Financial Economics Field Exam — August 2011

There are two questions on the exam, representing Macroeconomic Finance (234A) and Corporate Finance (234C). Please answer *both* questions to the best of your ability. Do not spend too much time on any one part of any problem (especially if it is not crucial to answering the rest of that problem), and don't stress too much if you do not get all parts of all problems.

Good luck!

Question #1. Macroeconomic Finance (Economics 234A)

This question is about the price and welfare effects of financial innovation when not all future outcomes are equally salient to investors. Consider an economy over three dates $t = 0, 1, 2$ with two assets B and A, which pay off at $t = 2$. B pays $R > 1$ for sure, while A pays y_i with probability π_i where i indexes the three possible states of the world at $t = 2$, which are: g (growth), d (downturn), r (recession). Assume that $y_g > 1 > y_d > y_r$ and that $\pi_g > \pi_d > \pi_r$. At $t = 0$ both assets, which are in unit supply, are owned by a patient risk-neutral intermediary with preferences

$$\max E\left[C_0 + C_1 + C_2\right].$$

The economy also has an infinitely risk-averse investor with initial wealth w and preferences

$$\max E\left[C_0 + C_1 + \theta \min\left(C_{2g}, C_{2d}, C_{2r}\right)\right]$$

where $\theta > 1$.

At $t = 0$ financial claims are traded and prices set. At $t = 1$ a signal $s \in \{s_L, s_H\}$ observed, claims are re-traded and new prices set. Here s_H is a "good signal" which raises the probability of state g and reduces that of r, while s_L is a "bad signal" which raises the probability of r and reduces that of d. The exact signal distribution will not be important for answering the questions. At $t = 2$ returns are realized and distributed.

Assume that both actors are price-takers and that asset prices are determined to equate demand and supply.

Part A

Assume that both actors are rational, and that the financial claims traded, which we label the bond and the share, coincide with the basic assets B and A.

(a) Show that at $t = 0$ the investor's reservation price is θR for the bond and θy_r for the share. What is the intermediary's reservation price for these two financial claims? From now on, assume that $\theta y_r < E_1\left[y|s_L\right]$. Argue that this condition implies that there is no trade in shares. ($E_1\left[.|.\right]$ denotes conditional expectations at $t = 1$.)

(b) To solve for the equilibrium in the bond market at $t = 0$, plot the demand curve of the investor and the supply curve of the intermediary in a diagram where the vertical axis is the bond price and the horizontal axis is the bond quantity. Recalling that the investor may be constrained by her total wealth, show that demand is first horizontal then decreasing, and compute the point at which is starts to decrease. Explain why supply is a step function. Assuming that w is large enough, what is the equilibrium bond price $p_{B,0}$? Indicate the area in the diagram which measures the gains from trade.

(c) What is the bond price at $t = 1$ after the signal is realized? Why?

Part B

Now we introduce financial innovation. Both actors are still rational, but now the intermediary can repackage some of the payoffs of A to obtain a new synthetic safe bond which promises to pay R with certainty at $t = 2$. The synthetic bond is a perfect substitute for the true bond and can be sold to the investor, while the intermediary keeps the residual risky claim.

(d) What is the maximum amount of synthetic bonds that the intermediary can create from the unit supply of A?

(e) Assume that w is large enough. Draw the new demand and supply curves in the combined market for both types of bonds at $t = 0$. How does the supply curve of bonds change? What is the bond price? How do the gains from trade change? Is the financial innovation Pareto-improving? What is the bond price at $t = 1$ after the signal is realized?

Part C

Now we explore financial innovation in the presence of a behavioral bias called local thinking. We assume that on each date, both actors only pay attention to the two most likely states of the world, and neglect the least likely state.

(f) Given that at $t = 0$ the least likely state is r, what is the total amount of the synthetic bond the intermediary will issue? Are synthetic bonds perfect substitutes of real bonds now? Are they perceived as perfect substitutes by the two actors?

(g) Draw the demand and supply curves in the bond market at $t = 0$. Assuming that w is in the range that with the new bonds the price falls below your answer in (e), derive an expression for the equilibrium bond price.

(h) Assume the signal structure is such that after s_L both actors think about states g and r (and neglect d). Suppose that s_L is realized at $t = 1$. Compute the investor's new reservation prices for the synthetic bond and for the true bond. Show that the intermediary reservation prices are $\left[\Pr^L(y_r|s_L)(y_r/y_d) + \Pr^L(y_g|s_L)\right] R$ (which we denote $\omega^L R$) for the synthetic bond and R for the true bond, where $\Pr^L(.|.)$ denotes conditional probabilities for the local thinker. Explain why the markets for the synthetic and true bond segment in this event.

(i) Draw the demand and supply curves for the old bond at $t = 1$ after s_L is realized. Maintaining all of the above assumptions, what will be the price of the old bond? How does it change relative to $t = 0$? Assuming that $\theta R \cdot (y_r/y_d) < \omega^L R$, also draw the demand and supply curves of the synthetic bond in this event at $t = 1$. Who sells and who buys this security now? How does the amount of capital available to the intermediary affect the price of the synthetic bond?

(j) What aspects of events in the mortgage bond market in 2007 and in the market for money market funds in 2008 are consistent with this model?

(k) In this model, would incentive-based policies reduce the size of the price drop in the synthetic bond market? What other policies might be effective?

Question #2. Corporate Finance (234C - Financial Decision-Making in Firms)

Applying Differences in Beliefs to Investment and Capital Structure Policies (*maximum of 64 points*)

In class, we considered the implications of differences between managerial and market beliefs about the profitability of a firm's investment project for internal investment, external investment (mergers), and for capital structure decisions. Capital structure decisions include the decision to payout dividends, which we did not draw out explicitly in the models and empirical analyses considered class. In this exam, we will again investigate investment and financing decisions, but also undertake a simply attempt to model out the dividend decision. Moreover, we will consider a new model of differences in beliefs.

Consider an all-equity firm with a CEO who acts in the interests of all shareholders. The number of shares is normalized to one, and all investors are risk neutral. The risk-free interest rate is 0.

Time Structure. There are three dates. At date 0, the CEO and the market observe signals about a project available to the firm. At date 1, the CEO pays a dividend and/or raises external financing, and also invests capital in the project. At date 2, the cash flows from the project are realized. The cash flows are used to pay off creditors who provided external financing at date 1. Any remaining funds go to shareholders as the final dividend.

Investment. An investment $I \geq 0$ in the project at date 1 yields cash flows of $Y \cdot f(I)$ at date 2, where Y is the project quality, modelled as a random variable, normally distributed with mean μ_y and precision η_y (standard deviation $1/\eta_y$) and the function f is increasing and concave with $f(0) = 0$.

Prior to the investment decision, at date 0, the CEO observes a signal s about the project available to the firm, where s is normally distributed with mean equal to the project quality Y and precision η_s. The expected value of the project quality conditional on the signal s, $y(s) \equiv E[Y|s]$ is calculated using Bayes rule. The initial beliefs about the project follow the condition: $\mu_y f'(0) \leq 1$.

Financing. At date 0, the firm starts out with cash $C_0 > 0$. At date 1, the CEO declares a dividend D and raises external financing F. We model external financing as costly (relative to internal financing) and capture this capital-market friction in a simplified manner: for a given amount F of external financing, the net cash received by the firm is only $(1 - \beta)F$, where the cost of external financing β is allowed to be 0 (benchmark of no friction) but assumed to be strictly smaller than one: $0 \leq \beta < 1$. The amount of dividend paid at $t = 1$ is limited by the total cash available at $t = 1$. Any cash remaining after dividend payout is invested in the project.

Question 1. As mentioned above, the initial beliefs about the project follow the condition: $\mu_y f'(0) \leq 1$. Explain what this condition implies for the ex-ante NPV of the project (i.e., the NPV prior to receiving any signal) and hence for the role of the signal in inducing the CEO to invest. (*2 points*)

Question 2. Calculate the CEO's posterior mean of the project quality $y(s) \equiv E[Y|s]$ using Bayes rule and provide an intuitive interpretation (i.e., describe the expression). (*2 points*)

Question 3. Express the level of investment I chosen by the CEO at time 1 as a function of the total amount cash available and the dividend payment. (*1 point*)

Question 4. Formulate the CEO's maximization problem. Hint: The CEO chooses a policy (I, D, F) to simultaneously determine the levels of investment, dividend, and external financing based on the signal s. Provide an intuitive interpretation of the objective function and the constraints. (*8 points*)

Question 5. In this model, we will not be considering the option of share repurchases. However, in terms of total value created, dividends and share repurchases would be perfect substitutes in this model. Under which assumptions is the CEO indifferent between them? (*1 point*)

In this model, it is easy to show that the investment, dividend, and financing policies depend on the signal s in the following manner:

(a) for lowest signal values, $s \leq \underline{s}$, there is no investment, no external capital is raised, and the initial cash C_0 is paid out as a dividend,

(b) for higher signal values, $\underline{s} < s < \hat{s}$, investment is positive but less than C_0 and is an increasing function of s, dividend is positive and a decreasing function of s, and external capital is not raised,

(c) for even higher signal values, $\hat{s} \leq s < \overline{s}$, investment equals C_0, dividend is not declared at time 1, and external capital is not raised, and

(d) for highest signal values, $\overline{s} \leq s$, investment exceeds C_0 and is an increasing function of s, dividend is not declared at time 1, and the amount of external financing is an increasing function of s.

Question 6. To gain an intuition for the above results, characterize the CEO's posterior beliefs about the returns to investment in each of the four regions (a) to (d) – both in terms of sign (positive, negative) and compared to the costs of financing. (You do not need to derive the above results (a) to (d) formally!) (*6 points*)

We now allow for differences in beliefs: The CEO believes that the signal s has precision $C\eta_s$. Thus, $C = 1$ indicates a rational CEO, $C > 1$ indicates an overconfident CEO who believes that his signal is more informative than it really is; and $C < 1$ indicates a "diffident" CEO. This difference in the interpretation of the signal influences, in turn, an overconfident CEO's investment, dividend, and external financing decisions. In this modified model, the following can be shown:

(a) Investment is weakly increasing in CEO overconfidence. (b) Dividends are weakly decreasing in CEO overconfidence. (c) The amount of capital raised through external financing is weakly increasing in CEO overconfidence.

Question 7. Calculate the CEO's posterior mean of the project quality, now allowing for bias C. That is, calculate $y(s, C) \equiv E[Y|s, C]$ using Bayes rule and provide an intuitive interpretation for the case of overconfidence ($C > 1$) compared to the rational case. (*3 points*)

Question 8. Provide an intuition for results (a) and (b) above, i.e., for the result that the more overconfident a CEO is, the more he will invest and the less he will pay out in dividends as follows: First compare how a rational and an overconfident CEO react to a positive (above average) signal – what are their expectations about project quality, the resulting investment decision, and the resulting dividend decision. Then compare how a rational and an overconfident CEO react to a negative (below average) signal – what are their expectations about project quality now, what the resulting investment decision now, and the resulting dividend decision now. Conclude. (*11 points*)

You would now like to test whether these predictions hold empirically. Suppose you had a credible measure of CEO overconfidence of the type modelled above at your disposal.

Question 9. Name four financial data sets you would need to access to test the model predictions and spell out for which variables? Also explain why it would be preferable to work with a panel data set rather than mere cross-sectional data. (*5 points*)

Question 10. Spell out the main regression equation to test the effect of overconfidence on dividend payments. Make sure to be precise about the normalization of various variables, about the set of control variables, fixed effects, and how you would calculate standard errors. (*6 points*)

Question 11. The most widely used measure of CEO overconfidence in the behavioral corporate finance literature is "Longholder," as first proposed by Malmendier and Tate (2005, 2008). This indicator variable identifies CEOs who hold an executive stock option until the year of expiration (typically year 10) at least once during their tenure even though the option is at least 40% in the money. What is the motivation for this proxy – why does holding on to options (= not exercising options early) indicate overconfidence? What are possible confounds that need to be addressed? (*8 points*)

Question 12. Explain why it might be problematic to employ this measure of overconfidence to test the above model, i.e., to test for the effect of overconfidence on dividend payments? Hint: Spell out what type of overconfidence (type of bias) is assumed (e.g., in Malmendier and Tate) to induce a CEO to overestimate the value of options and compare it to the type of overconfidence modeled above. Does the type of overconfidence modeled above necessarily imply late option exercise? Under what circumstances does it? (*6 points*)

Question 13. The figure below provides an example of an attempt to estimate the model using the Longholder variable. (You can ignore Model 2, given that both the "Pre-Longholder" and the "Post-Longholder" variables are significant. Point out at least five major short-comings / credibility concerns with the regression specification. (*5 points*)

Does CEO Overconfidence Affect Dividend Payout?

This table provides estimates from a random-effects tobit model, which is estimated on the pooled data. The dependent variable equals the ratio of total dividends to market value of equity. Stock Ownership is the ratio of total shares (owned by the CEO and his immediate family) to the number of shares outstanding. Vested options equals the CEO's ownership of options (exercisable within six months of the beginning of the year) as a fraction of shares outstanding. Longholder is a binary variable that equals 1 if the CEO held an option package until the last year before expiration at least once during his/her tenure *and* the option package held was at least 40% in the money entering its final year. Post-Longholder is a binary variable that equals 1 for all CEO-years after the CEO, for the first time, holds the option package until expiration. Pre-Longholder is a binary variable that equals 1 for CEO-years where Post-Longholder equals 0 and Longholder equals 1. Growth equals the ratio of the market value of assets to book value of assets, where the market value of assets equals the market value of equity plus the book value of total assets minus the book value of equity. Cash Flow equals the ratio of operating income before depreciation to book value of assets. Log of Sales equals the natural logarithm of sales. Tangible Assets equals the ratio of property, plant, and equipment to book value of assets.

	Model 1			Model 2		
Variable	**Coefficient**	**z**	**Pr>z**	**Coefficient**	**z**	**Pr>z**
Constant	0.0191	1.62	0.106	0.0140	1.18	0.239
Stock Ownership	-0.0325	-5.86	0.000***	-0.0326	-5.88	0.000***
Vested Options	-0.0256	-3.59	0.000***	-0.0253	-3.57	0.000***
Longholder	-0.0039	-3.22	0.001***			
Post-Longholder				-0.0068	-4.45	0.000***
Pre-Longholder				-0.0026	-2.04	0.041**
Growth	-0.0093	-17.92	0.000***	-0.0092	-17.50	0.000***
Cash Flow	0.0242	3.81	0.000***	0.0231	3.64	0.000***
Log of Sales	0.0005	0.91	0.365	0.0007	1.32	0.186
Tangible Assets	0.0205	5.80	0.000***	0.0208	5.90	0.000***
Industry Effects		Yes			Yes	
Observations		2778			2778	
Number of Firms		244			244	
Log Likelihood		6465.99			6470.84	
χ^2		474.92***			486.51***	

*** Significant at the 0.01 level.
** Significant at the 0.05 level.
* Significant at the 0.10 level.

Figure 1: