UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4335 – The Economics of Banking**

Date of exam: Monday, November 20, 2017 **Grades are given:** 12 December 2017

Time for exam: 09.00 a.m. – 12.00 noon

The problem set covers 5 pages (incl. cover sheet)

Resources allowed:

- No written or printed resources – or calculator - is allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences)

The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

Exam ECON 4335 Economics of Banking, Fall 2017

Total: 30 points.

Problem 1. (10 points) A firm wants to undertake a project that requires an initial investment that costs 1 unit of capital. The firm has no initial wealth and is protected by limited liability. In order to undertake the project the firm has to borrow from a lender. After a loan has been granted and a contract has been signed between firm and lender (claiming that R is to be repaid if the project succeeds), the firm takes an unverifiable action that affects the riskiness of the project. The firm has two options. The first option is a safe project, as given by the lottery $\{(p, 2); (1-p, 0)\}$: the gross return is 2 with probability $p \in (0, 1)$, and 0 with probability $1-p$. The other option is a risky project, as given by the lottery $\{(pq, 3); (1-pq, 0)\}$. We assume that p and q satisfy $2p > 1 > 3pq > 0$. Suppose that only success can be verified (not the size of the return nor which project has been chosen). The outside option of every lender is just to keep his funds (that is, ensure a gross risk-free return of 1 on each unit of capital). Firm and lenders are all risk neutral.

(1.1) (4 points) Show on a graph the expected profit of the firm as a function of R, for R in the interval $[0, 2]$, if the project is financed and the firm chooses the safe project. On the same graph, show the expected profit of the firm, if the project is financed and the firm chooses the risky project. Argue that there is a critical value $\hat{R} = \frac{2-3q}{1-q}$, such that for $R = \hat{R}$ the firm is indifferent between choosing the safe or the risky project.

(1.2) (4 points) If $R < \hat{R}$ will the firm choose the safe project or the risky one? What if $R > \hat{R}$? Can you provide an economic intuition to support your answer?

(1.3) (2 points) Assume that there are many lenders that compete to lend to the firm. Show that if $\hat{R} > \frac{1}{p}$ the firm is able to undertake the project and is asked to repay $R = \frac{1}{p}$ in case of success.

Problem 2. (8 points)

Consider a bank that operates a balance sheet as follows:

<table>
<tr><th>Assets</th><th>Liabilities</th></tr>
<tr><td>Loans and other financial assets</td><td rowspan="2">Deposits</td></tr>
<tr><td rowspan="2">Reserves</td></tr>
<tr><td>Equity</td></tr>
</table>

Suppose the bank is issuing a mortgage loan of 5 million NOK to a borrower, which consists of 4.5 million NOK principal and 0.5 million NOK interest.

(2.1) (3 points) Illustrate the bank's balance sheet with the new loan.

(2.2) (3 points) Explain briefly, in words, how reserves are affected when the borrower withdraws, and how the bank restores the level of reserves through liquidity management.

(2.3) (2 points) Explain briefly how the bank's loan supply is affected by credit risks and liquidity risks.

Problem 3. (12 points)

Consider a small open economy with a tradable goods sector and a nontradable goods sector. Only tradable goods can be traded internationally; nontradable goods have to be consumed domestically. The economy is populated by a continuum of identical households of measure one, living for 2 periods $t = 0, 1$, with preferences given by $u(c) = lnc_0^T + lnc_0^N + lnc_1^T$, in which c_0^T, c_0^N, c_1^T are consumption of tradable goods at $t = 0$, consumption of nontradable goods at $t = 0$, consumption of tradable goods at $t = 1$, respectively.

A representative household starts with initial asset b_0 at $t = 0$, and ends after $t = 1$ with zero asset, i.e., $b_2 = 0$. Note that b_0 can be positive or negative: when $b_0 < 0$, the household starts with initial debt. The timeline of events is as follows:

- At $t = 0$, the representative household receives both an endowment of tradable goods y_0^T and an endowment of nontradable goods y_0^N for consumption. Both y_0^T and y_0^N can be random variables drawn from certain distributions. After $\left(y_0^T, y_0^N\right)$ is revealed, the household can save ($b_0 > 0$) or borrow ($b_0 < 0$) from abroad by purchasing a one-period, non-state contingent foreign bond denominated in units of tradables. Interest rate r is normalized to be 0, determined exogenously in the world market. Normalize the price of tradables to 1 and denote the price of nontradable goods by p_0^N. In addition, the household's debt is securitized such that its total debt cannot exceed a fraction $0 < \kappa < 1$ of its total income from tradables and nontradables;
- At $t = 1$, starting with total asset b_1 the representative household only receives an endowment of tradable goods y_1^T for consumption. y_1^T is constant.

(1) (3 points) Specify the representative household's budget constraints, borrowing constraint, and life-time optimization problem.

(2) (3 points) Compute the first order conditions for the household's optimization problem:
   (a) Derive the first order conditions with respect to c_0^T and c_0^N, then determine p_0^N;
   (b) Derive the first order conditions with respect to c_1^T and b_1, then determine the Euler equation. Why is the borrowing constraint occasionally binding?

(3) (3 points) Determine c_0^T:
   (a) Under what condition(s) is the borrowing constraint not binding? In this case, use the results from exercise 2(b) to determine c_0^T;
   (b) When the borrowing constraint is binding, compute c_0^T.

(4) (2 points) Consider the case that the shocks only affect tradable goods: y_0^N is constant while the realization of y_0^T can be high or low. The economy can be either in normal state

$y_0^T = \bar{y}$, or crisis state with a lower tradable goods production: $y_0^T = \bar{y} - 1$. Remember that the household knows the true state before it borrows.

(a) If borrowing constraint is not binding in both states, how does c_0^T react to the crisis, compared with c_0^T in the normal state?

(b) If borrowing constraint is binding in both states, how does c_0^T react to the crisis, compared with c_0^T in the normal state?

(5) (1 point) Consider the case that the shocks only affect nontradable goods: y_0^T is constant while y_0^N can be high or low. In the normal state, $\left(y_0^T, y_0^N\right) = \left(y^T, y^N\right)$ and in the crisis state, $\left(y_0^T, y_0^N\right) = \left(y^T, y^N - 1\right)$. Does the shock to non-tradable goods affect the borrowing constraint and the consumption of tradable goods c_0^T? Why? (You may answer this question by solving the problem analytically to or simply argue with logic. In the latter case, the equations for borrowing constraint and tradable goods price p_0^N solved above are useful.)