Sample Question for the Midterm of Microeconomic Theory I (Fall 2009)

NOTE: This is a sample question that was initially in the midterm, but was subsequently dropped due to space limit (or time limit of the exam). Hence, you should view this as an example of what the actual exam questions look like.

Part Z (18%): Air Defense by Aircrafts or Missiles

Consider Daiwan's Ministry of National Defense (MND) who plans to defend Daiwan's airspace using either aircrafts (A) or anti-air missiles (M). The super computers of the MND's "office of war games has converted the effect of different weapons (say, F-16 vs. IDF or PAC-3 vs. Tien Kung-II) into standardized (continuous) units. Suppose Daiwan view the aircrafts and missiles as substitutes: If Daiwan owns a stronger fleet of aircrafts, the rate of substitution is X units of aircrafts for one unit of missiles. If Daiwan owns a stronger array of anti-air missiles, then the rate of substitution is X units of missiles for one unit of aircrafts. Assume initially that X=3.

1. (2%) Write down a utility function to describe the preferences of MND assuming that it is homothetic.
2. (4%) Solve for and draw the income expansion path for MND given the price for aircrafts is US$18.8 million per unit[1] and the price for missiles is US$9 million per unit.[2]
3. (2%) Derive the indirect utility function of MND.
4. (4%) Can you use the Roy's Identity to derive MND's demand? Why or why not?
5. (4%) Hence, or otherwise, derive MND's demand functions for both aircrafts and missiles.
6. (**bonus** 2%) What kind of preferences does Daiwan have if X goes to infinity?

Note: If you cannot find the appropriate functions to use in question 1, you may request a suggest function to be used in the subsequent questions. However, you will have to forfeit 2 point.

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[1] Wikipedia (http://en.wikipedia.org/wiki/F-16_Fighting_Falcon) states that each F-16C/D fighter jet costs US$18.8 million.
[2] Wikipedia (http://en.wikipedia.org/wiki/MIM-104_Patriot) states that each PATRIOT unit costs US$ 1 to 3 million. Here we are (rather arbitrarily) assuming that the most advanced PAC-3 system costs US$3 million, and three sets of PAC-3 is equivalent to one standardized unit (that is equivalent to a F-16 fighter).