United Nations University
WIDER
World Institute for Development Economics Research

Discussion Paper No. 2005/09

Financial Sector Structure and Financial Crisis Burden

A Model Based on the Russian Default of 1998

George Mavrotas[1] and Dmitri Vinogradov[2]

June 2005

Abstract

We consider an overlapping generations model with two production factors and two types of agents in the presence of financial intermediation and its application to the Russian default of August 1998. The paper focuses on the analysis of the consequences of a sudden negative repayments shock on financial intermediation capacity and consequently on the economy as a whole. The model exhibits a 'chain reaction' property, when a single macroeconomic shock can lead to the exhaustion of credit resources and to the subsequent collapse of the whole banking system. To maintain the capability of the system to recover, regulatory intervention is needed even in the presence of the state guarantees on agents' deposits in the banks (workout incentives). We compare the results for an intermediated economy with those derived under the assumption of a market economy, and draw some broad conclusions on the consequences of the crises, which are contingent on the financial sector structure.

Keywords: financial intermediation, banks, markets, overlapping generations models, general equilibrium, regulation, transition economies, financial crisis, Russian default

JEL classification: D50, G21, G28, E44, E53, O16

[1] UNU-WIDER, email: mavrotas@wider.unu.edu; [2] Corresponding author: Alfred Weber Institute, University of Heidelberg, email: Dmitri.Vinogradov@awi.uni-heidelberg.de

This study has been prepared within the UNU-WIDER project on Financial Sector Development for Growth and Poverty Reduction, which is directed by Basudeb Guha-Khasnobis and George Mavrotas.

UNU-WIDER gratefully acknowledges the financial contributions to the 2004-2005 research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

The World Institute for Development Economics Research (WIDER) was established by the United Nations University (UNU) as its first research and training centre and started work in Helsinki, Finland in 1985. The Institute undertakes applied research and policy analysis on structural changes affecting the developing and transitional economies, provides a forum for the advocacy of policies leading to robust, equitable and environmentally sustainable growth, and promotes capacity strengthening and training in the field of economic and social policy making. Work is carried out by staff researchers and visiting scholars in Helsinki and through networks of collaborating scholars and institutions around the world.

www.wider.unu.edu *publications@wider.unu.edu*

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Camera-ready typescript prepared by Liisa Roponen at UNU-WIDER

ISSN 1609-5774
ISBN 92-9190-723-5 (printed publication)
ISBN 92-9190-724-3 (internet publication)

1 Introduction

The relationship between the domestic financial system and the economy has attracted a lot of attention in the economic literature for many years. This literature includes the seminal contribution by Goldsmith (1969) as well as the money-growth literature of the 1960s, in particular, Gurley and Shaw (1960), Tobin (1965) and Patrick (1966). The 1970s witnessed a renewed interest in this relationship after the influential works of McKinnon (1973) and Shaw (1973), and those associated with financial repression literature. In the 1990s a new group of empirical studies using large cross-section datasets emerged with a particular focus on the empirics of the finance-growth relationship. See Fry (1988), Wachtel and Rousseau (1995), Hermes and Lensink (1996), Arestis and Demetriades (1997), Levine (1997), World Bank (2001), Demirgüç-Kunt and Levine (2001), Green and Kirkpatrick (2002), Wachtel (2004) and Mavrotas (2005a), among others, for a comprehensive review of this literature.[1]

Two important developments in the 1990s were also partly responsible for the revived interest in the finance-growth relationship. First, the emergence of a new group of countries, i.e., the transition economies of the former Soviet Union, in the early 1990s raised a spectrum of new policy issues regarding the specific problems and challenges these economies face, particularly with regard to the reforms needed in their banking systems to improve the overall transition process to market economy. The second important development is related to the Asian financial crisis in July 1997 which revealed *inter alia* that weak financial institutions and unregulated monetary systems may cause substantial financial instability with tremendous social and economic implications for the countries involved. In recent years, the same issue has been discussed further in connection with the Russian financial crisis in 1998 (as well as the Brazilian crisis in 1999).

A substantial number of transition countries have undertaken considerable financial reforms over the last decade. These reforms included the privatization of banks in certain cases, liberalization of the financial market, as well as efforts to build the capacity of central banks and financial authorities to conduct prudential regulation and supervision of the liberalized financial systems. The experience of many transition economies in recent years seems to suggest that transforming the financial structure of an economy is a complex process which necessitates a thorough understanding of all the interactions between financial sector reforms and the economy (Mavrotas 2005b). At the same time, the Asian financial crisis clearly suggests that whilst financial liberalization may be desirable, the process must be correctly regulated, which requires building institutional capacity—a costly, though important, process (Stiglitz 1999).

A relevant issue is the comparison of market-based and bank-based financial systems. This is particularly important for both developing countries and countries in transition. As Bolton (2002) notes, these countries face a challenging issue, namely, how to set up their financial systems, which type of financial system to adopt, and what kind of financial system would most efficiently promote economic development and growth.

---

1 See also Mavrotas and Son (2005) for a recent empirical study on the finance-growth nexus using dynamic panel data analysis.

In this paper we employ the main features of the overlapping generations model (OLG) with financial intermediation (Vinogradov 2003) to study the consequences of an external shock, such as the default of the Russian government in August 1998, on the economic system.

The 1998 default in Russia had three main effects. First, foreign debts were frozen, which was a signal for international investors to exit the Russian financial markets. This resulted in a sharp decrease in prices in the stock and other financial markets. Second, the default on domestic bonds created huge losses for major players in the Russian state obligations market (GKO—*Gosudarstvennye Kratkosrochnye Obligatsii*, state short-term bonds). These were primarily banks which in turn defaulted on deposits. Third, general panic led to a sharp devaluation of the Russian rubble, consumer prices skyrocketed, and real wages fell. Attempts by the authorities to control the situation (by fixing exchange rates and threatening 'inspections and penalties' for firms who increased prices) did not help, and the recovery process lasted several years with severe implications in both the social and economic spheres.

In view of the above, the purpose of this paper is to study whether the financial system could be structured so as to lower the financial burden borne by the population, and whether the consequences of default could be avoided through other types of government intervention. As a theoretical background, we intend to use the OLG-model of macroeconomic development with financial sector, which can be either market-based or intermediation-based. An OLG-setting can be applied for the study of short periods, under the assumption that long-lived agents are rather myopic, and make decisions in each period only for the next period of their life instead of maximizing life-long utility. This seems to be valid in the case of ignorance regarding the future and the impossibility of predicting for more than one period, which is exactly the case in a crisis situation. This is supported by the observation that in Russia in the 1990s the duration of long-term loans did not exceed three years (and in the worst case even a six-month loan was considered to be long term, whereas short-term loans were granted for less than one month). The main feature of the model used in the present paper is an unpredictable shock, which influences the asset side of the bank's balance sheet, or directly the earnings of the population in the case of a market-dominated system. As in the case of the Russian default, this shock deteriorates balance sheets and leads to a decrease of the real wages of the population. As a regulation measure we assume state guarantees on deposits, which prevent bank runs (large-scaled deposit withdrawals).[2] Under this assumption, we consider two additional interventions: liquidity injection to keep the banking system stay solvent,[3] and deposit rate ceiling, which creates a positive bank marge (difference between return on assets and interest on liabilities)—to cover negative capital of banks. Under these circumstances, the bank-based system can recover after a shock and reallocate the burden of the shock to several periods, whereas

[2] In fact, deposit withdrawals were forbidden immediately after the default in Russia. The government assisted with 'restructuring' deposits, after introducing guarantees on deposits in state-controlled Sberbank (Savings Bank) which forced depositors to transfer their savings from 'unsafe' banks to the 'safe' Sberbank, which however imposed withdrawal limits. This made bank runs effectively impossible.

[3] As usual we define solvency as the ability to meet (current) obligations (in contrast to bankruptcy) which means negative bank capital. In a static setting these concepts would coincide. However in a dynamic setting, a bankrupt institution (with negative capital) can still be solvent due to newly acquired funds from next generations.

the market-based system leads to a huge burden to be borne by the people in one period but does not provide intertemporal risk-smoothing. We can conclude that the banking system does not accelerate recovery after a crisis, but can smooth the shock among several generations (several periods), which may be more desirable in terms of poverty reduction.[4] The paper is also of great policy relevance to other transition economies and to those developing countries which have experienced similar shocks in recent years.[5]

The rest of the paper is structured as follows: section 2 describes the model and defines the macroeconomic shock; section 3 discusses the properties of the general equilibrium in the model and its evolution after the shock; section 4 compares the case of the pure market economy to that of an economy with financial intermediation. Regulatory measures are the subject of section 5 whereas section 6 analyses their effects in the intermediated economy. Section 7 discusses some empirical facts of the 1998 Russian crisis in order to compare them with the predictions of the theoretical model. The final section concludes by drawing some broad policy implications.

2 The model

2.1 Agents and decisions

Consider an economy with the population living for two periods and consisting of two groups: workers and entrepreneurs. The whole population is distributed at the interval $[0,1]$, and the subinterval $[0, p)$ belongs to workers, leaving $[p,1]$ for entrepreneurs, so that p is the share of workers in this generation.[6] The entrepreneurs can only operate their firms as they acquire some experience in the first period of their lives, so that the whole generation is only workers when young. The young generation works, consumes and saves. The old generation consumes (if workers) or produces and consumes (if entrepreneurs). All workers are therefore endowed with one unit of labour in each period, and the entrepreneurs possess equal entrepreneurial skills, which they apply in the second period of their lives, so that there is no heterogeneity among workers and entrepreneurs. This setting is similar to that of Gersbach and Wenzelburger (2003), who also consider a macroeconomy with financial intermediation and shocks.

All agents of generation t have identical intertemporal utility function $u(c_t,c_{t+1})$, which satisfies standard assumptions regarding monotonicity and concavity. Time-index denotes the beginning of the period, so that generation t is born at the moment t when

[4] In fact, as we show later in the analysis of liquidity injections, the lender of last resport can help the system to recover just as quick as in the case of the market, namely through a subsidy. This can be an extension in the case of a fairly priced insurance system, where the subsidy will be a payout for a ‘stabilization fund’, which is created through previously made contributions of the banks. We do not explore this in the current paper; we use instead a broader term ‘liquidity injections’ (Rochet 2004 uses the term ‘liquidity assistance’).

[5] A relevant issue is capital flight associated with financial instability. On this see Harrigan, Mavrotas and Yussop (2002) and Hermes, Lensink and Murinde (2004).

[6] We assume here for simplicity that the share of workers in each generation is fixed. This does not, however, seem to be crucial, as the same results can be obtained with the market-side switching as in Gersbach and Wenzelburger (2002a, 2002b).

the period t begins, is young until the moment t+1, is old in the period t+1, and dies at the moment t+2, which ends the period t+1.

All agents when young solve the intertemporal utility maximization problem, which determines their consumption c_t and savings e_t in period t. The agents have perfect knowledge about the wage rate w_{t+1} and interest rates r_t^d and r_t^c on deposits and credit correspondingly.

The optimization problem of the workers is given by:

$$\begin{aligned} &\max_{c_t, c_{t+1}} u(c_t, c_{t+1}) \\ c_t &= w_t - e_t^D \\ c_{t+1} &= \left(1 + r_t^d\right) e_t^D \end{aligned} \tag{1}$$

This problem determines the savings function of workers (depositors) $e_t^D\left(\underset{+}{r_t^d}, \underset{+}{w_t}\right)$.

Potential entrepreneurs solve their respective utility maximization problem:

$$\begin{aligned} &\max_{c_t, c_{t+1}} u(c_t, c_{t+1}) \\ c_t &= w_t - e_t^E \\ c_{t+1} &= \Pi_{t+1}^e\left(e_t^E, w_{t+1}, r_t^c\right) \end{aligned} \tag{2}$$

where Π_{t+1}^e denotes their expected profit in the period t+1. Note that there is no uncertainty about production. The only expected term in the expected profit could be the equilibrium wage rate in the next period. However as the entrepreneurs have perfect knowledge about their aggregate future demand for labour and as they know that the aggregate labour supply in the next period is exactly 1 (the whole young generation works), they have perfect knowledge about w_{t+1}. Therefore, their profit expectations are always true.

Note as well that in an equilibrium $\Pi_{t+1}^e \geq \left(1 + r_t^d\right) e_t^D$, and hence no problem of switching from entrepreneurs to depositors arises (as e.g. in Gersbach and Wenzelburger 2002a, 2002b). Indeed, if $\Pi_{t+1}^e < \left(1 + r_t^d\right) e_t^D$ then the entrepreneurs prefer to act as savers/creditors, and the credit supply is strictly positive under zero credit demand (no entrepreneurs want to invest). We come to the discussion of the equilibrium later.

Entrepreneurs run firms when old, and the production technology of these firms is given by $f\left(k_{t+1}, l_{t+1}\right)$, where $k_{t+1} =$ physical capital for production in period t+1 and $l_{t+1} =$ the amount of labour used for production in the period t+1. All entrepreneurs have access to the same production technology (so that there is no heterogeneity among entrepreneurs), and maximize their expected profits, thus defining both k_{t+1} and l_{t+1}. In period t potential entrepreneurs apply for credit I_t to finance their investment, which is needed to acquire capital stock k_{t+1}, so that $k_{t+1} = e_t^E + I_t$.

The profit maximization problem is then:

$$f(k_{t+1}, l_{t+1}) - (1 + r_t^c)(k_{t+1} - e_t) - w_{t+1} l_{t+1} \rightarrow \max_{k_{t+1}, l_{t+1}} \tag{3}$$

and the solution of this problem for any level of savings e_t appears as:

$$k(r_t^c, w_{t+1}) : \frac{\partial k}{\partial r_t^c} < 0, \frac{\partial k}{\partial w_{t+1}} < 0 \tag{4}$$

$$l(r_t^c, w_{t+1}) : \frac{\partial l}{\partial r_t^c} < 0, \frac{\partial l}{\partial w_{t+1}} < 0 \tag{5}$$

Note that the solution of the profit maximization problem does not depend on the amount of savings accumulated by the entrepreneurs since it determines the amount of capital stock needed to run the firm, but not the amount of borrowed capital. Given this optimal choice of production factors, the utility maximization problem of entrepreneurs determines their savings level:

$$\begin{aligned} &\max_{c_t, c_{t+1}, e_t^E} u(c_t, c_{t+1}) \\ &c_t = w_t - e_t^E \\ &c_{t+1} = \Pi_{t+1} = f(k_{t+1}, l_{t+1}) - (1 + r_t^c)(k_{t+1} - e_t^E) - w_{t+1} l_{t+1} \\ &\text{with } (k_{t+1}, l_{t+1}) = \arg\max \Pi_{t+1} \end{aligned} \tag{6}$$

so that savings of the entrepreneurs are given by:

$$e_t^E = e\left(\underset{+}{w_t}, \underset{-}{w_{t+1}}, \underset{+}{r_t^c}\right) \tag{7}$$

The properties of the solutions of the above optimization problems are taken as standard results of microeconomic analysis.[7]

2.2 Intermediation and interactions

Financial intermediation is presented in the economy through banks, who collect savings from workers in the form of deposits, and offer credit to entrepreneurs to finance their demand for credit. As derived above, the demand for credit is given by the excess of the optimal capital level for the production technology over the accumulated entrepreneurial savings (which play the role of own funds of the entrepreneurs).

---

7 To prove these properties it suffices to find respective derivatives of the implicit savings and factor demand functions, given by the first-order conditions. Of course, the standard assumption regarding the impossibility of corner solutions applies.

Collection of deposits D_t starts in period t, when the workers of generation t save the amount e_t^D. At the end of period t entrepreneurs apply for credit I_t to start their business (run firms). Entrepreneur payouts to banks take place within period t+1 and amount to $B_{t+1} = \min\left(f(k_{t+1}, l_{t+1}); (1+r_t^c)I_t\right)$. In the equilibrium, the profit of entrepreneurs can only be positive, hence it can be written $B_{t+1} = (1+r_t^C)I_t$.

There is no other storage technology in the economy so that the value of deposits made with the banks is equal to the value of aggregate savings of the workers: $D_t = pe_t^D$. In period t+1 banks have to repay $p\left(1+r_t^d\right)e_t^D$ to all depositors.

Entrepreneurs require credit from the banks to finance their investment demand and we assume that there is no credit rationing so that no credit application is rejected,[8] and $I_t = k_{t+1} - e_t^E$.[9] Investment (in production technology) takes place at the end of period t.[10] Within period t+1 all entrepreneurs repay the banks $(1-p)B_{t+1}$ as defined above.

If in the period t+1 total repayments from entrepreneurs to banks do not cover the total obligations of the banks, banks experience deficit. Deficit is transferred in the next period and can be defined recursively as:

$$d_{t+1} = d_t + (1-p)B_{t+1} - p\left(1+r_t^d\right)e_t^D \tag{8}$$

If in some period we observe that $d_{t+1} > 0$, we shall call it bank surplus. This equation indicates that the new bank surplus is the amount which the banks possess after deducting the deposit repayments from the total accumulated surplus of the previous period and the credit repayments received from the banks' debtors. Or, the new deficit is equal to the uncovered gap, which results after having covered the previous gap and paid out the deposits from the credit revenues of the current period.

Banks operate in a competitive environment so that neither deposit rates r_t^d nor credit rates r_t^c differ and we omit any indexes corresponding to individual banks, taking interest rates as uniform in the market. Moreover, in this competitive environment, either banks set credit and deposit interest rates equal (see e.g., Gersbach 2003 for a

8 Indeed, the homogeneity of entrepreneurs implies that their credit applications are similar, and there is no criterion according to which some applications should be rejected.

9 Capasso and Mavrotas (2003) develop a model of information asymmetries in the credit market in which the high costs of processing bank loan applications might obstruct investment in mature sectors. Their point of departure is that the efficiency of the banking system can have a profound impact on real resource and investment allocation directly (by reducing the amount of resources channelled to the credit market) as well as indirectly (by affecting entrepreneurs' investment decisions).

10 This can be also viewed as though entrepreneurs of generation t create their production facilities along the period t, investing in total k_{t+1}, so that the investment process is concluded at the end of the period t. This means that all credit is allocated by the banks in period t under interest rate r_t^c.

discussion of the case with market-side switching)[11] or take them equal as given by the market so that in pure competitive environment $r_t^d = r_t^c = r_t$ (see e.g., Baltensperger and Jordan 1997).[12]

Banks are owned by all agents in the economy in equal shares, and the ownership is transferred to subsequent periods (future generations) through bequests, hence a stock market for bank shares is not considered. Dividend payments could shift intertemporal budget constraints in the utility maximization problems solved by the agents, but we assume them to be negligibly small, and they are not presented in optimization problems (1) and (2) of the agents above.[13]

2.3 Macroeconomic shock

The economy is assumed to experience a macroeconomic shock, which influences the deficits of the banks, with which they start the period t+1. We assume that the shock creates the deficits in the banks proportionally to the amount B_t repaid by the entrepreneurs, which induces the following change in the equation (8):

$$d_{t+1} = d_t + q_{t+1}(1-p)B_{t+1} - p\left(1+r_t^d\right)e_t^D \qquad (8')$$

In the absence of the shock $(1-p)B_{t+1} = p\left(1+r_t^d\right)e_t^D$ otherwise banks' profits are not zero, which is a contradiction to the perfect competition assumption. As a result we can reformulate the equation (8′):

$$d_{t+1} = d_t - (1-q_{t+1})(1-p)B_{t+1} \qquad (9)$$

The shock parameter q_{t+1} has the following distribution:

$$q_{t+1} = \begin{cases} 1 & \text{if } t \neq \tau \\ q^* < 1 & \text{if } t = \tau \end{cases} \qquad (10)$$

---

[11] As noted earlier, the framework of the current paper can be extended to cover the case of heterogeneous agents, with entrepreneurs deciding on applying for credit to invest or deposit with the banks, depending on their (entrepreneurs') respective quality.

[12] Competition in the banking sector implies that the profit of banks equals zero, which induces the equality between the two interest rates.

[13] This point deserves some further discussion. Indeed, if we assume that the capital of the banks is negligibly small, all agents will receive infinitely small dividend payments, so that they do not influence consumption-saving decisions. Putting another way, we could also assume that the banks belong only to depositors, and in this sense resemble mutual funds so that there is no capital, which would differ from the deposits. Equally we could assume that dividend payments are made at a rate equal to deposit interest rate, so that bank capital could be considered equivalent to deposits. It is important to note that (possible) dividends are paid only in the case the banks work with a surplus, so that $d_t > 0$, otherwise any possible bank profit is used to cover deficit. As we focus here on the case $d_t \leq 0$, dividend payments do not play any role in the model.

Equation (9) can be rewritten for the period $\tau+1$:

$$d_{\tau+1} = d_{\tau} - \left(1-q^{*}\right)(1-p)B_{\tau+1} = -\left(1-q^{*}\right)(1-p)B_{\tau+1}$$

since d_{τ} is zero before the shock.

The shock is effectively unpredictable so that banks do not create any reserves against the shock. Recall from (8) that without the shock, deficits of the banks would be:

$$d_{\tau+1} = (1-p)B_{\tau+1} - p\left(1+r_{\tau}^{d}\right)e_{\tau}^{D} = 0$$

and hence we can write equivalently:

$$d_{\tau+1} = -\left(1-q^{*}\right)p\left(1+r_{t}^{d}\right)e_{t}^{D} \tag{11}$$

We assume that the shock is exogenously given and directly influences bank deficits. The case of production shock is considered in Vinogradov (2003), where three degrees of shock are introduced: insignificant production shock, which leaves entrepreneurs still able to repay their obligations; significant production shock, which influences repayments to banks, but does not influence wage repayments to workers; and extreme shock, which reduces repayments to banks to zero and leaves workers underpaid. If no shock happens (q = 1), then bank deficits remain at zero level. If the production shock destroys the economy (q = 0), then deficits of the banks are equal to the entire amount due to depositors $d_{t+1} = -p\left(1+r_{t}^{d}\right)e_{t}^{D}$, exactly as in (11).

Transfer of the shock from production technology directly to deficits simplifies exposition and allows us to study the case of nonproduction shocks. One example of this could be a sharp decrease in stock market prices, which reduces the value of bank assets below the value of liabilities, and leads to deficits. Since we do not explicitly model the stock market, and have no securities on the assets side of the banks' balance sheets, we assume that the exogenous shock influences deficits directly. Introduction of the stock market would possibly give a more reasonable explanation of the shock (e.g., how agents form their expectations), but would still leave us with an exogenous disturbance exactly as in the case of a deficit shock, and would not qualitatively change the results. For an alternative shock treatment, see the Appendix.

3 Markets and equilibrium

So far, the model describes two markets: one for capital and one for labour. We define the [temporary] equilibrium[14] in the economy in any period t as a price vector $\left\{r_t^{d*}, r_t^{c*}, w_{t+1}^*\right\}$ and an allocation $\left\{k_{t+1}^*, l_{t+1}^*, e_t^{E*}, e_t^{D*}\right\}$ under parameters $\{w_t, d_t\}$, which guarantee that:

1. The capital market is cleared, i.e., aggregate demand for capital equals its aggregate supply: $(1-p)k_{t+1} = pe_t^D + d_t + (1-p)e_t^E$. In other words, aggregate demand for credit equals aggregate supply:

$$(1-p)\left(k_{t+1}\left(r_t^c, w_{t+1}\right) - e_t^E\left(w_t, w_{t+1}, r_t^c\right)\right) = pe_t^D\left(w_t, r_t^d\right) + d_t \qquad (12)$$

2. Labour market is cleared, i.e., aggregate demand for labour, which is created by old entrepreneurs, is met by the aggregate supply of labour created by the old workers and the whole young generation (both young workers and young entrepreneurs, who have not yet started their businesses):

$$(1-p)l\left(r_t^c, w_{t+1}\right) = 1 \qquad (13)$$

3. Agents have no incentive to make changes in their choices (this condition is met by the optimal choice of agents).

Proposition 1. *The general equilibrium, given by definition above, exists and is unique for any period* $t > 0$. *It can be represented in the* (w_{t+1}, r_t)*-plane with an intercept of LM-line and CM-line, depicting equilibria in markets for labour and for capital, respectively. LM-line and CM-line are characterized with*

$$\frac{\partial r_t^{CM}}{\partial w_{t+1}} > \frac{\partial r_t^{LM}}{\partial w_{t+1}} \text{ and } \frac{\partial r_t^{LM}}{\partial w_{t+1}} < 0 \qquad (14)$$

Proof: For the proof see Vinogradov (2003) ■

3.1 Analysis of the equilibrium

The above proposition allows us to represent the general equilibrium in terms of two lines in the (w_{t+1}, r_t)-plane: LM depicting equilibria in the labour market and CM depicting equilibria in credit market. Note also that changes in the deficit level influence

---

[14] Obviously, given the initial conditions (w_0, d_0) and the definition of deficits (9) we can determine the whole equilibrium path $\left\{r_t^{d*}, r_t^{c*}, w_{t+1}^*\right\}_0^\infty$ as well as the deficits path $d_{t+1}\big|_0^\infty$, which would correspond to the standard intertemporal general equilibrium concept.

only the CM-line, and not the LM-line, although general equilibrium would differ for different values of d_t. Increase in deficits (or equivalently decrease in surplus, i.e. d_t falls below zero) increases equilibrium interest rate as defined by the credit market for any wage level w_{t+1} so that CM-line shifts upwards in (w_{t+1}, r_t)-plane:

$$\frac{\partial r_t^{CM}}{\partial d_t} < 0 \tag{15}$$

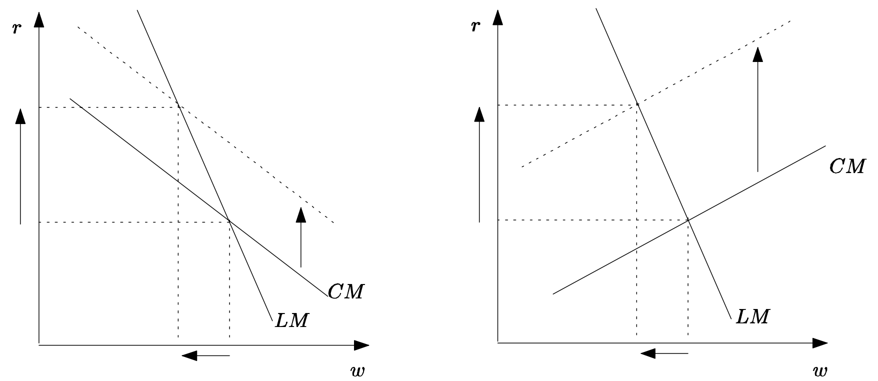
Proposition 2. *The equilibrium interest rate and the equilibrium wage level depend on the deficits in the banking sector so that the equilibrium interest rate increases and the equilibrium wage level decreases with an increase in deficits (fall in surplus)*:

$$\frac{\partial r_t^*}{\partial d_t} < 0; \frac{\partial w_{t+1}^*}{\partial d_t} > 0 \tag{16}$$

Proof: According to (15) and due to the independence of the labour market equilibrium from the deficits in the banking system, the equilibrium interest rate and wage level are determined by the movement of general equilibrium point along the LM-line, as shown in Figure 1. Since both CM- and LM-lines are continuous, this reasoning will be valid for any possible combinations of interest rate and wage level, which proves the statement. ■

The effect on the general equilibrium of banks deficits falling below zero is shown in Figure 1. Since the slope of CM-line can be either negative or positive (but never smaller than the slope of the LM-line, see Equation 14), both cases are presented here.

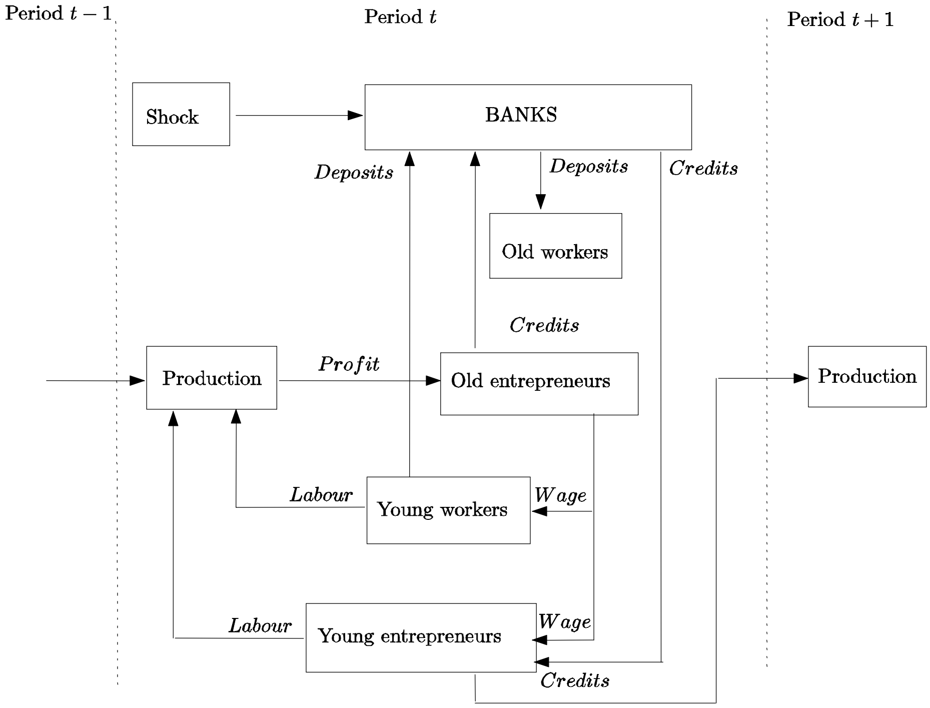
Figure 1
Effect of an increase in banks' deficits
($d \downarrow$, i.e. the banks experience greater lack of funds) on general equilibrium



3.2 Evolution of the economy

The sequence of events in the economy under the assumption of financial intermediation is presented in Figure 2:

Figure 2
Sequence of events in the intermediated economy



3.2.1 Before the shock

If $t < \tau$, the shock parameter q is always $q = 1$. The economy sets the equilibrium with zero deficits in the banks. This equilibrium is stationary until a shock occurs.

The system of equilibrium conditions (12-13) together with the definition of deficits (8) determines a dynamic system with respect to w and d: $\Phi(w_t, d_t) \rightarrow (w_{t+1}, d_{t+1})$ with the map $\Phi(w_t, d_t)$ given implicitly by the system of equations:

$$\Phi(w_t, d_t) \ : \ \begin{cases} (1-p)l_{t+1} = 1 \\ (1-p)I_t = pe_t^D + d_t \\ d_{t+1} = (1-p)B_{t+1} - p(1+r_t^d)e_t^D \\ I_t = k_{t+1} - e_t^E \\ B_{t+1} = \min\left(f(k_{t+1}, l_{t+1}); (1+r_t^c)I_t\right) \\ k_{t+1} = k(r_t, w_{t+1}) \\ l_{t+1} = l(r_t, w_{t+1}) \\ e_t^E = e^E\left(w_t, w_{t+1}, r_t^c\right) \\ e_t^D = e^D\left(w_t, w_{t+1}, r_t^d\right) \end{cases} \tag{17}$$

Proposition 3. *The dynamic system (17) has a steady state (stationary) with* $d = 0$ *and* $w = \hat{w}$*, which does not depend on the initial conditions.*

Proof: The map for deficits in (17) together with the credit market equilibrium condition (12) for period t implies:

$$d_{t+1} = (1 + r_t^d)d_t$$

which under a positive deposit interest rate is true if:

$$d_{t+1} = d_t = 0 = d$$

The first part of the statement is hence proved.

Now consider the modified map $\Phi_0(w_t) \equiv \Phi(w_t, 0)$:

$$\Phi_0(w_t) : \begin{cases} (1-p)l_{t+1} = 1 \\ (1-p)I_t = pe_t^D \end{cases} \quad (18)$$

with the rest defined as in (17). To prove the existence of the stationary point, it suffices to prove the existence of a solution to:

$$w_{t+1} = \Phi_0(w_t) = w_t$$

Substituting w_{t+1} instead of w_t into the labour demand, credit demand and savings functions in (18) reduces the problem to the case of market equilibrium. The slope of LM-line remains unchanged, since it depends only on w_{t+1}, and the slope of LM-line is always flatter than that of the LM-line (see 14), so that the general equilibrium exists for any value of w_t, and in particular for some value $\hat{w}$, for which the condition $\Phi_0(\hat{w}) = \hat{w}$ is met. By construction, this steady state does not depend on initial conditions. ■

Consider now the evolution of the economy after the shock $q = q^* < 1$, that is, for $t \geq \tau$. Banks experience in this case deficits $d_{\tau+1} = -(1-q^*)(1-p)B_\tau = -(1-q^*)p(1+r_\tau^d)e_\tau^D < 0$, with which they start the period $\tau+1$. A change in deficits (d falls from $d_\tau = 0$ to a level $d_{\tau+1} < 0$) causes CM-line to shift upwards (for any wage level credit market will clear with a higher interest rate), so that the change in general equilibrium is given by the LM-line, and the equilibrium wage level $w_{\tau+2}$ is lower than $w_{\tau+1} = w_\tau$. At the same time the equilibrium interest rate increases from r_τ to $r_{\tau+1}$. No new shocks and no changes in the behaviour of the agents occur. Further dynamics of the deficits in banks is given by:

$$d_{\tau+k+1} = (1-p)(1+r_{\tau+k}^c)(k_{\tau+k+1} - e_{\tau+k}^E) - p(1+r_{\tau+k}^d)e_{\tau+k}^D \quad (19)$$

Since the credit market is in equilibrium (12), and since $r_{\tau+k-1}^c = r_{\tau+k-1}^d = r_{\tau+k-1}^*$ due to the competition in banking sector, we obtain:

$$d_{\tau+k+1} = \left(1 + r^{*}_{\tau+k}\right) d_{\tau+k} \tag{20}$$

which is valid for any $k \in N$. As soon as $r^{*}_{\tau+k} > 0$, deficits in banks deteriorate until the banking system is bankrupt, i.e. $d_{\tau+k} = \underline{d_{\tau+k}} = -pe^{D}_{\tau+k}$. This last condition means that deficits in banking system are completely covered with newly accumulated deposits so that no new credit can be granted, and hence banks obtain zero repayments at the end of the period, and can no longer meet their obligations with respect to deposits.

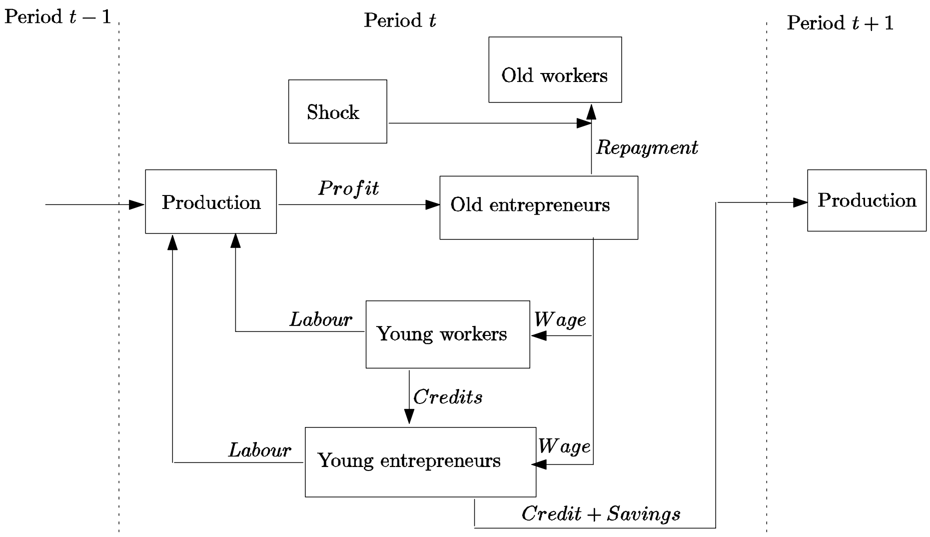
> **Corollary 1.** *Intermediated economy with long-lived banks and guarantees on deposits experiences a collapse of the banking system in the absence of an appropriate regulation in a finite number of periods.*

4 Pure market economy

Consider now the case of the market economy, where savers (depositors) have direct access to the firms (entrepreneurs), and therefore no intermediation in the fund-channelling occurs. The sequence of events in a pure market economy is presented in Figure 3.

The economy without intermediation (i.e. pure market economy) exhibits the same equilibrium as in the case of intermediated economy with zero deficits in banks. Indeed, in a pure market economy, the aggregate demand for credit $(1-p)I_t = (1-p)\left(k_{t+1} - e^{E}_{t}\right)$ equals the aggregate credit supply pe^{D}_{t} and since no intermediaries are presented here, there is no space for deficits in market equilibrium. The equilibrium at the labour market does not depend on intermediation, and is the same as in the intermediated case. Interest rate on savings in the pure market economy is equal to the credit interest rate $r^{d}_{t} = r^{c}_{t} = r_t$, since they circulate in the same market.

Figure 3
Sequence of events in the pure market economy



Temporary general equilibrium in the pure market economy in any period t is hence defined as a price vector $\{r_t^*, w_{t+1}^*\}$ and an allocation $\{k_{t+1}^*, l_{t+1}^*, e_t^{E*}, e_t^{D*}\}$ under parameters $\{w_t, d_t\}$, which provide that:

1. The credit market is cleared: $(1-p)\left(k_{t+1} - e_t^E\right) = pe_t^D$;

2. The labour market is cleared: $(1-p)l\left(r_t^c, w_{t+1}\right) = 1$;

3. Agents have no incentive to make changes in their choices (again, this condition is met by the optimal choice of agents).

Proposition 4. *A general equilibrium in the market economy, given by the definition above, exists and is unique for any period* $t > 0$.

Proof: The proof of the proposition follows from the existence of equilibrium for intermediated economy. It has only to be noted that d_t now represents (consistent with its definition) the difference between the actual and expected credit repayments from old entrepreneurs to old workers, and is always zero in the absence of shocks. ■

Without shocks the equilibrium in a pure market economy reaches its steady state as in the case of intermediated economy. If a shock occurs, creditors are not repaid in full,[15] and experience deficit $d_{t+1} = -(1-q^*)pB_t$. This affects the result in a following manner:

1. Old workers, who acted as creditors, obtain less repayment than expected, and their consumption in the shock period is less than needed to achieve the planned utility level. The extreme case $q^* = 0$ would leave old workers with zero consumption in the shock period.

2. Young workers do not suffer if we consider a payments shock only.[16] Saving decisions of the young generation repeat those of the old in the preceding period, so that the equilibrium persists.

3. After the shock the system stays at the steady state, so that the only part of population to suffer from the shock, are old workers. The loss in consumption is exactly $d_{t+1} = -(1-q^*)pB_t$.

---

[15] This can be understood as though the shock appears when the repayment goes through the payments system, which is not explicitly modelled here.

[16] In the case of a production shock it is possible that young workers obtain reduced wage repayments, which would change their savings decisions. If this happens, the savings in the after-shock period are lower than in steady state, and consequently the interest rate is higher than in the steady state. As a result, the shock affects some subsequent periods, and the recovery to the steady state lasts for several periods. For further details see Vinogradov (2003).

Corollary 2. *A market-based economy recovers to the steady state within one period after the shock, leaving the burden of the shock completely on savers of this period.*

5 Regulation

Collapse of the intermediated economy after a shock underlines the need for regulatory intervention to avoid the collapse of the banking system. We consider two possible regulatory interventions:

1. Liquidity injections to banks,

2. Setting a deposit rate ceiling.

In both cases we assume banks to be credible institutions (possibly under guarantees by the regulator) so that the question of credibility and bank runs does not arise.

5.1 Liquidity injections

Let us assume that the regulator possesses a stock $\overline{S}$ of liquid funds, which can be accessed only by banks experiencing deficits and are not used otherwise. If deficits occur ($d_t < 0$), banks can apply for one-period credit from the regulator. The regulator charges an interest rate r^S to the applicants. This is a general formulation, setting $r^S = -1$ corresponds to the case of subsidy. The total amount of credit granted by the regulator in period t has to cover the deficits in the banking sector and is therefore:

$$S_t = \begin{cases} -d_t, & \text{if } d_t < 0 \\ 0 & \text{if } d_t \geq 0 \end{cases} \tag{21}$$

The regulator credits banks (provides them with liquidity assistance) at the end of period *t*. This liquidity injection covers deficits accrued in period *t*. The banks repay at the end of the period *t* + 1 in total amount of $(1 + r^S)S_t$.

The equilibrium condition in the credit market (12) changes to:

$$(1-p)\left(k_{t+1} - e_t^E\right) = pe_t^D + d_t + S_t \tag{21}$$

To complete the description we assume that the interest (if any) gained on such liquidity injections is used to increase the stock $\overline{S}$. Therefore, we leave aside all possible fiscal distortions (taxes and income redistribution) and focus only on the bailout effect of such intervention.

5.2 Deposit rate ceiling

The regulator sets deposit rate ceiling $r^d = r^{dreg}$ when the capital adequacy ratio is not fulfilled (surplus accumulated in the banks is smaller than a certain fraction α of the total banks' assets):[17]

$$d_t < \alpha(1-p)\left(k_{t+1} - e_t^E\right) \tag{23}$$

In this case, either credit rates are below the ceiling, so that no bank is interested in setting the deposit rate above the credit rate, and hence the situation is similar to the case without regulation with $r^c = r^d = r^*$; or credit rate (interest rate determined by the credit market) is above the ceiling, which means that the deposit rate is fixed:

$$r^d = \min\left(r^{dreg}, r^c\right) \tag{24}$$

Fixing the deposit rate makes the deposit supply dependant only on the wage level. The deposit market is still in equilibrium (all deposits supplied are acquired by banks). This does not change the conclusion regarding the existence and uniqueness of general equilibrium.

The above definition of general equilibrium is valid for the regulated case as well. Moreover, the equilibrium condition for the labour market is not disturbed by introducing the regulation since depends only on credit interest rate:

$$(1-p)l\left(r_t^c, w_{t+1}\right) = 1 \tag{25}$$

The equilibrium condition in the credit market simplifies to:

$$(1-p)\left(k\left(w_{t+1}, r_t^c\right) - e^E\left(w_t, w_{t+1}, r_t^c\right)\right) = pe^D\left(w_t, w_{t+1}, r^{dreg}\right) + d_t \tag{26}$$

The right-hand side of (26) is no longer dependant on the credit interest rate. Obviously equilibrium credit rate is negatively related with the regulated deposit rate, since the left-hand side of (26) negatively depends on the credit rate: $\frac{\partial r_t^c}{\partial r^{dreg}} < 0$. This is easily explained by the fact that decreasing the deposit rate leads to less bank deposits, and therefore to a lower supply of credit, which becomes more expensive in order to hold the equilibrium. In other words, setting the regulated deposit rate at a level below that of the unregulated equilibrium, increases the credit interest rate and hence makes banks' profit margin positive (since in unregulated case the rates are equal). Graphically this corresponds to an upward shift of CM-line as soon as the regulated deposit interest rate is set below the equilibrium level, similarly to the effect of deficits in the banking system, which is depicted in Figure 1.

---

17 This is again a general formulation. In the economy considered here, bank surplus is zero due to competition, therefore the deposit rate ceiling is introduced from the beginning.

6 Intermediated economy: regulated dynamics

Let us now assume that the economy has settled in the steady state with $d_t = 0$. Consider how the above mentioned regulatory interventions affect the economy after the shock and whether the interventions prevent the collapse of the economy (bankruptcy of the banking system), which happened in the unregulated case.

6.1 Liquidity injections

Assume that the payments shock creates deficits in the banking system in period τ so that the banking system starts period $\tau+1$ with deficits $d_{\tau+1} < 0$. Credit market equilibrium condition (22) implies:

$$(1-p)\left(k_{\tau+2} - e^E_{\tau+1}\right) = pe^D_{\tau+1} + d_{\tau+1} + S_{\tau+1} \tag{27}$$

Since a subsidy (credit) from the regulator covers exactly the deficits, $S_{\tau+1} = -d_{\tau+1}$, the equilibrium in the credit market remains unchanged, and hence credit interest rate and wages stay at their stationary levels. Further change in deficits is given now by:

$$d_{\tau+2} = (1-p)\left(1 + r^c_{\tau+1}\right)\left(k_{\tau+2} - e^E_{\tau+1}\right) - p\left(1 + r^d_{\tau+1}\right)e^D_{\tau+1} - \left(1 + r^s\right)S_{\tau+1} \tag{28}$$

Now, two scenarios are possible:

1. Liquidity injection does not change (for whatever reason) profit expectations of the banks. Expected profit of the banks for period $\tau+2$ is then:

   $$\Pi^e_{\tau+2} = (1-p)\left(1 + r^c_{\tau+1}\right)\left(k_{\tau+2} - e^E_{\tau+1}\right) - p\left(1 + r^d_{\tau+1}\right)e^D_{\tau+1} = 0$$

   The expected profit is equal to zero due to competition in the banking sector. This implies:

   $$d_{\tau+2} = -\left(1 + r^s\right)S_{\tau+1} = \left(1 + r^s\right)d_{\tau+1} \tag{29}$$

   Hence, with $r^s > 0$, deficits in the banking sector deteriorate further. Unrestricted continuation of the policy of liquidity injections repeats the steps described above, and, as in case of unregulated dynamics, collapse is unavoidable. The banking system becomes bankrupt. The stock of liquid funds $\overline{S}$ cannot be exhausted since starting period $\tau+2$ deficits in the banking system are exactly the indebtedness of the banks to the regulator. As a result, the 'liquidity' injections do not actually require a transfer of liquid funds, but rather take the form of 'virtual' credit, which results only in an accumulation of unpaid interest. Setting $r^s = 0$ allows to postpone the collapse without an accumulation of this kind of debt. But in any event, such a forbearance policy[18] does not create any incentive for the banks to repay their debt to the regulator, because they expect deficits to be covered

[18] Recall that banks are bankrupt since their assets are below their liabilities.

repeatedly by new liquidity injections from the regulator without restrictions, and do not anticipate repayments in profit expectations.[19]

2. Liquidity injection changes the profit expectations of banks. Expected bank profit for period $\tau+2$ is then:

$$\Pi^{e}_{\tau+2}=(1-p)\left(1+r^{c}_{\tau+1}\right)\left(k_{\tau+2}-e^{E}_{\tau+1}\right)-p\left(1+r^{d}_{\tau+1}\right)e^{D}_{\tau+1}-\left(1+r^{s}\right)S_{\tau+1}=0$$

Zero expected profit (due to competition) implies that the banks set the deposit interest rate below the credit interest rate (which is fixed by the credit market equilibrium) as soon as $r^{s}>-1$. The new level of deficits in banking system is then:

$$d_{\tau+2}=0$$

At the same time, the amount of deposits in the banking sector decreases due to a decrease in deposit interest rate ($e^{D}_{\tau+1}<e^{D}_{\tau}$) and credit market is cleared with higher credit interest rate for any wage level: $(1-p)\left(k_{\tau+2}-e^{E}_{\tau+1}\right)=pe^{D}_{\tau+1}$. This corresponds to the upward shift of CM-line and new equilibrium is achieved at the level $r^{c}_{\tau+1}>r^{c}_{\tau}$, $w_{\tau+2}<w_{\tau+1}$.

In period $\tau+2$ the economy returns to the steady state since competition implies:

$$\Pi^{e}_{\tau+3}=(1-p)\left(1+r^{c}_{\tau+2}\right)\left(k_{\tau+3}-e^{E}_{\tau+2}\right)-p\left(1+r^{d}_{\tau+2}\right)e^{D}_{\tau+2}=0$$

and therefore the equality between deposit and credit interest rates $r^{c}_{\tau+2}=r^{d}_{\tau+2}$.

The above discussion leads to the following conclusions:

Corollary 3. *Liquidity injections after a payments shock can have different effects depending on the arrangements:*

1. *The forbearance policy of the regulator, in which the banks believe to be credited and are credited each time they face deficits, either postpones the collapse (if injections are made in form of credits with zero interest rate) or prevents the collapse (in case of the subsidy). In both cases the burden of payments shock is borne by the regulator.*

2. *Short-term crediting with sufficient restrictions on further access for banks to the liquid funds of the regulator shifts the profit expectations of*

[19] The case of subsidy ($r^{s}<0$) would prevent collapse but requires substantial changes in the model to meet budget constraints: up to now it was assumed that there were no external inflow of funds into the economy.

the banks and prevents a collapse. The burden of the payments shock is borne by the population in the period following the shock: depositors receive deposit interest at rates below credit interest rate. At the same time they receive lower wages due to a fall in production, which also leads to lower consumption level of entrepreneurs.

6.2 Deposit rate ceiling

If the banking system starts with zero deficits, intervention rule (23) is fulfilled, and regulation is introduced from the beginning. If $r^{dreg} > r^{c}$, the deposit interest rate will be equal to the credit rate $r^{c} = r^{d} = r^{*}$ so that regulated dynamics yields the same results as the unregulated case. After the shock, however, credit interest rate increases, as shown for the case of unregulated dynamics, and at some point the inequality $r^{dreg} < r^{c}$ will be met. As a result, the deposit rate is fixed by the regulation.[20]

Assume that this happens at $t = \tau$ so that $r^{d}_{\tau+k} = r^{dreg}$ ($k \in N$). The dynamics of the deficits in banks is then given by:

$$d_{\tau+k+1} = (1-p)\left(1 + r^{c}_{\tau+k}\right)\left(k_{\tau+k+1} - e^{E}_{\tau+k}\right) - p\left(1 + r^{dreg}\right)e^{D}_{\tau+k} \tag{30}$$

Due to the condition $r^{dreg} < r^{c}$ and credit market equilibrium condition (12) we can write:

$$d_{\tau+k+1} = \left(1 + r^{c}_{\tau+k}\right)d_{\tau+k} + p\left(r^{c}_{\tau+k} - r^{dreg}\right)e^{D}_{\tau+k} \tag{31}$$

To reduce deficits, i.e. to achieve $d_{\tau+k+1} > d_{\tau+k}$, it is necessary that:

$$r^{dreg} < r^{c}_{\tau+k}\left(1 + \frac{d_{\tau+k}}{pe^{D}_{\tau+k}}\right) < r^{c}_{\tau+k} \tag{32}$$

The simplest way to meet this criterion is to set $r^{dreg} = 0$. However, this sharp measure is needed only in case the system nears bankruptcy, that is, when $\left(-d_{\tau+k}\right) \to pe^{D}_{\tau+k}$. In all other cases this criterion can be met with strictly positive values of deposit rate ceiling. Since equilibrium credit interest rate increases with the deterioration of bank deficits, the deposit rate ceiling can be established at the level of stationary credit interest rate, observed in the pre-shock economy: $r^{dreg} = r^{c}\Big|_{d=0}$.

Corollary 4. *An economy with appropriately chosen (in sense of inequality 32) deposit rate ceiling recovers after the shock to a steady state with* $d = 0$.

---

[20] Of course if the deposit rate ceiling is not set too high: $r^{dreg} < r^{crit}$ where r^{crit} provides that $d_t = -pe^{D}\left(\cdot, r^{crit}\right)$. This is the critical value of the market interest rate, under which the banking system is actually bankrupt, and no further development occurs.

7 The Russian crisis of 1998

First, we review the Russian economy in the pre-crisis period in order to check whether the principal assumptions of our model are satisfied. We consider the years 1998 and 1999 to fully represent the situation before and immediately after the August 1998 financial crisis. For comparison, we also consider the years upto 2003 in order to determine how the Russian financial system developed after the crisis. Second, we draw some conclusions on possible scenarios of macroeconomic development after the default.

7.1 Justification of theoretical assumptions

As Table 1 shows, in 1998 and 1999 the market for corporate bonds was strictly dominated by the market for credit from the banking system to enterprises and by the market for state short-term obligations. Two main features are revealed: (i) the share of market-based finance is very small in funding the private sector, which is mostly done through the banking system, and (ii) the market for state bonds is much more developed than the market for corporate bonds, although it is not the primary source of finance for the government, which also relies on the banking system including monetary authorities. These two features are mostly associated with the absence of credit histories of enterprises, quite common in transitory countries.

The year 1999 indicates a shrinking market for government bonds, which are mostly replaced by indirect finance through the banking system and monetary authorities. This immediate reaction of the markets to the default develops further and, in 2003, leads to a diminished market finance for the government and almost nonexistent credit from the monetary authorities. Bank finance is the leading source both for government and enterprises. This is the first stylized fact that is relevant for our model. *Enterprises are financed primarily by banks; the role of financial markets for private securities is negligible, and the Russian economy can be described as bank-dominated.*

Considering banking sector in 1998, we note the second stylized fact of the Russian financial system (Figure 4). *Banks obtain domestic funds primarily in the form of deposits and own capital.* All other domestic sources of funds are relatively small. An important assumption in our model is that banks have no shareholders capital. Violation

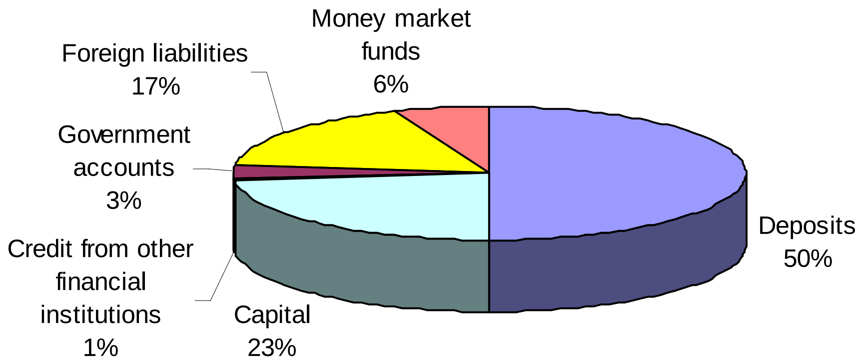
Table 1
Financial markets and instruments in the Russian Federation in 1998–2003
(end of the year, billion roubles)

	Corporate bonds	Bank credit to enterprises	State bonds	Credit from monetary authorities to RF government	Bank credit to government bodies
1998	20.7	300.2	387.1	483.5	263.7
1999	28.6	445.2	266.9	496.2	445.3
2000	38.9	763.3	184.2	264.2	532.7
2001	67.2	1191.5	160.1	193.2	588.7
2002	108.9	1612.7	217.0	193.7	696.0
2003	157.6	2299.9	314.6	31.7	742.8

Source: BEA (2004: Tables 17, 18, 20).

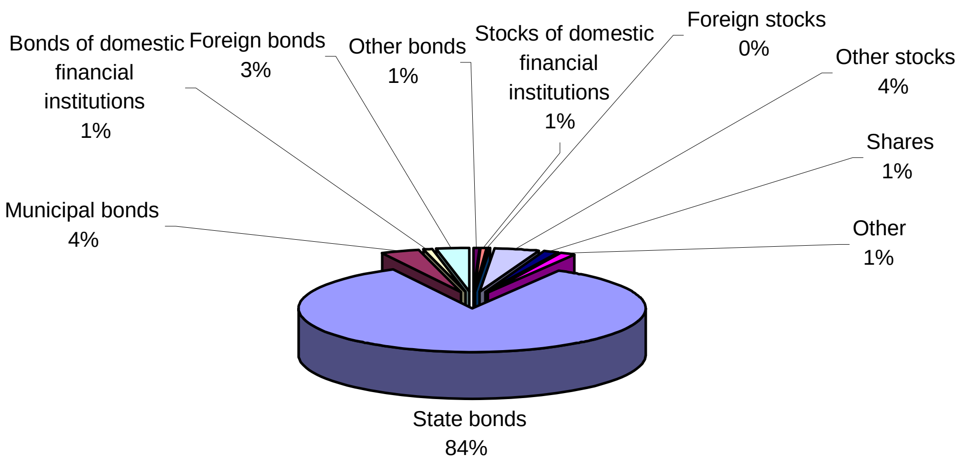
of this assumption would not lead to a difference between credit and deposit interest rates if dividend payments offer shareholders the same return as deposits. Another result based on this assumption is related to the concept of deficits, which the banks experience in the event of payments shock. As capital serves as a cushion against shock (insufficient repayment leads to a reduction of the capital, not necessarily to deficits), we can expect that the consequences of default are partially smoothed out by the capital cushion.

Figure 4
Financial sources of the banks in the Russian Federation in June 1998



Source: CBRF (1999: Table 1.9).

Figure 5
Securities in financial portfolios of the banks in the Russian Federation in June 1998



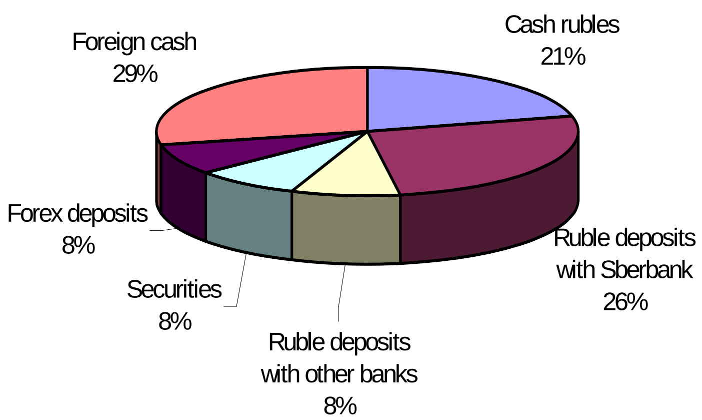
Source: CBRF (1999: Table 4.3.5).

The third stylized fact concerns the Russian financial system on the eve of the financial crisis. *Banking securities portfolio is not diversified and is concentrated mostly in state bonds*. More than 84 per cent of the banks' securities portfolios consist of state bonds two months before the crisis (Figure 5). Recall that we have not introduced state obligations as an investment opportunity for the banks in our model. Instead, we have considered the production sector with no diversification assumed. This allowed us to consider the direct influence of the shock on production capacities (through credit markets). According to the Central Bank of the Russian Federation (CBRF), total bank credit to enterprises in June 1998 amounted to 198 billion roubles compared to 163 billion roubles invested in state securities (CBRF 1999: Tables 4.3.1 and 4.3.5). Hence, the credit channel still plays a significant role in transferring the shock to the production sector.

At the same time, the huge share of state bonds in the securities portfolios of the banks explains why the government default can be considered a shock factor for the banking system. A decrease in bond prices leads to a decrease in the return for banks. This corresponds to what we call a 'payments shock'. Although enterprises repay their debts, the banking system still faces deficit caused by an external factor. In this case, the external factor is the state bonds. Their devaluation leads to a sharp reduction in the book value of the banks' assets, and results in a shortage of funds needed to repay on deposits.

And finally the fourth stylized fact: *bank deposits dominate household savings, but other strategies exist*. The structure of savings is given in Figure 6. Three main savings components can be noted: (i) domestic (rubble) cash, (ii) deposits with the banking system, and (iii) foreign cash as the principal substitute for deposits. The share of securities is negligibly small. Hence, our assumption of deposits being the only storage technology available to households is not far from reality. At the same time we can expect alternative storage technologies to provide again a kind of a cushion against the shock if the banks cannot repay deposits in full.

Figure 6
Structure of savings in June 1998



.

7.2 Developments after the default

Our model predicts four possible scenarios for a bank dominated economy: (i) deterioration of the economy and collapse of the banking system if no regulatory measures are implemented after the shock; (ii) delay of the real effect of the payments shock if repeated unrestricted liquidity injections are implemented by the regulator; (iii) relatively quick recovery of the economy, leaving the burden of the payments shock on depositors, who are underpaid on their deposits if short-term liquidity injections are used; and (iv) longer lasting recovery, which smoothes the negative consequences of the payments shock over several periods if a regulatory measure is chosen that allows banks to enjoy profit from interest rate margin (e.g., deposit interest rate ceiling considered above). The CBRF intervened immediately after the crisis in August 1998 with the following measures (see Thießen 2000):

1. allowing banks to draw on their reserves to make payments;

2. supporting off-sets of liabilities between banks;

3. providing 'stabilization credit' to problematic banks;

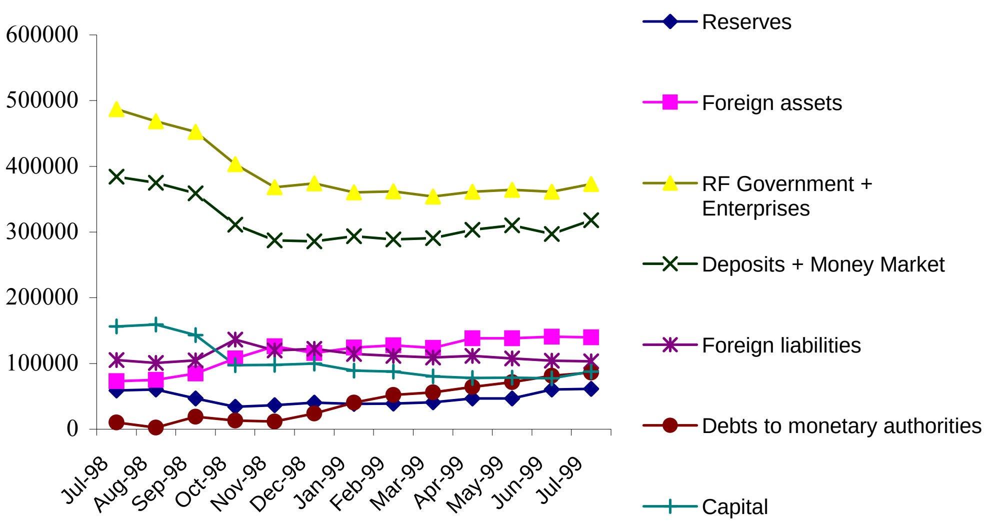
4. guaranteeing deposits in the state-owned Sberbank and stimulating the transfer of deposits from other banking institutions to Sberbank.

In total the central bank increased its lending to commercial banks in the ten months since June 1998 almost six times in real terms. These measures correspond largely to the liquidity injections studied in the model above, so one would expect a relatively quick recovery. But this was not the case, as it could be predicted with our model in the case of restricted short-term liquidity injections. We would rather argue that the cause was the forbearance policy adopted by the CBRF. The authorities suggested a bank restructuring strategy only by the middle of 1999, ten months after the crisis. The development of principal banking indicators in real terms (consumer price index for 1 July 1997 taken for 100 per cent) in the aftermath of crisis is shown in Figure 7. As can be seen, the amount of real credit (RF government plus enterprises) experienced a reduction immediately after the crisis, as did the amounts of deposits and banking capital, to stabilize in approximately three months. Apart from that, the figure reveals a significant increase in the banks' foreign assets and foreign debts, as well as an increase in credit from monetary authorities. We can expect that stabilization of total credit was achieved by 'pumping up' the banking system through credit from monetary authorities (which supports our conclusion regarding CBRF's forbearance policy).

The development of real interest rates is quite interesting (Figure 8). As expected, the absence of regulatory measures, which would create a positive profit margin, results in nearly equal real interest rates, and only from mid-1999 onward does the interest rate margin begin to increase. However both interest rates fall, although our model predicts them rather to rise (if there is a shortage of funds in the market) or to stay stable (if there are continuous liquidity injections on the part of the regulator, as was the case). A possible explanation for this fact is the scarcity of credit granted by banks, and their unwillingness to perform credit operations, causing credit rationing, a fact not considered in the model. If this is the case, interest rates are not determined by a market equilibrium condition, and do not respond to the shock.

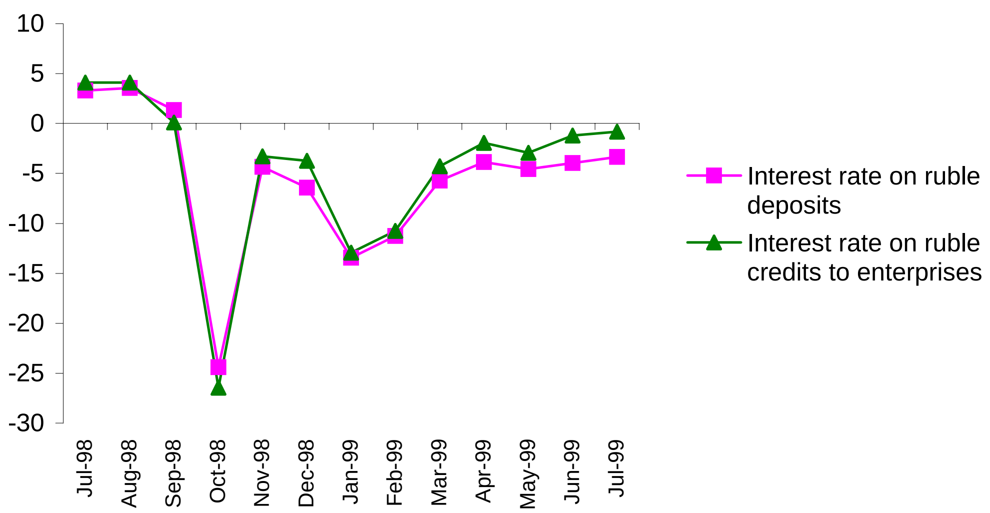
On the other hand, we calculated real interest rates, using announced nominal rates and the *actual* rate of inflation instead of the *expected* rate of inflation. If the expectations are not rational, they usually underestimate future inflation during a period of accelerating inflation. As a result, calculated real rates can move in the opposite direction to the theoretical projection.

Figure 7
Banking indicators in Russia in real terms in the aftermath of the crisis



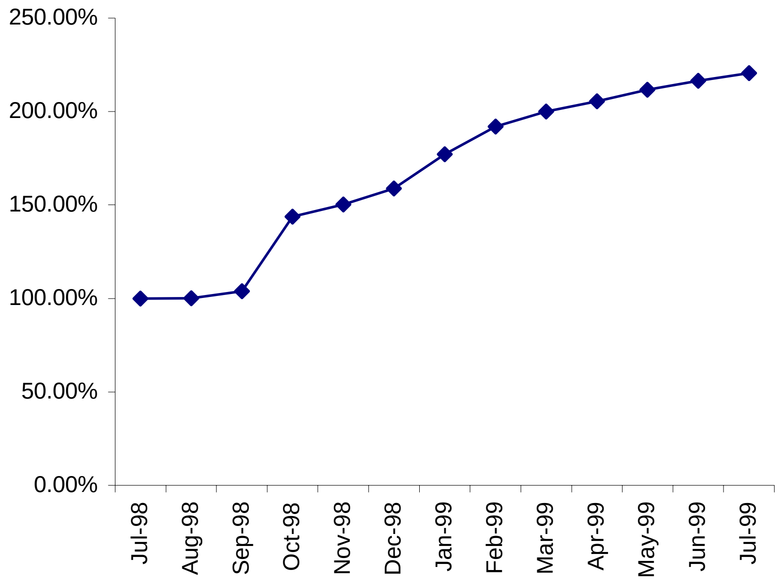
Source: CBRF (1999); own calculations.

Figure 8
Real interest rates in the aftermath of the crisis



Source: CBRF (1999); own calculations.

Figure 9
Consumer price index (1July 1998 = 100%)



Source: CBRF (1999); own calculations.

Finally, the nominal discount rate of the central bank was fixed at the annualized level of 60 per cent from 24 July 1998 till 9 June 1999 (CBRF 1999: Table 2.2). Given the inflation dynamics (see Figure 9) this resulted in a sharp fall of the real discount rate, which caused other real interest rates to fall as well.

According to the BEA (1999), the real income of the population decreased in the aftermath of the crisis by about 20 per cent, which is consistent with the predictions of our model. However the burden of the crisis was significantly alleviated by the fact that there was an alternative storage technology available to the depositors, namely US dollars, which are widely used in Russia as a mean of saving. This is a crucial difference between our model and the situation in Russia before and after the default of 1998.

Comparing the results of our model with available data on the financial crisis in Russia in 1998, we can draw the following broad policy implications:

1. The existence of a developed financial market and market-oriented financial system would accelerate recovery after a sharp macroeconomic shock. However, from an institutional perspective, establishing market-oriented financial systems is a much more difficult task, especially in emerging and developing economies. A banking system is relatively easy to establish, but needs proper regulation and intervention mechanisms in case of crises to avoid collapse. With a market-oriented financial system, the burden of a crisis is borne by the population immediately after the macroeconomic shock, and to alleviate this burden other (perhaps fiscal) measures may be necessary.

2. The banking system allows for postponing and smoothening of the negative effects of a crisis. Postponement can be achieved through liquidity injections, and the

smoothening through regulatory intervention that leads to positive profit margins for the banks. In the first case, the burden of the crisis can be shared by depositors and the regulator, and in the second case it is shared among several generations of population.

3. Additional storage technology (e.g., foreign currency to accumulate the savings of the population) provides a cushion against the negative effects of a crisis for the population.

8 Concluding remarks

We have presented a dynamic model that incorporates both labour and capital markets and describes the role of financial intermediation in the evolution of the economy after a macroeconomic shock. From the analysis, it follows that deposit insurance itself cannot prevent macroeconomic collapse; these results are in line with the empirical findings of other studies.[21] This result is valid even if deposit insurance (bailout guarantees) does not change the risk incentives of banks (since there is no possibility for shifts in investment decisions of the banks in our model). The model provides a tool for analysis of the regulatory interventions in order to study their efficiency in recovering the system after a shock.

We find that a market-dominated system would provide a quicker recovery after the shock, but would leave the burden of the crisis on one generation. On the other hand, a bank-dominated financial system can follow several different scenarios. First, in the absence of regulation, the banking system can collapse since covering deficits through newly accumulated deposits resembles a financial pyramid, and the indebtedness of the banking system grows from period to period. Second, liquidity injections from the regulator can postpone the collapse. This has important policy implications for poverty reduction in countries experiencing financial crises because crises, when they result in recession, affect macroeconomic stability and thus contribute to higher unemployment and poverty.[22] Liquidity injections through appropriate regulatory policies may help to substantially reduce the detrimental impact of a crisis on the population. Third, a regulatory measure, which would create profit opportunities for banks (such as deposit rate ceiling) gives rise for smooth recovery, where the burden of the crisis is disseminated over several generations of the population.

---

21 For example, Demirgüç-Kunt and Detragiache (2000) question whether deposit insurance increases banking system stability; Barth, Caprio and Levine (2000) raise the same question with respect to regulation and ownership. Further empirical evidence on bank insolvencies and crises can be found in, for example, Caprio and Klingebiel (1996) and Arteta and Eichengreen (2000).

22 This is a critical issue for developing countries in the light of post-Monterrey initiatives to encourage the flow of private capital to developing countries and its effective use for investment and pro-poor growth.

References

Arestis, P., and P. Demetriades (1997). 'Financial Development and Economic Growth: Assessing the Evidence'. *Economic Journal*, 107 (May): 783-99.

Arteta, C., and B. Eichengreen (2000). 'Banking Crises in Emerging Markets: Presumptions and Evidence'. CIDER Working Paper C00-115. Berkeley: Center for International and Development Economics Research, University of Berkeley.

Baltensperger, E., and T. Jordan (1997). 'Seignorage, Banking, and the Optimal Quantity of Money'. *Journal of Banking and Finance*, 21: 781–96.

Barth, J. R., G. Caprio Jr., and R. Levine (2000). 'Banking Systems around the Globe: Do Regulation and Ownership Affect Performance and Stability?'. World Bank Working Papers WP2325. Washington, DC: World Bank.

BEA (Bureau of Economic Analysis) (1999). 'Russian Population a Year after the Crisis of August 1998: Income, Consumption and Savings'. Bureau of Economic Analysis, Issue 16. Available (in Russian) at www.beafnd.org .

BEA (Bureau of Economic Analysis) (2004). 'Review of Russian Economy'. Bureau of Economic Analysis, Issue 55. Available (in Russian) at www.beafnd.org .

Bolton, P. (2002). 'Banking in Emerging Markets'. *Journal of Financial Intermediation*, 11: 362-5.

Capasso, S., and G. Mavrotas (2003). 'Loan Processing Costs and Information Asymmetries: Implications for Financial Sector Development and Economic Growth'. WIDER Discussion Paper No. 2003/84. Helsinki: UNU-WIDER.

Caprio, G., and D. Klingebiel (1996). 'Bank Insolvencies: Cross-Country Experience'. World Bank Working Papers WP1620. Washington, DC: World Bank.

CBRF (Central Bank of Russian Federation) (1998 and 1999). 'Bulletin of Banking Statistics of the Central Bank of Russian Federation'. Moscow: CBRF.

Demirgüç-Kunt, A., and E. Detragiache (2000). 'Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation'. Proceedings of the 8th Econometric Society World Congress, Seattle, Washington, Contributed Paper No 1751.

Demirgüç-Kunt, A., and R. Levine (eds) (2001), *Financial Structure and Economic Growth*. Cambridge, MA: MIT Press.

Fry, M. J. (1988). *Money, Interest, and Banking in Economic Development.* Baltimore and London: The Johns Hopkins University Press.

Gersbach, H. (2003). 'Double-Sided Bertrand Competition in Financial Intermediation with Market Side Switching. Heidelberg: University of Heidelberg. Mimeo.

Gersbach, H, and J. Wenzelburger (2002a). 'Banking and the Macroeconomy'. Discussion Paper No. 343. Heidelberg: University of Heidelberg.

Gersbach, H, and J. Wenzelburger (2002b). The Workout of Banking Crises: A Macroeconomic Perspective'. Discussion Paper No. 490. Bielefeld: University of Bielefeld.

Gersbach, H., and J. Wenzelburger (2003). 'Banking Crises and Recoveries'. Heidelberg: University of Heidelberg. Mimeo.

Goldsmith, W. (1969). *Financial Structure and Development,* New Haven: Yale University Press.

Green, C. J., and C. Kirkpatrick (2002). 'Finance and Development: An Overview of the Issues'. *Journal of International Development*, 14 (2): 207-10.

Gurley, G. J., and S. E. Shaw (1960). *Money in a Theory of Finance*. Washington, DC: Brookings Institution.

Harrigan, J., G. Mavrotas, and S. Yussop (2002). 'On the Determinants of Capital Flight: A New Approach'. *Journal of the Asia Pacific Economy*, 7 (2): 203-41.

Hermes, N., and R. Lensink (eds) (1996). *Financial Development and Economic Growth: Theory and Experience from Developing Countries.* London: Routledge Studies in Development Economics.

Hermes, N., R. Lensink, and V. Murinde (2004). 'Flight Capital and its Reversal for Development Financing', in M. Odedokun (ed.). *External Finance for Private Sector Development*. Basingstoke: Palgrave-Macmillan for UNU-WIDER.

Rochet, J. C. (2004). 'Macroeconomic Shocks and Banking Supervision'. *Journal of Financial Stability*, 1 (1): 93-110.

Levine, R. (1997). 'Financial Development and Economic Growth: Views and Agenda'. *Journal of Economic Literature*, 35: 688-726.

Mavrotas, G. (2005a). 'Savings and Financial Sector Development: An Assessment', in C. Green, C. Kirkpatrick and V. Murinde (eds), *Finance and Development: Surveys of Theory, Evidence and Policy*. Aldershot: Edward Elgar.

Mavrotas, G. (2005b). 'Domestic Resource Mobilization for Growth and Poverty Reduction', in *Commonwealth Ministers' Reference Book 2005*. London: Henley Media Group.

Mavrotas, G., and S. Son (2005). 'Financial Sector Development and Growth: Re-examining the Nexus', in M. Bagella, L. Becchetti and I. Hasan (eds), *Transparency, Governance and Markets*. Amsterdam: Elsevier Publishers (forthcoming).

McKinnon, R. I. (1973). *Money and Capital in Economic Development*. Washington, DC: Brookings Institution.

Patrick, H. T. (1966). 'Financial Development and Economic Growth in Underdeveloped Countries'. *Economic Development and Cultural Change*, 14: 174-89.

Sachs, J. (1998). 'Alternative Approaches to Financial Crises in Emerging Markets', in M. Kahler (ed.), *Capital Flows and Financial Crises.* Manchester: Manchester University Press.

Shaw, E. S. (1973). *Financial Deepening in Economic Development*. New York: Oxford University Press.

Stiglitz, J. (1999). 'Responding to Economic Crises: Policy Alternatives for Equitable Recovery and Development'. *The Manchester School*, 67.

Thießen, U. (2000). 'Banking Crises in Transition Countries. Theory and Empirical Evidence: The Case of Russia'. DIW Discussion Paper No. 193. Berlin: German Institute for Economic Research (Deutsches Institut für Wirtschaftsforschung).

Tobin, J. (1965). 'Money and Economic Growth'. *Econometrica*, 33: 671-84.

Vinogradov, D. (2003) 'Macroeconomic Evolution after a Shock; The Role for Financial Intermediation'. Paper presented at the 35th Annual Conference of Money, Macro and Finance Research Group, Cambridge.

Wachtel, P. (2004) 'How Much Do We Really Know About Growth and Finance?'. *Research in Banking and Finance*, 4: 91-113.

Wachtel, P., and P. Rousseau (1995) 'Financial Intermediation and Economic Growth: A Historical Comparison of the US, UK and Canada', in M. Bordo and R. S. Irwin (eds), *Anglo-American Financial Systems*. Homewood: Irwin

World Bank (2001). *Finance for Growth: Policy Choices in a Volatile World*. New York: Oxford University Press.

Appendix: Variation of the macroeconomic shock

So far we have assumed that the economy suffers from a macroeconomic shock q_{t+1}, which influences the deficits of banks in period $t + 1$.

The only endogenous source of a change in deficits could be insufficient repayment from entrepreneurs to the banks: if the shock $q^* < 1$ happens in period $t + 1 = \tau + 1$, repayments to the banks are

$$\hat{B}_{t+1} < \left(1 + r_t^c\right)\left(k_{t+1} - e_t\right) \tag{A1}$$

We assume that the shock is exogenously given and influences the ability of borrowers (entrepreneurs) to pay the debt. In Vinogradov (2003), which considers a negative production shock, entrepreneurs are the first to suffer from the shock. This is caused by a priority of payments: entrepreneurs should first pay wages to workers. After having deducted wage repayments from the revenue, entrepreneurs repay their debts to the banks. If they can do this in full, and the profit is still positive, entrepreneurs can use the rest for consumption in the second period.

Now we assume that entrepreneurs have an option to default on their bank obligations. One possible explanation for this would be that the shock does not influence production directly, but influences the decisionmaking of entrepreneurs who overestimate their expected profit in a way[23]

$$\Pi_{t+1}^e = \frac{1}{q_{t+1}} f\left(k_{t+1}, l_{t+1}\right) - \left(1 + r_t^c\right)\left(k_{t+1} - e_t\right) - w_{t+1} l_{t+1} \tag{A2}$$

This changes[24] optimal decisions of entrepreneurs:

$$\frac{\partial k_{t+1}}{\partial q_{t+1}} < 0, \frac{\partial l_{t+1}}{\partial q_{t+1}} < 0, \frac{\partial e_t^E}{\partial q_{t+1}} < 0 \tag{A3}$$

which means that changing q from $q = 1$ to $q^* < 1$ leads *ceteris paribus* to an increase in capital demand, labour demand and savings of entrepreneurs. In addition, as the new period starts and actual production stays at the level $f\left(k_{t+1}, l_{t+1}\right)$, entrepreneurs first repay first workers $\hat{W}_{t+1} = \min\left(w_{t+1} l_{t+1}, f\left(k_{t+1}, l_{t+1}\right)\right)$. The possibility of default now changes the priority of repayments, so that entrepreneurs deduct from their net revenue $f\left(k_{t+1}, l_{t+1}\right) - \hat{W}$

---

23 This can be considered as an expectation of technological breakthrough, and the suggested expected production technology is a variation of AK-production function. We introduce $A = \frac{1}{q}$ and leave shock parameter q below unit to make the results tractable and comparable with Vinogradov (2003).

24 Over-estimation of expected profit could also appear in a way $\Pi_{t+1}^e = \frac{1}{q_{t+1}}\left[f\left(k_{t+1}, l_{t+1}\right) - \left(1 + r_t^c\right)\left(k_{t+1} - e_t\right) - w_{t+1} l_{t+1}\right]$. In this case, decisions of entrepreneurs with regard to the capital and labour demand remain unchanged, and only the savings decision is influenced: an increase in expected profit requires from entrepreneurs to increase their savings, which would lead to a downward shift of CM-line and consequent decrease in both equilibrium interest rate and equilibrium wage rate immediately before the deficits appear in the banks.

the amount dedicated for their consumption $\hat{C}_{t+1} = \min\left(f\left(k_{t+1}, l_{t+1}\right) - \hat{W}_{t+1}; \Pi^e_{t+1}\right)$, where $\Pi^e_{t+1} = \frac{1}{q_{t+1}} f\left(k_{t+1}, l_{t+1}\right) - \left(1 + r^c_t\right)\left(k_{t+1} - e_t\right) - w_{t+1} l_{t+1}$.

The rest is obtained by the banks as debt repayment $\hat{B}_{t+1} = f\left(k_{t+1}, l_{t+1}\right) - \hat{W}_{t+1} - \hat{C}_{t+1}$. Assuming that the shock influences only banks, that is, $w_{t+1} l_{t+1} < f\left(k_{t+1}, l_{t+1}\right)$ and $f\left(k_{t+1}, l_{t+1}\right) - w_{t+1} l_{t+1} > \Pi^e_{t+1}$, we obtain $\hat{W}_{t+1} = w_{t+1} l_{t+1}$, $\hat{C}_{t+1} = \Pi^e_{t+1}$ and $\hat{B}_{t+1} = \left(1 + r^c_t\right)\left(k_{t+1} - e_t\right) - \left(\frac{1}{q_{t+1}} - 1\right) f\left(k_{t+1}, l_{t+1}\right)$. This equation tells us, that the repayment to banks from entrepreneurs is insufficient and leads to deficits in the banking sector. In this sense it is equivalent to (A1).

This case differs from the one considered in the paper in that interest rate and wages start to change one period before deficits appear in banking sector. Further development is still driven by the dynamics of deficits. As the shock is still exogenous, and the driving force is concentrated in banks' deficits (which dynamics is not influenced by the nature of shock) we have transferred the influence of the shock directly to deficits in the paper to simplify the exposition.