ii}, P_{ii})$. We know from (3.8) that

$$R_D = R^j_{D,i} = R^k_{D,ii}. \tag{B.5}$$

Moreover, since $\mathbb{E}[\Phi^j] - \mathbb{E}[T^j] = 0$ for $\tau^j = \tau_i = \bar{\tau}(\vartheta)$ with $P^j = 0$, and $\mathbb{E}[\Phi^k] - \mathbb{E}[T^k] = 0$ for $\tau^k = 0$ with $P^j = 1$, we obtain

$$\mathbb{E}[U^j_i] = \mathbb{E}[U^k_{ii}] = R_D \cdot (K - k_{F,i}) + f(k_{F,i}) \tag{B.6}$$

with $k_{F,i} = f'^{-1}(R_D)$.

Taking (B.5) into account, we know from the Proof of Proposition 2.2 that there is no deviation from Point i that can increase Country j's expected utility if Country k chooses Point ii.

Given that Country j chooses Point i, and because $\dfrac{\partial R^{k,\text{IN}}_F}{\partial \tau^k} < 0$ and $\dfrac{\partial R^{k,\text{IN}}_F}{\partial \Theta^k} < 0$, we obtain that any deviation of Country k from Point ii yields

$$R^k_F < R_{F,i} \tag{B.7}$$

and therefore, all the banking activities are shifted to Country j. Thus, Country k cannot increase its utility by deviating from Point ii, given Country j chooses Point i.

Finally, we note that in any equilibrium, a country must be either at Point i or Point ii. The reason is the following. If Country j chooses Point i, any deviation of Country k from Point ii, which reduce the returns offered in Country k as (B.7) shows, will leave room to Country j to increase its tax rate—at least marginally—while still achieving $R^j_D > R^k_D$. Indeed, because (A.80) is positive for $\tau^j = \bar{\tau}$, Country j can increase its expected utility by increasing its tax rate such that $R^j_D > R^k_D$ still holds. The same reasoning applies if Country k chooses Point ii and Country j deviates from Point i. □

B.3 Proof of Proposition 3.4

Let $\tilde{\Theta}$ maximize UU^j with $\tilde{\Theta} \in (0, \bar{\Theta})$ and consider a $\dot{\Theta}$ ($\dot{\Theta} > \tilde{\Theta}$) with

$$UU^j(\tilde{\Theta}) > FU^k(\Theta; \Theta \in (\dot{\Theta}, \bar{\Theta})) \tag{B.8}$$

$$UU^j(\tilde{\Theta}) = FU^k(\dot{\Theta}), \tag{B.9}$$

where $FU^k = UU^j + \mathbb{E}[T^j]$.

We initially assume that Country j chooses $\Theta^j_{\text{reg}} = \tilde{\Theta}$ and Country k chooses $\Theta^k_{\text{reg}} \geq \dot{\Theta}$.

That yields

$$R_D = R_D^j = \frac{1+(1-\delta)\tilde{\Theta}}{\sigma+\tilde{\Theta}} \cdot \sigma\overline{R} > R_D^k \tag{B.10}$$

and

$$\begin{aligned} \mathbb{E}[U^j] = UU^j =& R_D \cdot (K - k_F) + f(k_F) - \mathbb{E}[T^j] && \text{(B.11)} \\ \mathbb{E}[U^k] = FU^k =& R_D \cdot (K - k_F) + f(k_F). && \text{(B.12)} \end{aligned}$$

Step 1:
We show that Country j cannot increase its expected utility by deviating from $\Theta^j_{\text{reg}} = \tilde{\Theta}$, given Country k sets $\Theta^k_{\text{reg}} \geq \dot{\Theta}$.

Deviation of Country j to a Θ' with $\tilde{\Theta} \neq \Theta' < \dot{\Theta}$:

Because Θ' is still smaller than Θ^k_{reg}, we obtain

$$R_D^j > R_D^k \tag{B.13}$$

and therefore, because of Lemma 2.2, $b^j = 1$, $b^k = 0$ and $\mathbb{E}[T^j] > 0$.

That is, $\mathbb{E}[U^j] = UU^j$ and because $\tilde{\Theta}$ maximizes UU^j, we conclude

$$\mathbb{E}[U^j(\Theta')] < \mathbb{E}[U^j(\tilde{\Theta})]. \tag{B.14}$$

Deviation of Country j to a Θ' with $\Theta' > \Theta^k_{\text{reg}}$:

Because Θ' is larger than Θ^k_{reg}, we obtain

$$R_D^k > R_D^j \tag{B.15}$$

and therefore, because of Lemma 2.2, $b^j = 0$, $b^k = 1$ and $\mathbb{E}[T^k] > 0$.

That is, $\mathbb{E}[U^k] = UU^k$ and $\mathbb{E}[U^j] = FU^j$. Because of symmetry $\tilde{\Theta}$ also maximizes UU^k and since $\Theta^k_{\text{reg}} > \tilde{\Theta}$ we obtain

$$\mathbb{E}[U^j(\tilde{\Theta})] > UU^k(\Theta^k_{\text{reg}}) \qquad \forall \Theta^k_{\text{reg}} \geq \dot{\Theta}. \tag{B.16}$$

From (B.8), and exchanging j with k and vice versa (because now $\Theta^j_{\text{reg}} > \Theta^k_{\text{reg}}$) we obtain

$$UU^k(\Theta^k_{\text{reg}}) > FU^j(\Theta') = \mathbb{E}[U^j(\Theta')]. \tag{B.17}$$

Combining (B.16) and (B.17), we conclude that if $\Theta^j_{\text{reg}} = \Theta' \geq \dot{\Theta}$, then

$$\mathbb{E}[U^j(\tilde{\Theta})] > \mathbb{E}[U^j(\Theta')]. \tag{B.18}$$

We showed that if Country k chooses $\Theta^k_{\text{reg}} \geq \dot{\Theta}$, Country j cannot increase its expected utility by deviating from $\Theta^j_{\text{reg}} = \tilde{\Theta}$.

Step 2:

We show that Country k cannot increase its expected utility by choosing any $\Theta^k_{\text{reg}} < \dot{\Theta}$, given that Country j sets $\Theta^j_{\text{reg}} = \tilde{\Theta}$.

Deviation of Country k to a Θ' with $\tilde{\Theta} < \Theta' < \dot{\Theta}$:

Because Θ' is larger than Θ^j_{reg}, we obtain

$$R^j_D > R^k_D \tag{B.19}$$

and therefore, because of Lemma 2.2, $b^j = 1$, $b^k = 0$ and $\mathbb{E}[T^j] > 0$.

That yields

$$\mathbb{E}[U^k(\Theta')] = FU^k = UU^j(\tilde{\Theta}) + \mathbb{E}[T^j(\tilde{\Theta})] \tag{B.20}$$

which is equal to the expected utility of Country k as it is given by (B.12).

Deviation of Country k to a Θ' with $\Theta' < \tilde{\Theta}$:

Because Θ' is smaller than Θ^j_{reg}, we obtain

$$R^k_D > R^j_D \tag{B.21}$$

and therefore, because of Lemma 2.2, $b^j = 0$, $b^k = 1$ and $\mathbb{E}[T^k] > 0$.

That yields

$$\mathbb{E}[U^k(\Theta')] = UU^k(\Theta') < UU^k(\tilde{\Theta}) \tag{B.22}$$

because UU^k is maximized at $\tilde{\Theta}$.

Finally, *deviation of country k to $\Theta' = \tilde{\Theta}$* results in $\mathbb{E}[U^k(\Theta')] = FU^k - \mathbb{E}[T^j]/2$.

We showed that if Country j chooses $\Theta^j_{\text{reg}} = \tilde{\Theta}$, Country k cannot increase its expected utility by choosing $\Theta^k_{\text{reg}} < \dot{\Theta}$.

Step 3:

From Step 1 and Step 2 we conclude that if Country j chooses $\Theta^j_{\text{reg}} = \tilde{\Theta}$ and Country k chooses $\Theta^k_{\text{reg}} \geq \dot{\Theta}$, there is no utility-increasing deviation. □

C Proofs for Chapter 4

C.1 Proof of Proposition 4.1

An equilibrium needs to satisfy the system of equations (4.20)-(4.24). (4.21) is satisfied because of (4.9). (4.22)-(4.24) are satisfied from the market clearing conditions. Finally, we prove (4.20) by substituting for (4.19) into (4.16) and (4.17), and calculating $\overline{c} - \underline{c}$. □

C.2 Proof of Proposition 4.3

An equilibrium needs to satisfy the system of equations (4.51)-(4.60). (4.52) – (4.60) are immediate. Finally, we prove (4.51) by substituting for γ^* into (4.45) and (4.46) and calculating $\overline{c} - \underline{c}$. □

C.3 Proof of Proposition 4.4

We note that $\underline{R}_E \geq 0$ because $\Theta_{\text{reg}} \geq \bar{\Theta}$, i.e., banks are resilient. We know from Definition 4.2 and (4.28) that an equilibrium yields the optimal allocation if and only if $\overline{c} - \underline{c} = \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R}-f'}{f'-\underline{R}}\right)$. Taking (4.21), (4.41) and (4.51) into account, we obtain that an equilibrium with financial intermediation, where banks are resilient, is optimal if and only if

$$\frac{\overline{R} - R_s}{R_s - \underline{R}} = \frac{\overline{R}_E - R_s}{R_s - \underline{R}_E}. \tag{C.1}$$

Substituting for $\overline{R}_E$ and $\underline{R}_E$, as given by (4.42) and (4.43), respectively, into the RHS of (C.1), we obtain the following optimality condition:

$$\frac{\overline{R} - R_s}{R_s - \underline{R}} = \frac{(1-\tau) \cdot \overline{R} - R_s}{R_s - (1-\tau) \cdot \underline{R}}, \tag{C.2}$$

which holds if and only if $\tau = 0$. □

C.4 Proof of Proposition 4.5

We note that $\underline{R}_E = 0$ because $\Theta_{\text{reg}} < \bar{\Theta}$, i.e., banks are fragile, and thus, they default in the bad state of the world. We know from Definition 4.2 and (4.28) that an equilibrium yields the optimal allocation if and only if $\overline{c} - \underline{c} = \frac{1}{A} \cdot \ln\left(\frac{\sigma}{1-\sigma} \cdot \frac{\overline{R}-f'}{f'-\underline{R}}\right)$. Taking (4.21), (4.41) and (4.51) into account, and because $\underline{R}_E = 0$, we obtain that an equilibrium with financial intermediation, where banks are fragile, is optimal if and only if

$$\frac{\overline{R} - R_s}{R_s - \underline{R}} = \frac{\overline{R}_E - R_s}{R_s}. \tag{C.3}$$

Substituting for $\overline{R}_E$, as given by (4.42), into the RHS of (C.3) and using (4.59), we obtain the following optimality condition:

$$\frac{\overline{R} - R_s}{R_s - \underline{R}} = \frac{1+\Theta}{\Theta} \cdot \frac{(1-\tau)\cdot\overline{R} - R_s}{R_s}. \tag{C.4}$$

We now prove in three steps that for every $\Theta < \bar{\Theta}$, there exists a τ, with $0 < \tau < 1$, that satisfies the optimality condition.

Step 1:

Let $\Theta = \bar{\Theta}$. That is, banks are on the edge of default, but they do not default. Formally, $\underline{R}_E = 0$ and $T = 0$. Substituting for $\Theta = \bar{\Theta}$, as given by (2.12), into (C.4), we obtain

$$\frac{\overline{R} - R_s}{R_s - \underline{R}} = \frac{(1-\tau)\cdot\overline{R} - R_s}{R_s - \underline{R}}, \tag{C.5}$$

which holds if and only if $\tau = 0$.

Step 2:

Because $\partial\left(\frac{1+\Theta}{\Theta}\right)/\partial\Theta < 0$, and taking Step 1 into consideration, we know that for $\Theta < \bar{\Theta}$, optimality condition (C.4) can be satisfied only with a strictly positive τ.

Step 3:

Taking Step 2 into consideration, we infer that the largest value of τ in order for (C.4) to be satisfied, will be needed for Θ close to zero. Even if we allow $\Theta = 0$, (C.4) is satisfied if and only if $\tau = 1 - \frac{R_s}{\overline{R}}$.

Steps 1–3 prove that for every $\Theta < \bar{\Theta}$, there exists a tax rate τ that yields the optimal allocation. □

D Proofs for Chapter 5

D.1 Proof of Lemma 5.1

Investors solve the following problem:

$$\max_{\overline{c}^i, \underline{c}^i} \left\{ \sigma \overline{c}^i + (1-\sigma)\underline{c}^i \right\} \tag{D.1}$$

$$\text{s.t. } (\gamma\nu + \gamma(1-\nu) + (1-\gamma)) \cdot K \leq K. \tag{D.2}$$

Households' consumption in their capacity as investors in the good state and the bad state of the world read as follows:

$$\overline{c}^i = \left(\gamma\nu \cdot R_F + \gamma(1-\nu) \cdot R_D + (1-\gamma) \cdot \overline{R}_E\right) \cdot K + \Pi_F + \overline{\Pi}_R \tag{D.3}$$

$$\underline{c}^i = (\gamma\nu \cdot R_F + \gamma(1-\nu) \cdot R_D + (1-\gamma) \cdot \underline{R}_E) \cdot K + \Pi_F + \underline{\Pi}_R - T. \tag{D.4}$$

Substituting for $\overline{c}^i$ and $\underline{c}^i$ into (D.1), and taking (5.3) and (5.16) into account, we can re-write investors' problem as follows:

$$\max_{\gamma,\nu} \{(\gamma\nu \cdot R_F + \gamma(1-\nu) \cdot R_D + (1-\gamma) \cdot \mathbb{E}[R_E]) \cdot K + \Pi_F + \mathbb{E}[\Pi_R] - (1-\sigma)T\} \tag{D.5}$$

$$\text{s.t. } (\gamma\nu + \gamma(1-\nu) + (1-\gamma)) \cdot K = K. \tag{D.6}$$

Note that budget constraint must be satisfied with equality because of the linearity of the objective function. We showed that the expected utility of investors depends linearly on the expected returns on their investment choices. Taking into account that, due to the assumption of perfect competition, they cannot influence the aggregate variables of Π_F, $\overline{\Pi}_R$, $\underline{\Pi}_R$ and T, we prove that it is optimal for them to invest in the asset with the highest expected returns. □

D.2 Proof of Lemma 5.2

We prove Lemma 5.2 by proving (5.35), (5.36) and (5.37). For the proof of Lemma 5.2, we temporarily use the following auxiliary assumptions:

Assumption D.1
$R_F = f'(k_F)$.

Assumption D.2
$\bar{R}_R = \overline{R}$ *and* $\underline{R}_R = \underline{R}$.

Assumption D.3
Bankers demand a strictly positive amount of deposits.

Assumptions D.1 and D.2 become redundant after the characterization of entrepreneurs' optimal decisions in equilibrium (see Subsection 5.3.2). Assumption D.3 becomes redundant after the characterization of bankers' optimal decision in equilibrium (see Subsection 5.3.3).
Proof of (5.35)*:*
We know from (5.27) and (5.28) that $E > 0$. Thus, and taking Lemma 5.1 into account, we obtain

$$\max\{R_F, R_D\} \leq \mathbb{E}[R_E]. \tag{D.7}$$

Taking Assumption D.1 into account, and because of Inada conditions, we obtain that in equilibrium, k_F must be strictly greater than zero. Otherwise, R_F will become infinitely large and (D.7) would be violated. Thus, and because of Lemma 5.1, we obtain

$$\max\{R_D, \mathbb{E}[R_E]\} \leq R_F. \tag{D.8}$$

Finally, because of Assumption D.3 and Lemma 5.1, we obtain that deposits are positive and thus,

$$\max\{R_F, \mathbb{E}[R_E]\} \leq R_D. \tag{D.9}$$

From (D.7) to (D.9), we conclude that

$$R_F = R_D = \mathbb{E}[R_E] \tag{D.10}$$

must hold in equilibrium.
Proof of (5.36)*:*
Taking (5.35) into account, we calculate the equilibrium returns in the case of a fragile

banking sector, which results in R_D^{frg}, and in the case of a resilient banking sector, which results in R_D^{rsl}, by requiring $R_D = \mathbb{E}[R_E]$, where $\mathbb{E}[R_E]$ is given by substituting for (5.17) and (5.18) into (5.16). We also use Assumption D.2 by substituting for $\overline{R}_R = \overline{R}$ and $\underline{R}_R = \underline{R}$.

Proof of (5.37)*:*
From Assumption D.2, we re-write (5.12) as follows:

$$\bar{\Theta} = \frac{R_D^{\text{frg}}(\bar{\Theta}) - (1-\lambda)\underline{R}}{(1-\lambda)\underline{R}} = \frac{R_D^{\text{rsl}}(\bar{\Theta}) - (1-\lambda)\underline{R}}{(1-\lambda)\underline{R}}. \tag{D.11}$$

Substituting for R_D^{frg} and R_D^{rsl} according to (5.36), and solving for $\bar{\Theta}$, we obtain

$$\bar{\Theta} = \frac{\sigma\left(\overline{R} - \mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}. \tag{D.12}$$

The proofs of (5.35), (5.36) and (5.37) establish Lemma 5.2. □

D.3 Proof of Lemma 5.3

The representative banker raised E' in the first step. In the second step, he faces the following problem:

$$\max_{E,D} \{\mathbb{E}[R_E]\} \tag{D.13}$$

$$\text{s.t. } \Theta \geq \Theta_{\text{reg}}, \tag{D.14}$$

where $\mathbb{E}[R_E]$ is given by (5.16), with $\Theta = \frac{E}{D}$. We also substitute for $\overline{R}_R$ and $\underline{R}_R$ according to (5.42) and (5.43), respectively. Note that due to perfect competition, the representative banker is price taker and therefore, cannot affect R_D.

We prove Lemma 5.3 in three steps.

Step 1: *Fragile Bank*
If the bank is fragile, the banker faces the following problem:

$$\max_{E,D} \left\{\mathbb{E}[R_E] = \sigma \cdot \frac{(1-\lambda)(D+E)\cdot\overline{R} - D\cdot R_D^{\text{frg}}}{E}\right\} \tag{D.15}$$

$$\text{s.t. } \Theta = \frac{E}{D} \geq \Theta_{\text{reg}}. \tag{D.16}$$

FOC read as follows:

$$\frac{\partial \mathbb{E}[R_E]}{\partial E} = -\sigma D \frac{(1-\lambda)\overline{R} - R_D^{\text{frg}}}{E^2} \tag{D.17}$$

$$\frac{\partial \mathbb{E}[R_E]}{\partial D} = \sigma \frac{(1-\lambda)\overline{R} - R_D^{\text{frg}}}{E}. \tag{D.18}$$

We now show that $R_D^{\text{frg}} < (1-\lambda)\overline{R}$. Substituting for $\Theta = 0$ into (5.36), we obtain $R_D^{\text{frg}}(\Theta = 0) = (1-\lambda)\overline{R}$. Thus, and taking Corollary 5.1 into account, as well as that, because of (5.27) and (5.28), $\Theta > 0$, we conclude that $R_D^{\text{frg}} < (1-\lambda)\overline{R}$. Hence, $\partial\mathbb{E}[R_E]/\partial E < 0$ and $\partial\mathbb{E}[R_E]/\partial D > 0$.

Step 2: *Resilient Bank*
If the bank is resilient, the banker faces the following problem:

$$\max_{E,D} \left\{ \mathbb{E}[R_E] = \frac{(1-\lambda)(D+E)\mathbb{E}[\widetilde{R}] - DR_D^{\text{rsl}}}{E} \right\} \tag{D.19}$$

$$\text{s.t. } \Theta = \frac{E}{D} \geq \Theta_{\text{reg}}. \tag{D.20}$$

FOC read as follows:

$$\frac{\partial \mathbb{E}[R_E]}{\partial E} = -D \frac{(1-\lambda)\mathbb{E}[\widetilde{R}] - R_D^{\text{rsl}}}{E^2} \tag{D.21}$$

$$\frac{\partial \mathbb{E}[R_E]}{\partial D} = \frac{(1-\lambda)\mathbb{E}[\widetilde{R}] - R_D^{\text{rsl}}}{E}. \tag{D.22}$$

We know from (5.36) that $R_D^{\text{rsl}} = (1-\lambda)\mathbb{E}[\widetilde{R}]$. Hence, $\partial\mathbb{E}[R_E]/\partial E = \partial\mathbb{E}[R_E]/\partial D = 0$.

Step 3:
From Step 1, we conclude that, for all $\Theta_{\text{reg}} < \bar{\Theta}$, bankers, aiming to maximize the expected returns on equity, raise no further equity and demand deposits until constraint (D.16) is satisfied with equality. From Step 2, we conclude that, for all $\Theta_{\text{reg}} \geq \bar{\Theta}$, bankers are indifferent with regard to their capital structure. Thus, and taking Assumption 5.1 into account, we conclude that bankers set $\Theta = \Theta_{\text{reg}}$. □

D.4 Proof of Proposition 5.1

We know from Lemma 5.2 that

$$R_D = R_F = \mathbb{E}[R_E] \tag{D.23}$$

with

$$R_D(\Theta,\lambda)=\begin{cases} R_D^{\text{frg}}=(1-\lambda)\cdot\frac{1+\Theta}{\sigma+\Theta}\cdot\sigma\overline{R} & \forall\Theta\in\left(0,\bar{\Theta}\right); \\ R_D^{\text{rsl}}=(1-\lambda)\cdot\mathbb{E}[\widetilde{R}] & \forall\Theta\in\left[\bar{\Theta},+\infty\right) \end{cases} \tag{D.24}$$

and

$$\bar{\Theta}=\frac{\sigma\left(\overline{R}-\mathbb{E}[\widetilde{R}]\right)}{(1-\sigma)\underline{R}}. \tag{D.25}$$

Because of (5.38), in equilibrium, $k_F = f'^{-1}(R_D)$ and in order for the capital market to clear, we also obtain $k_R = K - k_F$.

It remains to show that the consumption good markets in the good state and the bad state of the world clear.

Consumption Good Market in Good State
We need to show that

$$\overline{C}^h = f(k_F) + k_R\cdot\overline{R}. \tag{D.26}$$

Indeed,

$$\begin{aligned}\overline{C}^h =& f(k_F) - k_F R_D \\ &+ DR_D + \frac{E}{\Theta}\left((1-\lambda)(1+\Theta)\overline{R} - R_D\right) + k_F R_D \\ &+ \lambda\cdot(D+E)\cdot\overline{R} \\ =& f(k_F) + k_R\cdot\overline{R}.\end{aligned} \tag{D.27}$$

Consumption Good Market in Bad State
We need to show that

$$\underline{C}^h = f(k_F) + k_R\cdot\overline{R}. \tag{D.28}$$

Indeed, if banks are resilient,

$$\begin{aligned}\underline{C}^h =& f(k_F) - k_F R_D \\ &+ DR_D + \frac{E}{\Theta}\left((1-\lambda)(1+\Theta)\underline{R} - R_D\right) + k_F R_D \\ &+ \lambda\cdot(D+E)\cdot\underline{R} \\ =& f(k_F) + k_R\cdot\underline{R},\end{aligned} \tag{D.29}$$

and if banks are fragile,

$$
\begin{aligned}
\underline{C}^h =& f(k_F) - k_F R_D \\
&+ DR_D + k_F R_D \\
&- DR_D + (D+E)\cdot(1-\lambda)\cdot \underline{R} \\
&+ \lambda \cdot (D+E)\cdot \underline{R} \\
=& f(k_F) + k_R \cdot \underline{R}.
\end{aligned} \tag{D.30}
$$

This completes the proof. □

D.5 Proof of Proposition 5.3

Politicians and bankers can at least achieve d^π and d^b, respectively. (d^π, d^b) is the result of optimal allocation $\hat{k}_F$.

In order for an agreement to be reached, there must be an allocation k_F that satisfies (5.58) and (5.59).

Proof of claim (i):

Let $\vartheta \geq \bar{\Theta}$.

From (5.54), we obtain that a strictly positive λ can only reduce $\mathbb{E}[R_E]$. Since $d^b = \mathbb{E}[\widetilde{R}]$, we conclude that bankers will not offer a strictly positive λ. This, according to Axiom 5.1, yields the disagreement outcome.

Proof of claim (ii):

Let $\vartheta < \bar{\Theta}$.

Because of the Inada conditions, and taking (5.47) and Lemma 5.2 into account, we know that

$$\frac{\partial \mathbb{E}[R_E]}{\partial k_F} < 0. \tag{D.31}$$

Since $d^b = \mathbb{E}[\widetilde{R}]$ occurs when $k_F = \hat{k}_F$, (D.31) implies that (5.58) holds with an allocation that satisfies

$$k_F \leq \hat{k}_F. \tag{D.32}$$

Because

$$\frac{\partial \mathbb{E}[U^\pi]}{\partial k_F} = \eta \cdot R_D - (\eta(1-\lambda) + \lambda)\, \mathbb{E}[\widetilde{R}], \tag{D.33}$$

and knowing that d^π is achieved with $k_F = \hat{k}_F$, whereas (5.58) needs $k_F \leq \hat{k}_F$, we obtain that, in order for (5.58) and (5.59) to hold simultaneously, bankers' offer must satisfy

$$\lambda^E \leq \lambda \leq \lambda^{\text{SO}}, \tag{D.34}$$

where λ^{SO} is given by (5.53), and λ^E is derived by requiring $\frac{\partial \mathbb{E}[U^\pi]}{\partial k_F} \leq 0$ and is given by (5.61).

Because of (D.31) we hence conclude that (5.57) is maximized by an allocation k_F that is as low as possible satisfying $\lambda \geq \lambda^E$.

Since k_F is decreasing in R_D, which in turn, is decreasing in λ, we conclude that in order for $\mathbb{E}[R_E]$ to be maximized, the first inequality of (D.34) must be satisfied with equality, i.e., $\lambda = \lambda^E$.

Using $\frac{\partial f}{\partial \Theta} = \frac{\partial f}{\partial k_F} \cdot \frac{\partial k_F}{\partial \Theta}$, and taking (5.38) into account, we obtain:

$$\frac{\partial \mathbb{E}[U^\pi]}{\partial \Theta} = \frac{\partial k_F}{\partial \Theta} \cdot \left(\eta \cdot R_D - (\eta(1-\lambda) + \lambda)\, \mathbb{E}[\widetilde{R}] \right). \tag{D.35}$$

Substituting for $\lambda = \lambda^E$, and taking (5.48) into consideration, we obtain $\frac{\partial \mathbb{E}[U^\pi]}{\partial \Theta} = 0$ $\forall \Theta < \bar{\Theta}$.

That is, politicians are indifferent between the capital regulation levels as long as $\lambda = \lambda^E$, whereas bankers are better off with a laxer capital regulation. Hence, bankers' offer $(\Theta_{\text{reg}}, \lambda)$ is accepted by politicians—and $\mathbb{E}[R_E]$ is maximized—for $\lambda = \lambda^E$ and $\Theta_{\text{reg}} = \vartheta$, satisfying thus the constraints (5.58) and (5.59). □

E List of Notations*

Symbol	***Meaning***
δ	Equity issuance cost per unit of equity
η	Factor of political participation
$\bar{\Theta}$	Minimum equity-to-debt ratio required by banks to be resilient
Θ	Bank equity-to-debt ratio
Θ_{reg}	Capital requirements imposed on banks by government
ϑ	*A priori* minimum capital requirements
κ	Productivity reduction due to banking crisis
$\overline{\Lambda}$	Lobbying contributions in good state
$\underline{\Lambda}$	Lobbying contributions in bad state
λ	Lobbying intensity
σ	Probability that the good state of the world occurs
τ	Tax rate imposed on either RT output or banks' balance sheet by government
$\overline{\Phi}$	Tax revenues in good state
$\underline{\Phi}$	Tax revenues in bad state
$\mathbb{E}[\Phi]$	Expected tax revenues
A	Risk aversion parameter
b	Banking operations index
B_F	Risk-free bonds issued from FT entrepreneurs
B_R	Bonds issued from RT entrepreneurs
$\bar{c}$	Consumption of representative household in good state
$\underline{c}$	Consumption of representative household in bad state
$\bar{c}^i$	Consumption of representative household in its capacity as investor in good state
$\underline{c}^i$	Consumption of representative household in its capacity as investor in bad state
$\bar{C}^{\pi}$	Aggregate consumption of politicians in good state
$\underline{C}^{\pi}$	Aggregate consumption of politicians in bad state
$\bar{C}^{\text{oh}}$	Aggregate consumption of ordinary households in good state
$\underline{C}^{\text{oh}}$	Aggregate consumption of ordinary households in bad state

* Country index is omitted from the variables in this list, for the sake of generality. A variable with the superscipt j or k in the text refers to Country j or Country k, respectively.

$\bar{C}^{\mathrm{h}}$	Aggregate consumption of all households in good state
$\underline{C}^{\mathrm{h}}$	Aggregate consumption of all households in bad state
D	Deposits
E	Bank equity
FT	Free-of-risk Technology
RT	Risky Technology
j	Generic-country index
k	Generic-country index $(k \neq j)$
s	Supranational jurisdiction index
t	Time period
P	Bank resolution mechanism
X	Bank fragility index
k_F	Amount of capital allocated in FT
L_R	Amount of loans granted to RT
R_F	Returns on FT bonds
$\mathbb{E}[R_F]$	Expected returns on FT bonds
R_D	Returns on deposits
$\mathbb{E}[R_D]$	Expected returns on deposits
$\overline{R}_E$	Returns on equity in good state
$\underline{R}_E$	Returns on equity in bad state
$\mathbb{E}[R_E]$	Expected returns on equity
$\overline{R}$	Returns on investment in RT sector in good state
$\underline{R}$	Returns on investment in RT sector in bad state
$\mathbb{E}[\widetilde{R}]$	Expected returns on investment in RT
$\overline{R}_R$	Returns on RT bonds or loans in good state
$\underline{R}_R$	Returns on RT bonds or loans in bad state
$\mathbb{E}[R_R]$	Expected returns on RT bonds or loans
$\mathbb{E}[U]$	Expected utility of households
$\mathbb{E}[U^i]$	Expected utility of households in their capacity as investors
$\mathbb{E}[U^\pi]$	Expected utility of politicians
Π_F	Profits in FT
$\overline{\Pi}_R$	Profits in RT in good state
$\underline{\Pi}_R$	Profits in RT in bad state
$\mathbb{E}[\Pi_R]$	Expected profits in RT sector
$\mathbb{E}[T]$	Expected bailout expenditures
T	Bailout expenditures (materialized)
K	Total endowment of investment good in each country

z_K	Excess demand function in capital market
$\overline{z_c}$	Excess demand function in consumption good market in good state
$\underline{z_c}$	Excess demand function in consumption good market in bad state
$f(\cdot)$	Production function in FT

F Glossary*

Bailout: Payment by government of a bank's liabilities that are associated with contractually defined non-contingent returns when bank cannot honor its promise to the holders of these liabilities.
Bail-in: Conversion of bank's liabilities—associated with contractually defined non-contingent returns—into equity in the case of a bank failure.
Bailout Expenditures (Costs): Total value of liabilities (including interest), the repayment of which is guaranteed by government, minus the liquidation value of the asset side of bank balance sheets.
Bank: Financial institution that acts as intermediary between households and technologies with state-contingent returns.
Bankers: Managers running banks on behalf of bank owners with the aim of maximizing the expected returns on bank equity.
Bank Failure: Bank failure to honor the entirety of its contractually defined obligations to liability holders.
Bank Fragility: Lack of capacity of a bank to withstand a negative macroeconomic shock. Namely, the dependence of a bank on its assets' returns for honoring the entirety of its contractually defined obligations.
Bank Leverage: Reliance of bank financing on liabilities associated with contractually defined, non-contingent, returns as compared to liabilities that are not associated with contractually defined returns.
Bank Resilience: Capacity of a bank to withstand a negative macroeconomic shock. Namely, the ability of bank to honor the entirety of its contractually defined obligations regardless of the returns on bank assets.
Bank Resolution: Government decision in regard to the distribution of losses among taxpayers and deposit holders in the case of a bank failure.
Capital Regulation: Government decision on the capital requirements imposed on banks in the form of a minimum equity-to-debt ratio.
Communication Barriers: Provisions that hinder the exchange of information between agents.

* The terms are defined in the context of this dissertation. Different definitions of the same terms may exist in a different context.

Deposit: Bank liability, repaid with contractually defined, non-contingent, returns.

Deposit Guarantee: Government's guarantee that the promised returns to the depositors (principle plus interest) will always be honored within its jurisdiction, even if the associated bank fails, and without discrimination between domestic and foreign depositors.

Equity: Bank liability with non-negative returns that depend on bank assets' returns and the returns on senior bank liabilities.

Equity Issuance Cost: Cost per unit of issued equity.

Government: Sovereign that sets the legislation in regard to capital regulation, tax policy and bank resolution, within its jurisdiction, aiming at maximizing the welfare of the households that reside within its jurisdiction.

Households: Economic agents that invest their initial endowment aiming at maximizing their expected utility that is derived from consumption.

Regulatory Competition: Situation in which two governments set legislation, aiming to maximize the welfare of the households that reside within their jurisdiction, and being free of considerations in regard to the sum of the welfare of the two jurisdictions.

Lobbying Contributions: Value of transfers by a group with special interests to politicians in exchange of regulation by the latter that favors the interests of the former.

Lobbying Intensity: Fraction of the revenues of a special interest group, which is transferred to politicians in exchange of regulation by the latter that favors the interests of the former.

Lump Sum Taxation: Emergency tax, besides regular tax policy, that can be imposed by government to households in order to cover any remaining bailout expenditures that are not covered by tax revenues.

Legislative Scheme: Set of government decisions with legal force within government's jurisdiction.

Net Expected Tax Revenues: Tax revenues minus bailout expenditures, in expected terms.

Policy Space: Space that is characterized by the government's policy tools.

Policy Space Dichotomy: Dichotomy splitting the policy space into a sub-space with positive net expected tax revenues and a sub-space with negative net expected tax revenues.

Politicians: Fraction of households, who run the government.

Political Participation: Situation in which households are also politicians.

Resilience Boundary: The level of equity-to-debt ratio above of which a bank can withstand a negative macroeconomic shock, honoring the entirety of its contractually defined obligations.

Supranational Government: A governmental structure with the competence—conferred by member states—to set legislation, aiming at maximizing the total welfare of the households that reside within its members.

Systemic Risk Tax: Government decision on the tax rate imposed on the liability side of bank balance sheets.

Tax Policy: Government decision on the tax rate imposed on risky sector output.

Tax Revenues: Revenues raised by the government in accordance with its tax policy.

Technology: Machines and structures that transform inputs (investment goods) into outputs (consumption goods) with a specified relationship between the amount of outputs that can be produced for any given amount of inputs.

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