Practice Quiz 6: Inflation (Solutions)

1. This year, Amy spent about $2,000 on clothes. If inflation is 2% per year, how much will it cost her to purchase the same amount of clothes in four years? How about in ten years? Alternatively, if she still spends $2,000 on clothes in ten years, how much clothes will she be able to buy in ten years compared to today? (Assume Amy buys similar clothes in the future, and that the price changes of clothes are in line with inflation.)

Ans. At 2% inflation, $2,000 worth of clothes today will cost $2,000*$1.02^4$ = $2164.86 in four years. In ten years, the clothes will cost $2,000*$1.02^{10}$ = $2,437.99.

If Amy continues to spend $2,000 on clothes in ten years, she will only be able to afford 82% of the amount of clothes she purchase with $2,000 today:

$$P_T = P_0(1+i)^T \rightarrow \frac{P_0}{P_T} = \frac{1}{(1+i)^T} = \frac{1}{(1.02)^{10}} = 0.82$$

In other words, Amy will only be able to afford the same amount of clothes as she could get by spending 0.82*$2,000 = $1,640 today.

2. Back in 1990, Rich earned $45,000 per year as salesman at his town's local hardware store (specializing in lawn mowers). Twenty years later, in 2010, Rich remains in the same position, but now commands a salary of $65,000 per year, and attributes this increase to his employer's acknowledgement of his first-class salesmanship. Rich also noticed that a standard lawn mower increased in price from about $150 to $200 over this period. This confuses Rich, because he thoroughly understands the lawn mower industry and knows that lawn mower manufacturers have become more efficient over this time period, and based on his understanding of economics, thinks that the lawn mower prices should have fallen because of this. Inflation has averaged 2.5% during these twenty years. Calculate Rich's *real* wage growth between 1990 and 2010. Can Rich afford to buy more with his new salary? What is the price today of a lawn mower in 1990 dollars? Has the cost of a lawn mower risen or fallen in *real* terms?

Ans. If Rich's wages had increased with the 2.5% inflation over the 20 years, he would now earn almost $74,000:

$$\$65{,}000 * 1.025^{20} = \$73{,}738$$

Because this is greater than Rich's updated salary of $65,000 per year, it is clear that Rich's wages did *not* increase in real terms. To calculate Rich's *real* wage growth, first calculate his new salary in 1990 dollars:

$$\frac{\$65{,}000}{1.025^{20}} = \$39{,}668$$

This corresponds to real annual wage growth of -0.63% over the twenty years:

$$\$45{,}000 * (1+g)^{20} = \$39{,}668 \rightarrow g = \left(\frac{\$39{,}668}{\$45{,}000}\right)^{\frac{1}{20}} - 1 = -0.63\%$$

That is, Rich's real wages shrunk by a rate of 0.63% per year! Therefore, Rich's purchasing power has declined since 1990, and he can now afford to buy less with his salary.

The 2010 price of a lawn mower in 1990 dollars is:

$$\frac{\$200}{1.025^{20}} = \$122.05$$

So, although the nominal price of lawn mowers increased from $150 to $200, the real cost of a lawn mower has declined. The real price of a good is set by supply and demand, and the declining real price of lawn mowers is consistent with Rich's observation that efficiency gains have lowered lawn mower production costs (therefore increasing supply and lowering the real price).

3. Twelve years ago, in 2001, Janice invested $15,000 in the stock market. Over the twelve years, she realized returns of 13% per year on her investment. Inflation over this period averaged 2.4% per year. What was the *real* return on her investment? How much are her stocks worth today? How much are they worth in 2001 dollars?

Ans. The real return on Janice's investment can be calculated as:

$$r = \frac{1+n}{1+i} - 1 = \frac{1.13}{1.024} - 1 = 10.4\%$$

Nominally, her stocks are worth $15,000*1.13^{12} = $64,017 today. In real (2001 dollars), however, the value of her stock only grew by 10.4% per year and are worth $49,172.

4. John is helping his parents, who plan to retire in 20 years, plan for their retirement. The couple currently has $120,000 in retirement savings, and expects to earn about $20,000 per year from Social Security benefits. They would like to augment their Social Security benefits with withdrawals of another $20,000 per year from their savings, and would like to know how much to contribute each year to be able to do so. John explains that, while Social Security is adjusted for inflation, their withdrawals are not, so they will actually want to save enough to withdraw greater than $20,000 per year after they retire to be able to maintain their target standard of living. Assuming his parents can earn 8% on their investments per year for the next 20 years and 4% during retirement, an inflation rate of 2%, and that they wish to save enough to withdraw today's equivalent of $20,000 per year for 30 years, how much must they contribute each year in *today's* dollars? How large must their contribution be in ten years (in nominal dollars)? How much must they withdraw during their first year of retirement? How about their fifth year of retirement? (Assume all cash flows occur at the end of the year.)

Ans. First, calculate the *real* return John expects his parents to earn while saving in retirement:

$$r = \frac{1+n}{1+i} - 1 = \frac{1.04}{1.02} - 1 = 1.96\%$$

To sustain withdrawals of $20,000 in today's dollars throughout retirement, John's parents must accumulate a balance of $450,403 in today's dollars:

Time Value of Money	
P/Y	1
PMT	$20,000
FV	$0
N	30
I/Y	1.96%
PV=	-$450,403

The *real* return John expects his parents to earn while saving for retirement is:

$$r = \frac{1+n}{1+i} - 1 = \frac{1.08}{1.02} - 1 = 5.88\%$$

To accumulate $450,403 in today's dollars, they must make annual contributions of $2,042.36 in today's dollars:

Time Value of Money	
P/Y	1
PV	-$120,000
FV	$450,403
N	20
I/Y	5.88%
PMT=	-$2,042.36

Therefore, John's parents must make annual contributions of $2,042.36 in *today's* dollars over the next 20 years. To find the nominal amount of cash they must actually contribute, these cash flows must be adjusted for inflation each year. At the end of the fifth year, the contribution must be:

$$\$2{,}042.36 * 1.02^5 = \$2{,}254.93$$

The real value of their balance, in today's dollars, in 20 years when they retire will be $450,403. Nominally, their balance will be:

$$\$450{,}403 * 1.02^{20} = \$669{,}275$$

This will then sustain withdrawals of $20,000 in today's dollars per year for 30 years. Nominally, the first withdrawal should be:

$$\$20{,}000 * 1.02^{21} = \$30{,}313$$

This should increase with inflation each year, and the fifth withdrawal should be:

$$\$20{,}000 * 1.02^{25} = \$32{,}812$$