

SOLUTIONS 2. 16.2.2016

Q1. If $x \geq 0$, $x_+ = x$, $x_- = 0$. So $|x| = x_+ + x_- (= x + 0)$, $x = x_+ - x_- (= x - 0)$, giving (i).

If $x < 0$, $x_- := -\min(0, x) = \max(0, -x) = |x|$, $x_+ = 0$. So $|x| = x_+ + x_- (= 0 + |x|)$, $x = x_+ - x_- (= 0 - |x|)$, giving (ii).

The proof above of (ii) contains (iii): $(-x)_- = x_+$.

For put-call parity:

$$P - C = (K - S)_+ - (S - K)_+ = (K - S)_+ - (K - S)_- = K - S.$$

So (in the notation of Week 2) $\Pi := S + P - C = S + (K - S) = K$. //

Q2. *Barings Bank and Nick Leeson*. Barings Bank – Britain’s oldest bank, and bankers to HMQ – collapsed in 1995 after huge losses in unauthorised trading by one rogue trader, Nick Leeson (see Wikipedia [”W” below] for details). This spectacular failure highlighted the risks to banks of unauthorised trading, and the need for internal checks and supervision to detect it. Not all the lessons have been learned – there have been several subsequent scandals and court cases.

The board of Barings at the time thought that in Leeson they had a star performer, who had worked out a clever way of exploiting price differences between the Singapore and Osaka stock exchanges so as to be able to profit from price movements in either direction. As in the text: this is obviously impossible, on theoretical grounds. In economic language: arbitrage opportunities are transient, as arbitrageurs move in en masse to exploit them (”pick up free money”), thereby eliminating them (”arbitraging them away”). In Physics language: this would be the financial equivalent of a perpetual motion machine. One cannot have a perpetual motion machine, as motion has to overcome friction, and this would gradually drain away the energy. This illustrates the Second Law of Thermodynamics: entropy increases (entropy is a measure of disorder). Such a ”Leeson trick” would be the financial equivalent of ”Maxwell’s demon” – a demon able to suck heat from a cooler gas to a hotter gas by letting pass only the faster (”hotter”) molecules.

Q3. *Financial failures*.

(i) *Barings* – above.

(ii) *LTCM (Long Term Capital Management)*. See I.3. The presence on

the LTCM board of two Nobel prizewinners greatly enhanced the prestige of LTCM before its crash in 1998. After the crash, it caused great reputational damage to Mathematical Finance as an area (as the authors of Bingham & Kiesel, 1st ed. 1998/2nd ed. 2004 are well aware!).

(iii) *Lehman Brothers*. W:

"Financial services firm Lehman Brothers filed for Chapter 11 bankruptcy protection on September 15, 2008. The filing remains the largest bankruptcy filing in U.S. history, with Lehman holding over \$600 billion in assets.

Contents

1 Background. 1.1 Exposure to the mortgage market; 1.2 Lehman's final months

2 Bankruptcy filing. 2.1 Breakup process

3 Impact of bankruptcy filing

4 Neuberger Berman

5 Controversies. 5.1 Controversy of executive pay during crisis; 5.2 Accounting manipulation; 5.3 Sale ... Read the ghastly details for yourself.

Q4. *Sovereign default*

(i) *Russia's default*. W: "The Russian financial crisis (also called "Ruble crisis" or the "Russian Flu") hit Russia on 17 August 1998. It resulted in the Russian government and the Russian Central Bank devaluing the ruble and defaulting on its debt.

Contents

1 Background and course of events

2 Crisis and effects. 2.1 Inflation; 2.2 Fiscal; 2.3 Agriculture; 2.4 Political fallout. 3 Recovery

4 Effects on countries in the world: Baltic states; Belarus; Kazakhstan; Moldova; Ukraine; United States; Uzbekistan ...

(ii) *Mexico's default*. Mexico defaulted in 1994, and previously in 1982. See W for details, and of indebtedness problems in Latin America.

Q5. *Financial fraud*.

(i) Barings: see Q1.

(ii) Société Générale: Jérôme Kerviel, imprisoned Oct. 2010, \$6.7B losses.

(iii) UBS: Kweku Adeboli (crisis, Sep. 2011; conviction and imprisonment, 20 Nov. 2012).

Again, see W for the ghastly details.

NHB