Economics of the Financial Crisis   Spring 2014

Homework Assignment #4: Answer Sheet

1. Suppose we have three firms (A, B, and C) with different levels of leverage. The interest rate is 10% and the return on assets is 5% (this obviously should have read 15%, as in the table, else part b makes no sense). Each firm as $200,000$ in assets. Fill in the missing values in the columns for firms B and C in table 1.

Table 1: ROA=15%, i=10%

	Firm A	Firm B	Firm C
Assets	200,000	200,000	200,000
Debts	0	100,000	190,000
Equity (NW)	200,000	100,000	10,000
Leverage	0	1	19
Return on Assets	30,000	30,000	30,000
Interest Payments	0	10,000	19,000
Net Return	30,000	20,000	11,000
ROE(Net Return/Equity)	15%	20%	110%

(a) Which firm has the highest return on equity? If firm C had the same level of equity as firm A (i.e., $200,000$) and maintained its leverage ratio, how large would it be in terms of assets?

   brief answer *Firm C has the highest ROE = 110%. If C had the same amount of equity (20 times more) it would have 20*200,000=$40,000,000 in assets.*

(b) Suppose that ROA fell to 5%, interest rates on debt unchanged. What would happen to the ROE of each of the firms? Fill in the missing elements in table 2.

   brief answer *ROE falls for all three, most severely for firm C (= −90%).*

Table 2: ROA=5%, i=10%

	Firm A	Firm B	Firm C
Assets	200,000	200,000	200,000
Debts	0	100,000	190,000
Equity (NW)	200,000	100,000	10,000
Leverage	0	1	19
Return on Assets	10,000	10,000	10,000
Interest Payments	0	10,000	19,000
Net Return	10,000	0	−9,000
ROE(Net Return/Equity)	5%	0%	−90%

(c) Could all of the firms survive the fall in ROA? Explain.

   brief answer *We can see that they all still have positive net worth, so none have failed, even though firm B has zero ROE and firm C has negative ROE. Of course firm C could not last for long this way! Its equity exceeds losses only by $1,000.*

(d) Suppose that there are many firms of each type. If firms of type C take drastic action to cut their leverage as a result of the shock, will firms of type B be unaffected? What will they do? Explain. What about firms of type A? Explain.

brief answer *Yes! If C-type firms started to sell assets to payoff debt this could problems for B-type firms. The fire sale could spread problems to B-type firms, and then they have to sell. Of course, firm A may see this as a buying opportunity and get assets cheap.*

(e) Given your results why do firms take on high levels of leverage? Explain.

brief answer *Incentives. Look at the ROE in table 1. Presumably these high ROE increase equity prices. If managers' pay is related to return on equity they will do really well. The losses fall on debtholders, however. They may want to limit leverage, but if they do not there is not much incentive for managers to refrain. Of course, equity prices should reflect this – the M-M theorem still applies. But if the conditions of the theorem do not hold, or if the risk is not perceived, too much leverage might be assumed.*

2. Consider a firm that has two projects and has a debt level of 20. The payoffs for the two projects are state dependent. Project 1 pays off 100 in the good state and -100 in the bad state. Project 2 has payoffs of 10 in the good state and 0 in the bad state. Suppose the two states are equally likely.

   (a) Which project has higher expected value for the firm?

   brief answer *Project 2 has expected value = 5, project 1 = 0.*

   (b) If the manager's incentives are aligned with shareholders (say they get α of the return to equity, where $0 < \alpha < 1$) which project will the manager choose?

   brief answer *They will choose project 1. With project 1 they get $\alpha[.5(100) - 20] = \alpha(30) > 0$. With project 2 they get 0, as $5 - 20 < 0$, so equity holders get nothing.*

   (c) Suppose that asset markets are appreciating for a sustained period. Would this have any impact on the structure of incentives for risk-taking at financial firms? Explain.

   brief answer *If asset prices are appreciating, good states are more likely than bad states. So those who take risks will be rewarded. Since losses will be rarer, those that are more cautious will be weeded out. Taking risks in periods when asset prices are appreciating makes it look like you are a genius when you are just taking risk. When the risks are realized you wipe out your firm.*

   (d) What does your answer suggest, if anything, about the likelihood of future financial crises?

   brief answer *As long as we have financial markets where financial institutions have high powered incentives we are likely to have excessive risk taking. The incentives that encourage efficient use of shareholder's equity encourage excessive risk taking. No way around that.*

3. Consider an asset-backed security comprised of 100 subprime mortgages. The ABS is tranched in the normal way. Suppose there are two periods, and that the probability of default of a mortgage in any period is 10%, and that analysts believe that probability of default is independent for any mortgage.

   (a) Explain why the higher rated tranches of this ABS and of CDOs made from ABS like this will almost surely see no fall in their value if default occurs.

      brief answer *If defaults are independent and the probability of default is 10% then we would expect only 10 mortgages to default in either period. In ABS and CDOs made from them, the higher rated tranches are protected from below. The losses fall first on the lower rated tranches. If 10% of the mortgages fail there is still plenty of tranches to absorb the losses, so the AAA tranches should be okay.*

   (b) Now suppose that it turns out that defaults are not independent. Suppose instead that in period two defaults occur and that the correlation across mortgages is 30%. Explain why the higher rated tranches of the ABS are still likely to retain their value.

      brief answer *There is a 10% chance of default in any period, but since the default correlation is now 30% this means that in the event of default 30 mortgages default. It is like we have a ten-sided piece of dice and it came up default in period two. The AAA tranches of the ABS are still protected because the lower rated tranches can absorb 30% of losses. See figure 1. Even with 30% of mortgages defaulting the top rated tranches are safe.*

   (c) Explain why the higher rated tranches of CDOs are likely to lose value in the case of correlated defaults.

      brief answer *The problem for the CDO is that it is built up from lower rated tranches of the ABS. See figure 1 for a stylized example. When losses were uncorrelated, the lowest tranches could absorb 10% of the mortgages defaulting, and the CDO tranches were safe. With correlated defaults, so 30% of the mortgages default, the BBB tranches of the ABS are wiped out, but the CDO is built entirely from BBB tranches, so even the senior tranches of the CDO are wiped out.*
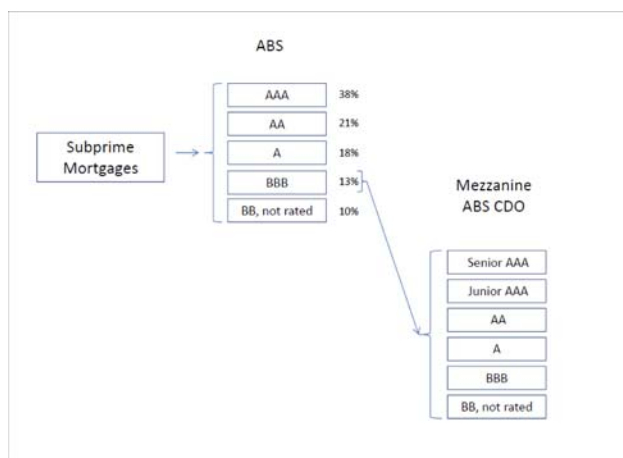

Figure 1: Stylized Example of ABS and CDO