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Risk Sharing, Macro-Prudential Policy and Welfare in an Overlapping Generations Model (OLG) Economy

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Abstract:

Purpose: *The general purpose of this research was to examine the impact of banking regulation on risk sharing and welfare in an Overlapping Generations model economy.*
Design/Methodology/Approach: *The study uses a stochastic Overlapping Generation model with banking, limited liability, and deposit insurance, examining how the banking regulation affects welfare with the introduction of the principle of risk sharing in the economy.*
Findings: *The results indicated support on previous studies and demonstrated that, using data from Turkey, banking regulation may lead to a welfare loss, a positive effect of optimal regulation on social welfare.*
Practical implications: *The main results show that the trade-off between risk sharing, and financial stabilization depends on the level of capital requirements, and the risk sharing behavior of the economy. The risk sharing model for both specifications (risky and safe) confirm that the introduction of behavior of risk sharing on the economy has a positive impact on the welfare.*
Originality/value: *This model allows us to evaluate quantitatively the key trade-off of risk sharing banking regulation and social welfare.*

Keywords: *Risk sharing, welfare, macro-prudential policy, capital requirements.*

JEL codes: *G32, D81, D6.*

Paper type: *Research article.*

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1. Introduction

As Diamond and Dybvig (1983), stated providing insurance against preference shocks by identifying the demand deposit which is a mechanism that facilitates risk sharing while the competitive market provides better risk sharing among people who need to consume at different random times. Risk sharing is a rational instrument to use to mitigate the excessive risk. The introduction of the risk sharing as key instrument for conducting any policy for the economic system might change the framework of the economic decision to be taken towards any macroeconomic issues.

For example, higher degree of consumption risk sharing enables countries to smooth their consumption in response to any unexpected shocks in terms of productivity, income, and financial indices. Introducing the risk sharing within the financial structure and banking product might influence or re-plan the game of the economic cycle. Reframing the economy within the principle of the risk sharing and not risk shifting might bring an innovative result for any policies it might be taken. The economic rational of this principal is determined as the key issues of several financial crisis over many centuries. Conducting a financial system based on risk sharing is inherently less prone to crisis because its risk sharing feature reduce leverage and encourage better risk management on the part of both financial institutions and their customers, (Kammer *et al.*, 2015). The principle of risk sharing is well suited to the financing of SME and startups, thereby contributing to more inclusive growth. Within the introduction of the risk sharing on the economy, a joint conduct of jurisprudential interpretation might give an emphasis for developing institution that enforce the contract, promote the property right, fostering good governance and providing a conductive environment for private initiative, and targeting the financial system towards sustainable growth.

Therefore, the introduction of risk sharing, promote economic development based on several key tools from this introduction in the economy. The different risk sharing features of banking transactions and a wide array of approaches in the application of capital requirements affect the measurement and comparability of capital buffer. Thus, the implementation of macroprudential policy taking into account the core principles, risk sharing, of economic system require an understanding of the implication of this principle for the macroprudential policy by targeting the profit and loss sharing of interbank transactions. Moreover, the identification and monitoring are particularly challenging for the banking system due to different interpretations and practices macroprudential measures compatible transactions across jurisdictions and differences in the supervisory and regulatory approach for the banking system.

The introduction of macroprudential policy of regulatory and supervisory framework aimed to strengthen the financial system and the macro-economy in general. Macroprudential regulation considers the systemic implications of the collective behavior of financial firms. This policy can be used to maintain financial stability, promote economic growth, and improve social welfare by aligning private incentives with social objectives.

This paper aims at providing a framework to study the implication of macroprudential regulation on risk sharing in economy and effects on social welfare. It is an overlapping-generations endogenous growth model in which banks served as financial intermediaries in a competitive market.

The rest of the paper is organized as follows. In section 2, we discuss how the paper fits in the existing literature. In section 3, we introduce the key elements of the core model; this section lays out the model for households, entrepreneur, and firms. Section 4 analyses the implication of the model for growth, section 5 is devoted to the implication of the model regarding optimal capital requirements. Section 6 presents calibration and reports our numerical results. Section 7 considers extensions to the basic framework. Section 8 contains concluding remarks.

2. Literature Review

Our model builds on a large literature which includes capital requirement and risk sharing and welfare. The most recent work related to this is the study by Agénor and da Silva (2017), where the authors studied the effects of capital requirements on risk taking and welfare in a stochastic overlapping model of endogenous growth with banking, limited liability, and government guarantees.

Several literature focused on the impact of low interest rate on risk taking the need for coordinating monetary and macroprudential policies to promote macroeconomic and financial stability such as the works by Agur and Demertzis (2012), Cociuba *et al.* (2016), and Collard *et al.* (2017). Cociuba *et al.* (2016) argued that low policy rates have conflicting effects on bank risk taking, they make riskier assets more attractive than safe bonds, and they reduce the amount of safe bonds available for collateralized borrowing in interbank markets which facilitates reallocation of resources between financial intermediaries in response to new information about the riskiness of their investments. However, borrowing against safe bonds also allows intermediaries to take advantage of their limited liability and to overinvest in risky projects. Thus, relaxing collateral constraints may increase risk taking and reduce welfare.

Collard *et al.* (2017) look at the interplay between prudential and monetary policy instruments in a related model where deposit insurance can also lead to socially excessive risk taking by banks. Kilinc and Neyapti (2012) conduct a study exploring the welfare implications of bank regulation and supervision through a general equilibrium model. It is observed that the decision of banks to monitor and charge differentiated interest rates to firms depends on the distribution of firm-specific moral hazard rates, bank monitoring increases profits as the distribution of producer type improves.

Van den Heuvel (2008) conducted a research paper to study the effect of macroprudential regulation, in the form of bank capital requirements, on welfare in a growth setting. He argues that capital adequacy requirements may have conflicting effects on welfare, by including banks to hold less risky portfolios they mitigate the probability of a financial crisis which enhances welfare, and by including a shift in banks portfolios away from risky but more productive investment projects towards safer but less productive investment projects, it may hamper economic growth and have an adverse effect on welfare. A limitation in this paper is that economic growth is exogenous and it is an extension (Van den Heuvel, 2019). Thus, the implication of trade-off between banking efficiency and financial stability for long-run growth, and the extent to which it can be internalized when setting regulatory policy instruments, cannot be fully explored

Indeed, several recent articles analyze the topic by presenting quantitative macroeconomic models of optimal bank capital regulation, including Begenau (2020), Clerc *et al.* (2015), Nguyen (2018) and Goel (2016). In the calibration of these papers, the proposed models yield an interior level of the capital requirement that maximizes a welfare criterion. These papers are similar in several points; however, they present a difference with our model as they rely on a full calibration of the model to draw out quantitative implications.

Clerc *et al.* (2015) find that, depending on the risk-weights, the optimal capital requirement should be around 10.5% for business loans and 5.25% for mortgages, while Begenau (2020) and Goel (2016) report optimal leverage ratios at 14% and 28% respectively.

Diamond and Kashyap (2016) and Calomiris *et al.* (2015) put forth a rational for liquidity requirements in terms of preventing bank runs. De Nicolò *et al.* (2014) conduct a quantitative examination of the effects of both liquidity and capital requirements, by adopting a microprudential perspective they present a partial equilibrium model of banks that engage in maturity transformation and are tempted to take on excessive risk due to deposit insurance.

Our paper shares the goal of finding rational macroprudential policies and their impact on the welfare with papers that have recently developed related to the topic, including Van den Heuvel (2019; 2008), Agénor and da Silva (2017), Collard *et al.* (2017), Boissay and Collard (2016), and Clerc *et al.* (2015).

We model the relationship that affecting the economic growth between macroprudential regulation and risk sharing based on overlapping generation endogenous growth model based on the framework of Agénor and da Silva (2017). We model the risk sharing in financial institution in particular and the economy in general using the framework of Bohn (2009) and Gale (2010) because it provides a rational for the use of the modeling to introduce the behavior of risk sharing.

Our model follows Collard *et al.* (2017) and Freixas and Rochet (2008) in which the need for capital requirements arises from limited liability and deposit insurance. As in Collard *et al.* (2017), the modeling of the regulated economy is based on the following assumption: excessive risk taking involves the type of projects that banks may be tempted to finance because limited liability protects them from incurring large losses, and deposit insurance decouples their funding costs from their risk taking.

The framework, based on Van den Heuvel (2019) embeds the role of bonds government in the growth model. Also, our model suppose that the investment is financed by borrowing from banks and issuing equity to households. Finally, our paper shares the goal of finding a rationale for macroprudential policies with papers that have recently put the emphasis on risk sharing and endogenous economic growth, including Agénor and da Silva, (2017), Van den Heuvel (2019; 2008), and Collard, *et al.* (2017).

3. The Model

The model consists to an extension to the standard OLG model. Banks serve as financial intermediaries and banking regulation is modeled as a constraint on bank's portfolio. We consider an OLG economy with two-periods, it consists of continuum risk neutral households, entrepreneurs, and firms which produce final goods, banking, and government.

For the young generation, agents are endowed with one unit of labor, which they supply inelastically during the first period of their life for a wage w_t denominated in final goods, at the end of the period, these agents incur a "productivity" shock. At the end of the date *t* a random selected fraction $\varkappa$, $0 < \varkappa < 1$, is endowed with banking ability, which they will be able to set up a bank and use their wage as equity. $1 - \varkappa$ has no working ability and retires, becomes depositor. So, $(1 - \varkappa)w_t$ is divided between consumption and saving via deposits. $\varkappa w_t$ is used as equity to start a bank.

At the end of the period *t*, bankers combine their equity with deposits to lend to entrepreneurs, who invest to produce capital using one of two technologies. Entrepreneurs have access to two technologies to the production of capital, one is safe and the other is risky. Our setup considers with two technologies to highlight a familiar connection between limited liability and excessive risk taking. The ability to default on loans in the event of failure tempts entrepreneurs to use risky technology. If capital producers are not monitored properly, they may take on more risk than a hypothetical social planner would. We assume that using the risky technology to any degree is always inefficient from the planner's perspective. However, entrepreneurs may have an incentive to use the risky technology because they have limited liability, these adverse incentives create a role for prudential regulation. Banks are needed to monitor the entrepreneurs who claim to use the safe technology to ensure that they do so. We assume that only banks have the appropriate monitoring skills. We assume that the capital stock must be refurbished at the end of each period by capital producers who need to borrow the necessary funds.

Capital becomes available at the period t+1. Producers of final good are perfectly competitive and combine the capital with the labor endowment of the next generation to form a homogeneous final good. At the period *t+1*, banks receive the return on the loans that they made in period t and use it to pay back depositors, returning any profits lump–sum to the now old households, and close their doors. The new generation of young households having received their wage, then form their own set of banks which have no direct link to the previous banks and the process repeats itself. The bankers use the wage that they receive during their first period as equity to set-up a new bank under the protection of limited liability. It is assumed that a bank cannot operate without a strictly positive value of equity.

At the beginning of the period *t*, all agents borrow from banks to finance investment and make their optimization decisions. Entrepreneurs using the risky technology are subject to a failure shock that is identically and independently distributed across them. We assume that the probability of failure is known up-front, but the identity of failing entrepreneurs is only discovered after the realization of the shock. The risk is measured in terms of the composition of banks' loan portfolios.

During the second period, the savers choose to deposit their income from the previous period at the bank. Deposits are insured by the government, at the end of the second period they receive their deposit back, pay taxes and consume. They derive utility from their consumption.

We consider that a market economy with government, subject to fiscal transfers, to model the fiscal policy, let b_t denote per-capita transfers from the government to retirees. b_t is defined as encompassing all components of retirees' generational account.

3.1 Households

As in Bohn, (2009) we assume power utility over consumption of CRRA preferences. The utility of U_t of a household with all members born in period *t* is given by:

$$U_t = \frac{1}{1-\left(\frac{1}{\epsilon}\right)}\left[(C_t^1)^{1-\left(\frac{1}{\epsilon}\right)} + \frac{\Lambda}{(1+\Lambda)}(C_{t+1}^2)^{1-\left(\frac{1}{\epsilon}\right)}\right] \quad (1)$$

Where C_t^1 and C_{t+1}^2 is the consumption of the household respectively for the period t and t+1. U is strictly increasing, strictly concave, twice continuously differentiable and satisfies INADA's conditions. $0 < \Lambda \leq 1$ is time preference, $\epsilon > 0$ is the elasticity of intertemporal substitution; the limit $\epsilon \to 1$ captures log-utility. We are choosing the CRRA function to model the risk sharing in consumption in economy. Our objective is to document that risk sharing is efficient in a particular direction for a wide range of parameters and policies. The households receive a wage w_t when young. The government imposes a time invariant T on income of the young household, so after-tax earnings are $(1-T)\ w_t$. The households are born with no capital or bonds holdings. The households when they retired, and they live off of their capital and bond income. Thus, each member of the initial old generation is endowed with an equal share of the aggregate capital stock k_o

Government bonds also derive a convenience value from holding government bonds, which stems from their liquidity and safety. The representative household's period budget constraints are thus given by:

$$C_t^1 + d_t = (1-\varkappa)(1-T)\ w_t \tag{2}$$

$$C_{t+1}^2 = R^D d_t + \prod\nolimits_{t+1} + b_t \tag{3}$$

$\prod_{t+1}$ is the expected profits received from banks,
b_t is government bonds issuing,
R^D is the return on deposits,
R^b is cost of purchase bonds,

Solving the household optimization problem yields the first order condition:

$$C_{t+1}^2 = \left(\frac{\Lambda}{1+\Lambda}R^D\right)^{\epsilon} C_t^1$$

By combining (2) and (3), the optimal deposit is:

$$d_t = \frac{1}{{R^D}^{1-\epsilon}\left(\frac{\Lambda}{1+\Lambda}\right)^{\epsilon}+1}\left[(1-\varkappa)(1-T)\ w_t - \frac{\prod_{t+1}+b_t}{R^D+{R^D}^{\epsilon}\left(\frac{\Lambda}{1+\Lambda}\right)^{\epsilon}}\right] \tag{4}$$

3.2 Entrepreneur

Each Entrepreneur chooses to operate either a Safe technology *S* or a risky technology *R*. The return of the risky technology is stochastic due to limited liability, those using the risky technology will default on their loans in the event of failure.

As in Bernanke *et al.* (1999) we assume that entrepreneurs belong to a sequence of overlapping generations of two period lived risk-neutral agents. Entrepreneurs are the only agents who can own and maintain the capital stock. they own the capital good and they rent it in each period to the firms for the production of the final goods. We assume that entrepreneurs operating in the first period didn't generate income in the first period. Regardless the technology used, the return that they earn from renting is $R^K > 1$, which is the marginal product of capital in a competitive equilibrium.

Therefore, entrepreneurs do not consume in that period and derive utility only from

their old-age consumption. $U_t = \frac{1}{1-\left(\frac{1}{\epsilon}\right)}\left[(C_{t+1}^2)^{1-\left(\frac{1}{\epsilon}\right)}\right]$ (5)

Entrepreneurs finance their capital holdings with their own initial net worth and loans from the banks and by issuing equity to households E_t^j **.** Thus, capital produced by entrepreneur j is given by:

$$K_{t+1}^j = l_t^j + E_t^j \tag{6}$$

Choosing the technology R is subject to a failure shock θ_t that is independently distributed across risky producers. If the investment is successful, capital is given by:

$$K_{t+1}^j = \varsigma_t^j exp(\varepsilon_t^R)\left(l_t^j + E_t^j\right) \tag{7}$$

where ε_t^R is an exogenous stochastic productivity.

We assume that the realization of ε_t^R is always positive $(\varepsilon_t^R > 0)$ which ensure that in the absence of failure the risky technology is always more productive than the safe technology. And

$$\{\varsigma_t^j = 0 \ \ with\, probability\, \phi \qquad \varsigma_t^j = 1\, with\, probability\, 1-\phi \tag{8}$$

where $\phi \in (0,1)$ is the exogenous probability of failure,
the mean value of the failure shock is $1-\phi$,
entrepreneur j choose whether to use technology S or technology R before observing the realization of ς_t^j.

The setup of the model with two technologies serves to highlight a familiar connection between limited liability and excessive risk, if entrepreneurs are not monitored properly, they may take on more risk than a hypothetical social planner would. For exposition purpose, we assume that using the risky technology to any degree is always inefficient from a planner's perspective, as we demonstrate formally later. However, due to limited liability, entrepreneurs may have an incentive to use the risky technology.

Therefore, there is a need to monitor entrepreneurs who claim to use the safe technology; we assume that only banks have the appropriate skills for monitoring. This is motivating entrepreneurs to get funds from banks to buy unfurnished capital. We assume that the risky technology is inefficient and thus undesirable from the regulator perspective, for all realizations of ε_t^R, the following condition is imposed

$(1-\phi)exp\,(\varepsilon_t^R) \leq 1-\psi\ ,\forall\ \varepsilon_t^R > 0\ ,\phi \in [0,1)\ and\ \psi\ > 0$

ψ is the exogenous marginal resource cost of monitoring a entrepreneur who claim to use the safe technology. The left-hand side of the condition represents the expected benefit of allocating one unit of unfurnished capital to the risky technology. The right-hand side is the opportunity cost which is the output of the safe technology net of the monitoring cost.

We assume that rate of return incurred when choosing technology $h = S, R$ by borrowing l_t^j by issuing equity to households E_t^j be denoted respectively R_{t+1}^{hl} and R_{t+1}^E.

PROPOSITION 1:
If the rate of return is defined by the following equation $R_{t+1}^{Rl} + R_{t+1}^E = exp\,(\varepsilon_t^R)\big(R_{t+1}^{Sl} + R_{t+1}^E\big)$ *entrepreneurs are indifferent between the safe and risky technologies.*
If the $R_{t+1}^{Rl} + R_{t+1}^E > exp\,(\varepsilon_t^R)\big(R_{t+1}^{Sl} + R_{t+1}^E\big)$ *, then no entrepreneurs invest in the risky technology.*

Lemma 1:
An entrepreneur using the safe technology chooses K_{t+1}^j and l_t^j and E_t^j , maximizes expected profit $R^K K_{t+1}^j - R_{t+1}^{Sl} l_t^j - R_{t+1}^E E_t^j$ subject to ; the solution is $R^K = R_{t+1}^{Sl}$ with respect to l_t^j and $R^K = R_{t+1}^E$ with respect to E_t^j

An entrepreneur using technology R chooses K_{t+1}^j and l_t^j and E_t^j, maximizes expected profit $(1-\phi)\left(R^K K_{t+1}^j - R_{t+1}^{Rl} l_t^j - R_{t+1}^E E_t^j\right) + p.0$ subject to and ; the solution is $R^K exp\,(\varepsilon_t^R) = R_{t+1}^{Rl}$ with respect to l_t^j, and $R^R exp\,(\varepsilon_t^R) = R_{t+1}^E$ with respect to E_t^j.

Our model allows for a different rate of return, banks need to monitor the entrepreneur that borrow at the lower rate to ensure that they use the associated technology. So as stated in the proposition the entrepreneur is indifferent between the safe and the risky technology when:

$$R_{t+1}^{Rl} + R_{t+1}^E = exp\,(\varepsilon_t^R)\big(R_{t+1}^{Sl} + R_{t+1}^E\big).$$

However, when $R_{t+1}^{Rl} + R_{t+1}^E > exp\,(\varepsilon_t^R)\big(R_{t+1}^{Sl} + R_{t+1}^E\big)$ there is not an investment in the risky technology and there is not a demand for risky loans.

If $R_{t+1}^{Rl} + R_{t+1}^E < R_{t+1}^{Sl} + R_{t+1}^E$, there is no equilibrium. Therefore, there is no need for banks to monitor entrepreneurs that claim to use the risky technology. And there will be no demand for risky loans if the rate of return $R_{t+1}^{Rl} + R_{t+1}^{E}/R_{t+1}^{Sl} + R_{t+1}^{E}$ is strictly higher than $exp\ (\varepsilon_t^R)$**.**

Entrepreneur are indifferent between the two technologies and $\frac{R_{t+1}^{Rl}+R_{t+1}^{E}}{R_{t+1}^{Sl}+R_{t+1}^{E}} = exp\ (\varepsilon_t^R)$ if the rate of return ratio on the left-hand side is higher than the critical value on the right-hand side, then entrepreneur use only safe technology.

3.3 Firms: Final Goods Producers

There is a perfectly competitive production of the final good. Firms combine capital rented from entrepreneurs and entrepreneurial labor inputs to produce the final good. Firms can only use a riskless or risky production technology. The riskless technology is standard. $\boldsymbol{F}(.)$ is a production function exhibiting constant returns to scale which allow us to write the production function as an aggregate relationship. We consider Cobb-Douglas production as a common assumption in OG and macro literature. We consider the attitude of the producer towards the risk in a further step when we measure the equilibrium within the deposit market, the steady state, and the macro-prudential policy by including to independent technologies the safe technology and the risky technology. As in (Bernanke *et al.*, 1999) we specify the aggregate production function relevant to the period t as:

$$Y_t = A_t N_t^{1-\alpha} K_t^{\alpha} \tag{9}$$

Y_t is aggregate output of wholesale goods; $0 < \alpha < 1$**;** A_t is a random variable, distributed over R_0^+ with density function$f(A_t)$ that captures aggregate risk. N_t is the number of worker, and K_t is the aggregate capital stock purchased by entrepreneurs in period t-1.

$$K_t = \int_0^1 K_t^j d_j \tag{10}$$

There is an Arrow –Romer type externality associated with the capital labor ratio:

$$k_t = \frac{K_t}{N_t} \text{ so that } A = A_t k_t^{1-\alpha} \tag{11}$$

thus the production per worker is define by $y_t = Ak_t$ (12)

As the firm operate in competitive conditions so the realized prices of capital rental and wage rate correspond to the realized marginal productivity in equilibrium:

$$\{w_t = (1-\alpha)A_t k_t^{\alpha} = (1-\alpha)Ak_t\ R^K = \alpha A_t k_t^{\alpha-1} = \alpha\ A\} \tag{13}$$

The firm maximizes shareholder value net of initial equity investment:

$$\pi^E = \frac{\left(F(K.N) - wN - R^l(K-E)\right)}{(R^E - E)} \tag{14}$$

The first order condition yields to

$$F_N(K.N) = w$$
$$F_K(K.N) = R^l$$

$$\frac{R^l}{R^E} = 1 - \mu \ \ , \mu \geq 0$$

As in Van den Heuvel (2008), If $R^E > R^l$, then $E = 0, and\ K = l$; it means that if bank loans are cheaper than equity finance, the firm chooses only bank loans to finance the stock of capital. If $R^E = R^l$, then the firm's financial structure is not determined by individual optimality.

3.4 Banks

The part of households $\varkappa$ that use their wage income to capitalize a bank with $E_t = \varkappa w_t$**,** so that bank equity is given by $E_t = \varkappa(1-\alpha)Ak_t$. They can make safe and risky loans. Some banks are specialized in the risky technology and others in the risk-free; they incur a cost of monitoring safe loans. They may hold government bonds b_t and finance these assets by accepting deposits d_t and raising equity E_t**.** So that their balance sheet identity is:

$$l_t^S + l_t^R + b_t = E_t + d_t - (1-T)\psi l_t^S \tag{15}$$

Assets		Liabilities	
l_t	Loans	d_t	Deposits
b_t	Bonds	E_t	Equity

According to the previous assumption of the model, risky project reduce welfare, thus the regulation will devise a sufficient penalty to prevent any risky project once it is detected. We need information friction to rule out a trivial and unrealistic solution in which the regulators directly forbid risk taking. As in (Van den Heuvel, 2019; 2008), (Collard *et al.*, 2017) and (Agénor and da Silva, 2017), we assume that banks can hide some risky loans in their portfolio from regulators. More specifically we suppose that regulators observe the total amount of loans made by each bank but cannot detect its risky loans up to a given fraction γ of its safe loans. The regulator imposes full risk-weighted capital requirement on risky loans above γ. The capital requirement is specified by the following formula:

$$E_t \geq \vartheta_t \left(l_t^S + l_t^R\right) + \underline{\vartheta}\, max\{0, l_t^R - \gamma l_t^S\}$$

ϑ is the capital adequacy ratio, the prudential authority will optimally choose a sufficient high $\underline{\vartheta}$ to ensure that $l_t^R < \gamma l_t^S$ in equilibrium. As in Van den Heuvel (2008) we assume that banks benefit from the government another form of regulation, deposit insurance. The deposit insurance fund ensures that no depositor suffers a loss in the event of a bank failure. That is all deposits are fully insured. The existence of this guarantee and the condition that equity is more expensive than deposit finance ensures that banks will hold no more equity than required by regulation and that will choose as much leverage as allowed by the financial regulator. Therefore, this is equivalent to rewriting the capital requirement as a minimum ratio of equity to loans:

$$E_t = \vartheta_t \, (l_t^S + l_t^R) \tag{16}$$

The government is not modeled. We assume that the government bonds have a zero-risk weight. Banks must satisfy a liquidity requirement by holding a minimum level of government bonds set equal to a fraction λ of deposits: $b_t \geq \lambda \, d_t$.
The expected bank profit can be defined as:

$$\pi_{t+1} = R_{t+1}^S l_t^S + (1-\phi) R_{t+1}^R \gamma l_t^S - R^D (d_t - b_t) + R^E E_t \tag{17}$$

To proof that bank equity finance are more costly than debt finance, we attribute a tax distortion. We assume that gross revenues from loans are taxed at the constant rate T after deduction for gross payment on deposits and monitoring cost.
Banks choose $E_t, d_t, b_t, l_t^S, l_t^R$ to maximize

$$U_t = \{(1-T) W_{t+1}\} - E_t - (1-T)\psi_t l_t^S \tag{18}$$

$$\text{and } W_{t+1} = max\left\{0, \frac{R_{t+1}^S}{\pi_{t+1}} l_t^S + (1-\phi)\gamma \frac{R_{t+1}^R}{\pi_{t+1}} l_t^S + \frac{R^b}{\pi_{t+1}} b_t - \frac{R^D}{\pi_{t+1}} d_t\right\} \tag{19}$$

Banks choose either l_t^S only, or l_t^R and l_t^S, to maximize their profit. To resolve the optimization problem, we present four implications:

- Each bank fund at most one risky project;
- All banks take no risk or the maximum undetected risk;
- The capital requirement is binding;
- There is a financial wedge that depends on capital requirements and exogenous variables.

As in Collard *et al.* (2017) we assume that bank funds the risky project of a number of entrepreneur j in some finite set I subject to:

$$\textstyle\sum_{j \in I} l_t^R(j) = l_t^R \tag{20}$$

$$\text{and } \quad r_{t+1} = \left(1 + R^{Rl}\right) \textstyle\sum_{j \in I} (1-\phi) l_t^R(j)\,, \tag{21}$$

r_{t+1} is the gross nominal return on the bank's portfolio of risky loans. We assume that $h_t = R^D d_t - R^S_{t+1} l^S_t - R^b b_t$, for a given $d_t, l^S_{t,} l^R_t$, and b_t.
The bank's objective is rewritten $E\{max[0, r_{t+1} - h_t]\}$
We have:

$$E\left(\left(1 + R^{Rl}\right) \sum_{j \in I} (1 - \phi) l^R_t(j)\right) = (1 - \phi)\left(1 + R^{Rl}\right) l^R_t \qquad (22)$$

So

$$E\{max[0, r_{t+1} - h_t]\} = Pr\{r_{t+1} > h_t\} E\{r_{t+1} - h_t | r_{t+1} > h_t\}$$

$$= E\{r_{t+1} - h_t\} - Pr\{r_{t+1} \leq h_t\} E\{r_{t+1} - h_t | r_{t+1} \leq h_t\}$$

$$= (1 - \phi)\left(1 + R^{Rl}\right) l^R_t - h_t - Pr\{r_{t+1} \leq h_t\} E\{r_{t+1} - h_t | r_{t+1} \leq h_t\}$$

The objective of the bank is minimizing the negative random variable on the right-hand side. Maximizing the gains to the bank when it does not default is equivalent to maximizing the losses of the deposit-insurance fund when the bank defaults. The resolution of the optimization problem can be summarized in the following proposition.

PROPOSITION 2:
All banks take only one risky project$(l^R_t = 0)$*, or they take the maximum undetectable risk*$(l^R_t = \gamma l^S_t)$*. There is no equilibrium with*$(0 < l^R_t < \gamma l^S_t)$.

We prove the following proposition using the same intuition as in Van den Heuvel, (2008); Collard *et al.* (2017), if, given the loan portfolio, bank equity is sufficiently small to be wiped out when risky projects fail, then banks do not internalize the cost of additional risk taking. Additional losses from increasing l^R_t, if risky projects fail, are truncated by deposit insurance and limited liability, consequently the only possibility of equilibrium with bank failure involves the corner solution $l^R_t = \gamma l^S_t$. Alternatively, if bank equity is sufficiently large for banks to remain solvent even when risky project fail, then banks internalize the cost of additional risk taking. In that case, basic on the assumption that the risky technology is inefficient banks can increase their actual profit by reducing. Accordingly, the only equilibrium without the possibility of bank failure involves the solution $l^R_t = 0$.

PROPOSITION 3:
In equilibrium, the capital constraint is binding

$$E_t = \vartheta_t \left(l^S_t + l^R_t\right) \qquad (23)$$

The proof of this proposition is provided the same as in Collard *et al*. (2016). We use $l^S_t + l^R_t + b_t = E_t + d_t - (1 - T)\psi l^S_t$ in order to eliminate d_t, and $E_t = \vartheta_t \left(l^S_t + l^R_t\right)$ to eliminate E_t.

We assume that in equilibrium $b_t = \lambda\, d_t$ (24)

The representative bank 's objective can be rewritten:

$$(1-T)E\{\pi(w_{t+1})\} - [\vartheta_t + (1-T)\psi - \lambda]l_t^S \quad (25)$$

and

$$W_{t+1} = max\left\{0, \frac{R_{t+1}^S}{\pi_{t+1}} l_t^S + (1-\phi)\gamma \frac{R_{t+1}^R}{\pi_{t+1}} l_t^S + \frac{R^b}{\pi_{t+1}} b_t - \frac{R^D}{\pi_{t+1}} d_t\right\} \quad (26)$$

So $W_{t+1} = \left[\frac{R_{t+1}^S - R^D}{\pi_{t+1}} + \vartheta_t \frac{R^D}{\pi_{t+1}}\right] l_t^S + \frac{R^b}{\pi_{t+1}} b_t$

In case $l_t^R = 0$:

The loan spread is given by $\frac{R_{t+1}^S}{R^D} = \frac{(1-\lambda)\left((1-\vartheta_t)+(1-T)\psi\right)}{(1+\vartheta_t)}$ (27)

Basic on this result the following proposition can be mentioned:

PROPOSITION 4:
The spread between the safe return and the deposit rate is increasing in the monitoring cost and capital adequacy and decreasing in the tax.

The intuition is the same as in Collard *et al.* (2017). The wedge reflects monitoring cost and the higher cost of equity funding that arises from the interaction between the tax distortion and capital requirements. A target policy of increasing ϑ_t increase the wedge by forcing banks to rely on equity finance more heavily.

A higher capital requirement raises the loans rate due to the regulatory constraint. In fact, with the given level of equity, the regulatory constraint implies that a higher ϑ_t raises the funding costs for banks; to keep profits constant, the cost of loans must increase.

In case $l_t^R = \gamma l_t^S$:

The loan spread is given by $\frac{R_{t+1}^S}{R^D} = \frac{(1-\lambda)\left((1-\vartheta_t)(1+\gamma)+(1-T)\psi\right)}{\left(1+ exp(\varepsilon_t^R)(1-\phi)\gamma+\vartheta(1+\gamma)\right)}$ (28)

PROPOSITION 5:
The bank enables to make risky loans once it makes risky loans. The financial wedge depend positively to the parameter γ and ϕ, and decreasing in the shocks ε_t^R related to the risky technology.

Banks at the maximum risk incur losses on their safe loans and make profits on their risky loans that compensate for these losses. In case that the bank didn't incur losses on their safe loans, then the maximum risk would not be at the equilibrium.
If the demand for safe and risky loans falls, higher capital requirement would induce less risk taking, in line with the common moral hazard argument emphasized in the literature.

3.5 Deposit Market Equilibrium

For banks that provide safe and risky loans, a necessary condition for raising deposits to be profitable is $R_{t+1}^{R} > R_{t+1}^{D}$ and $R_{t+1}^{S} > R_{t+1}^{D}$. Given that there is no equilibrium if $R_{t+1}^{R} < R_{t+1}^{S}$ and $R_{t+1}^{S} > R_{t+1}^{D}$, this condition is always satisfied. As the bank take the maximum of risk the demand of deposit in equilibrium will be until the regulatory constraint is binding. The demand for deposit can be solved using the balance sheet and capital requirements constraint, and bonds government constraint:

$$\{E_t = \vartheta_t\,(l_t^S + l_t^R)\; l_t^S + l_t^R + b_t = E_t + d_t - (1-T)\,\psi l_t^S\; b_t = \lambda\, d_t$$

If $\quad l_t^R = 0 \qquad d_t = \left(\frac{1+\psi(1-T)-\vartheta_t}{\vartheta_t(1-\lambda)}\right) E_t \qquad (29)$

If $\quad l_t^R = \gamma l_t^S \qquad d_t = \frac{(1+\gamma)(1-\vartheta_t)+\psi(1-T)}{\vartheta_t(1-\lambda)(1+\gamma)} E_t \qquad (30)$

In equilibrium, banks make zero, the supply of deposits by households is simply

$$d_t = \qquad \frac{1}{{R^D}^{1-\epsilon}\left(\frac{\Lambda}{1+\Lambda}\right)^{-\epsilon}+1}\left[(1-\varkappa)(1-T)\,w_t - \frac{b_t}{R^D+{R^D}^{\epsilon}\left(\frac{\Lambda}{1+\Lambda}\right)^{\epsilon}}\right] \qquad (31)$$

We assume that the deposit rate is exogenous on the capital market and equilibrium is obtained through a quantity adjustment. Therefore, in equilibrium the supply and demand for deposits must be equal. The following equation can be solved for $\varkappa$ the share of income allocated to equity, the size of the banking system. $E_t = \varkappa w_t$, and $b_t = \lambda d_t$

$$d_t = \frac{1}{\varrho}(1-\varkappa)(1-T)\,w_t \qquad (32)$$

Where $\varrho = {R^D}^{1-\epsilon}\left(\frac{\Lambda}{1+\Lambda}\right)^{\epsilon} + 1 + \frac{\lambda}{R^D+{R^D}^{\epsilon}\left(\frac{\Lambda}{1+\Lambda}\right)^{\epsilon}}$

If $\quad l_t^R = 0$

$$\varkappa = \frac{1}{\Omega_1} < 1 \qquad (33)$$

$$\Omega_1 = 1 + \frac{\varrho(1+\psi(1-T)-\vartheta_t)}{\vartheta_t(1-\lambda)(1-T)}$$

If $\quad l_t^R = \gamma l_t^S$

$$\varkappa = \frac{1}{\Omega_2} < 1 \tag{34}$$

$$\Omega_2 = 1 + \frac{\varrho\big((1+\gamma)(1-\vartheta_t)+\psi(1-T)\big)}{\vartheta_t(1-\lambda)(1+\gamma)(1-T)}$$

PROPOSITION 6:

An increase in the capital ratio ϑ_t increases the size of the banking system, $\frac{d\varkappa}{d\vartheta} > 0$, and lowers the share of deposits

The intuition is the same as in Agénor and da Silva (2017), a higher capital adequacy ratio increase equity needs. For a given wage, the equilibrium mechanism operates through a higher share of bankers in each household, who provide the initial net worth that banks use to fund their lending operations. The decrease of the share of deposits is an implication for an increase in capital requirements as it has an implication for the response of household income.

4. Welfare Analysis

In this part of the paper, we establish firstly the balanced growth path and then the steady state equilibrium.

$l_t^R = 0 \qquad K_{t+1}^j = l_t^j + E_t^j$

If $\quad l_t^R = \gamma l_t^S \qquad K_{t+1}^j = \varsigma_t^j exp(\varepsilon_t^R)\big(l_t^j + E_t^j\big)$

$$E_t = \vartheta_t\,(l_t^S + l_t^R)$$

Then:

$K_{t+1}^j = l_t^S + \vartheta_t l_t^S \qquad$ When $\quad l_t^R = 0$

$K_{t+1}^j = (1-\phi)exp(\varepsilon_t^R)\Big((1+\vartheta_t)\,(l_t^S + l_t^R)\Big) \qquad$ when $\ l_t^R = \gamma l_t^S$

Using $E_t = \varkappa(1-\alpha)Ak_t$ and $E_t = \vartheta_t\,(l_t^S + l_t^R)$

$$\frac{K_{t+1}}{K_t} = 1 + g = \frac{\varkappa}{(1+\vartheta_t)}(1-\alpha)A \quad \text{When} \quad l_t^R = 0 \tag{35}$$

$$E\left(\frac{K_{t+1}}{K_t}\right) = 1 + g = (1-\phi)exp(\varepsilon_t^R)\left(1+\frac{1}{\vartheta_t}\right)\varkappa(1-\alpha)A \quad \text{when} \ l_t^R = \gamma l_t^S \tag{36}$$

E is the expectations operator.

The equation (35) and (36) define the steady state growth rate of capital and using (18) the final output growth. The effect of an increase in the capital adequacy on the growth rate depends on the sign of $\frac{d\left(\frac{\varkappa}{\vartheta_t}\right)}{d\,\vartheta_t}$; more specifically an increase in ϑ_t reduces the growth rate directly. Also, confirming by the proposition 6, banks must raise more equity and the deposits, it will increase the size of the banking market and then promote the economic growth.

By comparing (35) and (36), and basic in the assumption 1 developed, whether growth is higher when the safe technology is used, compared to the risky technology, depends on whether Ω_1 (from (33)) is higher or lower than Ω_2 (from (34)). By comparing Ω_1 and Ω_2, we find that $\Omega_2 < \Omega_1$ which implies that the banking market size $\varkappa$ in case of $l_t^R = \gamma l_t^S$ is higher than the banking market size in case of $l_t^R = 0$. $\frac{d(\Omega_2-\Omega_1)}{d\gamma} < 0$, a higher detectability threshold tends to increase the growth rate under the equilibrium with risky loans, relative to the equilibrium with safe loans.

5. Prudential Policy

The government targets the market condition by two policy instruments: deposit insurance for monetary policy and capital requirements for prudential policy. Conduct bank supervision by the government is not only to enforce the capital requirement but also to monitor the excessive risk.

Our focus is on the gains from coordinating macroprudential and monetary policies. In this section we will consider different assumptions for how policymakers set their monetary and macroprudential instruments.

To deduct the capital requirements equation, we can use (33) and (34):
In case $l_t^R = 0$

$$\vartheta_t = \frac{\varkappa\varrho\big(1+\psi(1-T)\big)}{(1-\varkappa)(1-\lambda)(1-T)} \tag{37}$$

In case $l_t^R = \gamma l_t^S$

$$\vartheta_t = \frac{\varkappa\varrho\big((1+\gamma)+\psi(1-T)\big)}{(1-\varkappa)(1-\lambda)(1+\gamma)(1-T)+\varkappa\varrho(1+\gamma)} \tag{38}$$

In the steady state equilibrium, the optimal capital requirement can be determined by the welfare-maximizing value of the capital adequacy. The financial regulator act as a social planner considering the welfare of all generations of entrepreneurs and households. The financial regulator is concerned primarily by the safety of the financial system, is also concerned by the maximization of social welfare. To do so, it needs to calculate the welfare for each generation in which households consume in both periods and entrepreneurs consume only in adulthood.

Let's start by the welfare maximization of financial regulator in adulthood of entrepreneur:

If $l_t^R = 0$

An entrepreneur's income in case of using the safe technology is described by the following equation $C_{t+1}^e = R^K K_{t+1}^j - R_{t+1}^S l_t^S + R_{t+1}^E E_t^j$ using (13), (16), and (27), that imply:

$$C_{t+1}^e|_{l_t^R=0} = \frac{E_t}{\vartheta_t}\left[\alpha A + \vartheta_t - \left((1-\vartheta_t) + (1-T)\psi\right)R_{t+1}^D\right]$$

Using $E_t = \varkappa(1-\alpha)Ak_t$ and (6), an entrepreneur's indirect utility function is thus:

$$V_{t+1}^e|_{l_t^R=0} = V_m^e|_{l_t^R=0}\, k_t^{1-\left(\frac{1}{\epsilon}\right)}\left(\frac{1}{1-\left(\frac{1}{\epsilon}\right)}\right) \tag{39}$$

Where

$$V_m^e|_{l_t^R=0} = \left\{\left[\alpha A + \vartheta_t - \left((1-\vartheta_t) + (1-T)\psi\right)R_{t+1}^D\right]\varkappa(1-\alpha)\right\}^{1-\left(\frac{1}{\epsilon}\right)} \quad \vartheta_t^{\left(\frac{1}{\epsilon}\right)-1}$$

If $l_t^R = \gamma l_t^S$

An entrepreneur's income in case of using the risky technology is described by the following equation $C_{t+1}^e = R^K K_{t+1}^j - (1-\phi)R_{t+1}^R l_t^R + R_{t+1}^E E_t^j$ using (13), (16), (28) , and proposition 1 that imply:

$$C_{t+1}^e|_{l_t^R=\gamma l_t^S} = \frac{E_t}{\vartheta_t(1+\gamma)}\left[\alpha A(2\gamma+1) - \left((1-\phi)exp(\varepsilon_t^R)\gamma + (1+\gamma)\right)\left(\frac{(1-\lambda)\left((1-\vartheta_t)(1+\gamma)+(1-T)\psi\right)}{\left(1+exp(\varepsilon_t^R)(1-\phi)\gamma+\vartheta(1+\gamma)\right)}\right)R_{t+1}^D\right]$$

Using $E_t = \varkappa(1-\alpha)Ak_t$ and (6), an entrepreneur's indirect utility function is thus:

$$V_{t+1}^e|_{l_t^R=\gamma l_t^S} = V_m^e|_{l_t^R=\gamma l_t^S}\, k_t^{1-\left(\frac{1}{\epsilon}\right)}\left(\frac{1}{1-\left(\frac{1}{\epsilon}\right)}\right) \tag{40}$$

Where

$$V_m^e|_{l_t^R=\gamma l_t^S} = \left\{\left[\alpha A(2\gamma+1) - \left(\left((1-\phi)exp(\varepsilon_t^R)\gamma + (1+\gamma)\right)\left(\frac{(1-\lambda)\left((1-\vartheta_t)(1+\gamma)+(1-T)\psi\right)}{\left(1+exp(\varepsilon_t^R)(1-\phi)\gamma+\vartheta(1+\gamma)\right)}\right)\right)R_{t+1}^D\right]\varkappa(1-\alpha)\right\}^{1-\left(\frac{1}{\epsilon}\right)} \vartheta_t^{\left(\frac{1}{\epsilon}\right)-1}$$

For household given that there is no bequest, using (1), (2), (3), (13), and (32) their indirect utility function in both equilibria, using risky and safe technology, takes the form:

$$V_t^H = V_m^H \left(\frac{1}{1-\frac{1}{\epsilon}}\right) k_t^{1-\frac{1}{\epsilon}} \tag{41}$$

where:

$$V_m^H = \left[(1-\varkappa)(1-T)(1-\alpha)\left(1-\frac{1}{\varrho}\right)A\right]^{1-\frac{1}{\epsilon}}\left(1+\frac{\Lambda}{1+\Lambda}\left(\left(\frac{\Lambda}{1+\Lambda}\right)R_{t+1}^D\right)^{1+\epsilon-\frac{1}{\epsilon}}\right)$$

Households and Entrepreneur represent each one the half of the population as in De la Croix and Michel (2002), the welfare criterion is the equally weighted sum within each generation discounted sum of utility across an infinite sequence of generations.

$$F = \sum_{h=0}^{\infty} \rho^h 0.5\left(V_{t+1+h}^e + V_{t+h}^H\right) \tag{42}$$

$\rho \in (0,1)$ is the regulator's discount factor. Using (40) and (41), along the balanced path,

$$F = \sum_{h=0}^{\infty} \rho^h 0.5(V_m^e + V_m^H)\left(\frac{1}{1-\frac{1}{\epsilon}}\right) k_t^{1-\frac{1}{\epsilon}}$$

Using (35) and (36), k_t grows at a constant rate, $1+g$ q $\tilde{k}_{t+h} = (1+g)^{t+h} k_0$.

Thus, the sum of utility across an infinite sequence of generations is define by the following equation.

$$F = \sum_{h=0}^{\infty} \rho^h\, 0.5(V_m^e + V_m^H)\left(\frac{1}{1-\frac{1}{\varepsilon}}\right)\left((1+g)^{t+h}\right)^{1-\frac{1}{\epsilon}}$$

To solve the optimization problem, the derivation of F yield to the following solution:

$$F \simeq (V_m^e + V_m^H)\left(\frac{1}{1-\frac{1}{\epsilon}}\right)\frac{1}{1-\rho}\left(\left(\frac{1}{(1+g)^2}\right)\right)^{1-\frac{1}{\epsilon}}$$

The optimal value of ϑ_t is obtained by the maximization of F subject to $\vartheta_t.\ \frac{dF}{d\vartheta_t}$ =0. It is quite important de discuss the relation between the welfare maximization ant the optimal value of the capital adequacy. For that we assume that $\vartheta_t^*|_{l_t^R=\gamma l_t^S}$ and $\vartheta_t^*|_{l_t^R=0}$ denote the welfare maximization solution in the equilibrium respectively with risky technology and safe technology; and $F^*|_{l_t^R=\gamma l_t^S}$ and $F^*|_{l_t^R=0}$ denote the corresponding value of welfare, scaled by the value when $\vartheta = 0$. $F(\tilde{\vartheta})$ denote the relative value of welfare when $\vartheta = \tilde{\vartheta}$.

If $\vartheta_t^*|_{l_t^R=0} > \tilde{\vartheta}$ there is a welfare gain compared to $\vartheta = \tilde{\vartheta}$, as there is an increasing in welfare $F^*|_{l_t^R=0} > F(\tilde{\vartheta})$

If $\vartheta_t^*|_{l_t^R=0} < \tilde{\vartheta}$ the bank benefit a little from limited liability, as it incurs most of the loss on its risky loans when the risk materializes; therefore there is a welfare loss compared to $\vartheta = \tilde{\vartheta}$ and a decreasing in welfare $F^*|_{l_t^R=0} < F(\tilde{\vartheta})$

6. Numerical Analysis

The calibration of the model, which we view as illustrative, dwells on several literature related to monetary policy and economic growth in which authors develop models of Turkey. The calibration is based on annual data for Turkey over the period 1985-2015. The baseline parameterization of the model is partly based on values that are standard in the literature and partly on choices that constitute only a first attempt to illustrate the qualitative and potential quantitative properties of the model.

6.1 Calibration

We assume that an annual discount factor is 0.04 for both households and the regulator, and interpret a period as 30 years, yields an intergenerational discount factor $\rho = \Lambda = 0.308$**,** whereas the gross deposit rate is set at 1.047.

Regarding the technology parameter, we set α, the share of capital in the production function, to 0.4 as in Mimir and Sunel, (2019). The CRRA parameter is set to 1.5, which is a common value used in the literature. We set the aggregate productivity level A to 4.5. Following Collard *et al.* (2017) we set the probability of failure ϕ =0.034. The cost of monitoring is set $\psi = 0.15$ as in Alp and Elekdag (2011). We set the $\gamma = 1.0$ and $\lambda = 0.25$. We set the exogenous stochastic productivity $\varepsilon =$

0.032. The tax rate is set $T = 0.02$ as it is chosen in (Aoki et al., 2019). The table 1 reports all the parameter Values. One period in the model corresponds to one quarter in calendar time.

Table 1. *The Baseline parametrization of the model*

	Description	Parameter	Value
Households	discount factor	$\rho = \Lambda$	0.308
	elasticity of intertemporal substitution	ϵ	1.5
Entrepreneurs	probability of failure	ϕ	0.034
Firms	share of capital in the production	α	0.4
	The aggregate productivity	A	2.5
Banks	Cost of monitoring	ψ	0.15
	Risky loans fraction's of safe loans	γ	1.0
	Government bonds fraction's of deposits	λ	0.25
	Gross deposit rate	R^D	1.047
Shocks process	stochastic productivity	ε	0.032

Source: *Own Calibration, created by the authors using the results from the study.*

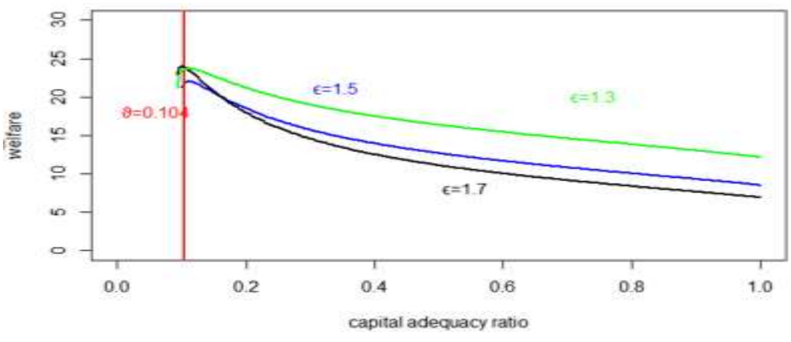
6.2 Results

We analyze the long-run implications of different levels of capital requirements, firstly and secondly the implications of productivity shocks on capital requirements and the welfare in steady state.

According to Basel Accord III (2013), the minimum threshold of the capital adequacy ratio is set to 0.104. In the rest of our result, we will take into consideration the limitation of the minimum. Our specification treats the two cases: use of risky technology and use of safe technology. To compute the impact of risk sharing on the welfare, the intertemporal elasticity of substitution is set at $\epsilon = 1.5$, $\epsilon = 1.3$, $\epsilon = 1.1$. The deviation of the risk sharing from the optimum provide an amelioration for the social welfare in case where $\vartheta = 0.104$.

However, $\epsilon > 1.5$ the welfare of the economy decreases comparing to the case of $\epsilon \leq 1.5$. This illustrates that higher CRRA parameter is not enough in a production-based general equilibrium model to match the high welfare. The risk sharing in safe loan equilibrium tends to have an important impact on the welfare once it is in the steady state equilibrium. More the economic system behaves with the risk sharing behavior more the cost of loans being low and more improvement of the investment and then rise the welfare of the economy. The introduction of risk sharing in safe loans improve the financial stability and the welfare of the economy as the agent had risk aversion towards the risky loans. The risk sharing model using the safe technology has an impact on targeting the investment for the most profitable system and target the monetary policy for the optimum by maintaining the financial stabilization.

Figure 1. *Growth welfare in safe-loan equilibrium*

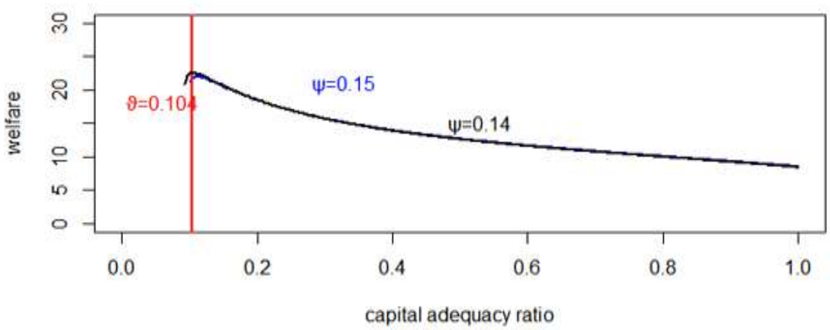


Source: *Own study.*

The capital adequacy ratio and the welfare have convex curve describing that the rise of the capital adequacy ratio is followed by the decrease of the welfare. The optimal value of the capital adequacy is $\vartheta_t^*|_{l_t^R=0} = 0.1106329$ which correspond to the value of welfare $F^*|_{l_t^R=0} = 22.06337$. The social welfare corresponds for the case of $\vartheta \simeq 0, F = 21.84521$. therefore, as ϑ decreases, the cost of monitoring declines as bank finances these loans with a large fraction of deposits which are cheaper than equity due to tax distortion, and so that the cost of borrowing for entrepreneurs declines and the capital stock rises. So based on that, ϑ decreases to ϑ^*, the welfare rises. The welfare loss when the regulator chooses $\vartheta = 0.104$ is 22 percentage points. So, the equilibrium with safe loans provides higher welfare gain which suggests a conflict in the trade-off between financial stability and welfare maximization.

As shown in Figure 1 a lower marginal cost of monitoring from $\psi = 0.15$ to $\psi = 0.14$ would decrease the optimal value of capital adequacy ratio $\vartheta_t^*|_{l_t^R=0}$ from 0.1106329 to 0.1047046. Then a lower monitoring cost rise the cost of borrowing and decreases the demand for loans. So, eliminating the risky-loan equilibrium requires therefore a lower capital adequacy ratio.

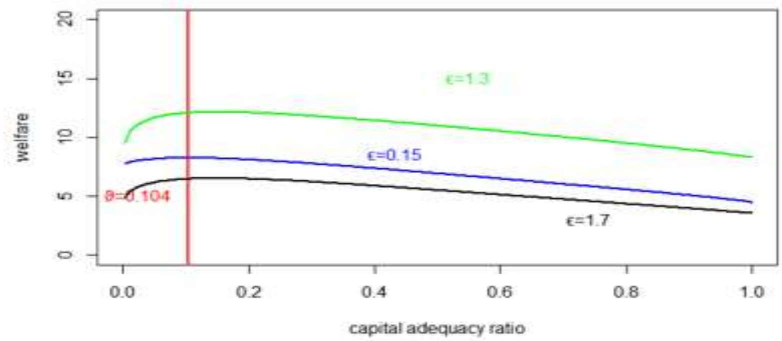
Figure 2. *Growth welfare in safe-loan equilibrium*



Source: *Own study.*

Now we turn to the loan-risky equilibrium. We take the case of fluctuation of the CRRA parameter between 1.3 and 1.7. The decrease of the risk sharing parameter from the optimum ($\epsilon = 1.5$) rise the welfare growth and the capital adequacy ratio. Thus, higher CRRA parameter than the optimum provides a lower growth. This can be explained by the behavior of the consumer, entrepreneur, and banker which they express high risk aversion towards the risky technology. The introduction of risk-sharing in the risky technology has an important impact on the banking system by mitigate the excessive risk, improve the investment, and then rise the welfare. However, risk sharing model didn't totally mitigate the excessive risk. This is confirmed that the micro-economic behavior to manage the risk through the CRRA model is not enough and the introduction of the corporate governance may influence on the monetary policy and targeting the macroprudential policy for the steady state equilibrium.

Figure 3. *Growth welfare in safe-loan equilibrium*



Source: *Own study.*

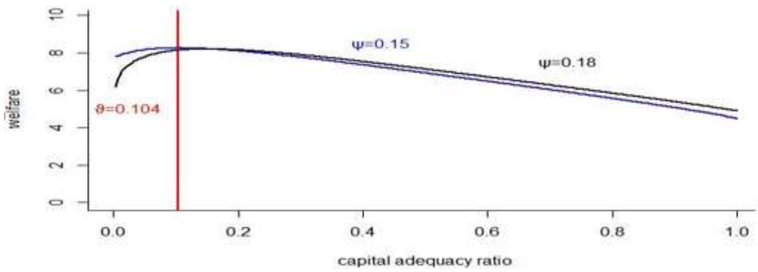
The optimal capital adequacy in risky-loan equilibrium is $\vartheta_t^*|_{l_t^R=\gamma l_t^S} = 0.10564$**,** which correspond to the welfare value in the steady state equilibrium $F^*|_{l_t^R=\gamma l_t^S}$ =8.256281.

We consider alternative specifications of prudential policy. $\vartheta_t^* = \vartheta_t$**,** $\vartheta_t = 0.104$**,** and $\vartheta_t = 0.14$**.** And we will measure the welfare cost for such specification. In the risky-loan equilibrium, the welfare is a decreasing function, an increase of the capital adequacy ratio provides a decrease in the welfare. For $\vartheta_t = 0.104$, the welfare value corresponds to $F^*|_{l_t^R=\gamma l_t^S}$ =8.256356.

Thus, when the regulator chooses $\vartheta_t = 0.104$ for the risky loan equilibrium, the welfare loss is 0.007 percentage points which is approximately zero. Then in the risky technology the regulator chooses the capital ratio adequacy which maximizes the social welfare without any loss. Therefore, the regulator is indifferent between the steady state value of capital adequacy ratio and the social welfare value that corresponds to the capital adequacy ratio $\vartheta_t = 0.104$**.** In case $\vartheta_t = 0.14$**,** the welfare value corresponds to $F^*|_{l_t^R=\gamma l_t^S}$ =8.229121, the welfare loss is 27 percentage points. The equilibrium with risky loans suggests a higher welfare in the steady state.

We will conduct a simulation for the cost of monitoring as the risky loan equilibrium suggests a conflict between welfare and financial stabilization. A higher marginal cost of monitoring from $\psi = 0.15$ to $\psi = 0.18$ would increase the optimal value of capital adequacy ratio from 0.10564 to 0.1149352**,** and the welfare value in the steady state would decrease from 8.256281 to 8.244813. Then, a higher monitoring cost would decrease the welfare.

Figure 4. *Growth welfare in safe-loan equilibrium*



Source: *Own study.*

7. Discussion

The model allows us to study the macroeconomic consequences of capital requirements in case of risk sharing model. The introduction of capital requirements as a tool to mitigate the excessive risk may have a macroeconomic consequence on the economy such as social welfare. The basic result of the model meets that the capital requirements affect the level of consumption, the deposits, the capital accumulation, and the social welfare. Simulations show that for both specifications (risky and safe) the loan equilibrium provides higher welfare gain which suggests a conflict in the trade-off between financial stability and welfare maximization.

The regulator requires to set a macroprudential policy targeting the financial stability by setting the capital adequacy ratio at a high level comparing to its value for the corresponding social welfare, which result a welfare loss. If the capital adequacy ratio set at a very high level optimally, they promote the development of the shadow-banking sector which may negatively affect the growth and reducing the welfare, weaken the financial stability, and distort the functioning of the banking system.

Then, the setting of the macroprudential policy need to be rationally targeted the optimal value of the capital adequacy ratio to resolve the trade-off between the financial stabilization and the welfare. The introduction of risk sharing in both specifications confirm that the risk sharing behavior of the financial have a positive impact on the social welfare and in setting the macroprudential policy. The high aversion towards the risk for both specifications confirm that the risk sharing model have a high significant and positive impact on the welfare, by reducing the cost of loans, and encourage the investment. The risk sharing model tend to target the economic system to the most profitable investment and target the monetary policy for the optimum by maintaining financial stabilization.

However, it is important to mention that the risk sharing model is not enough to mitigate the excessive risk and target the economy to the social welfare, the introduction of corporate governance in the financial system tend to maintain the role of the risk sharing model more significant to maintain the financial stabilization and promote the welfare.

8. Conclusion and Policy Implications

This paper conducts a study basic on stochastic overlapping generation model of endogenous growth with households, entrepreneurs, banks, and regulator. It tries to shed light on the potential implications of introducing a macroprudential tool. The model shows the linkage between bank regulation, risk sharing and macroeconomic performance. One distinctive feature of our model is that it contains intergenerational risk sharing in the risky and safe specifications. The banking regulation is measured by capital adequacy ratio as it is the main quantitative component of Basel Accords III. The regulator aims to promote financial stability by setting the capital adequacy ratio at the optimal level and resolve the trade-off between welfare and financial stabilization.

Our model produces several implications which are discussed in the section above. The main results show that the trade-off between risk sharing, and financial stabilization depends on the level of capital requirements, and the risk sharing behavior of the economy. The risk sharing model for both specifications (risky and safe) confirm that the introduction of behavior of risk sharing on the economy have a positive impact on the welfare.

We calibrate the model to reflect an economy such as Turkey. We found that the welfare loss is about 27-point percentage and 22 point percentage respectively for risky and safe technology when the economy operates in the steady state and not the social welfare. The risk sharing model for turkey confirms that the introduction of risk-sharing in the risky technology has an important impact on the banking system by mitigate the excessive risk and raising the welfare. The introduction of risk sharing model in turkey is not enough to maintain financial stabilization and promote welfare. Introducing the governance policy in financial system may influence on the risk-taking by eliminating the inefficient risk taking and targeting the macroprudential policy for macroeconomic performance.

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