

Application of Four-Rate Formula and Exchange Rate Formula to demonstration of single currency with different value and interest rate

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Abstract

Putting the theory of price system on the relationship among price, wage, labor time, interest rate and GNP (or GDP), four main variables in economics, Four-Rate Formula and Exchange Rate Formula are created (Xiaozhong Zhai 2003). Two formulas applying to analyses of economy and calculation can show some valuable data to macroeconomics, economist and policymaker. They can produce a proof to demonstrate single currency with different value and interest rate in different conditions and regions. Two formulas are very simple, practical and easy to deal with the complex phenomenon in economy. Exchange Rate Formula has an immediate signification in the international trade economy.

1 Introduction

The single currency with different value and interest rate in a big country or area where there are many administration areas or region with different productivity and economic diversity, for example, in European Union, United States of America and China, is an important question for the discussion of macroeconomics and money policy. This is a good example for the application of above two formulas to practice.

Supply and demand that like a red thread run through economics (John Sloman 1991). But, there is not a simple formula that can explain the complex change in the relation between the different moneys and between the four main variables that are price, wage, labor time, interest rate and GNP (or GDP). Four-Rate Formula and Exchange Rate Formula fill the gaps in economics.

Before analyzing some aspects of a single currency, let us review what Four-Rate Formula and Exchange Rate Formula are.

Four-Rate Formula and Exchange Rate Formula are deduced from the formula $W = \frac{P_r}{t}$.

The formula $W = \frac{P_r}{t}$ is a simplified form of $V_{u1} + V_{u2} = \frac{2p_r}{dp + 2d_3p_3}$.

In an enclosed territory or society, W represents compensation a worker receives for producing one unit of product within one unit time. It is an abbreviation of the sum of $V_{u1} + V_{u2}$. More consumer goods represented by the sum of V_{u1} and V_{u2} mean higher salary.

Character P_r is the price for one unit of product. It is shorthand for $2 P_r$.

Character t is the time spent on producing one unit of product, an abbreviation of $dp + 2d_3 p_3$. While $dp + 2d_3 p_3$ is the number of people (p and p_3) and the amount of time or day (d and d_3) needed for producing and exchanging one unit product.

Assuming full employment (p) and constant population in a society or a region, $\frac{dp}{GNP}$ is the time ($d = \text{year}$) in which one unit of product is produced. Therefore, we have: $e = \frac{GNP}{dp}$ that indicates how many units of product are produced in one unit of time (a year).

Here is one unit of product expressed by its price according to the definition of GNP.

The change in GNP reflects the change of production efficiency with reasonable accuracy in a political and economic stable society where many factors may be seen as constant. GNP and production efficiency change are positively related.

Hold wage constant, with higher efficiency, labor time (dp) put in one unit of product decreases, and t decreases. Thus, numerator p_r decreases. Lower efficiency means increases in dp , t and p_r .

Interest rate in exchange process is yet another important factor that influences exchange efficiency. Variation of interest rate will artificially change $2d_3 p_3$ or t and then p_r . Having high interest rate has the same effect as having more labor time in commodity exchange in a stable society. High interest rate increases $2d_3 p_3$, then t . Thus, hold wage constant, Price, p_r , increases. Hold wage constant, with lower interest, the value of $2d_3 p_3$, t and price, p_r will decrease.

There are two forms of Four-Rate-Formulas. One is called no blending formula with a condition on which the value of $\pm gnp\%$ is totally equal to that of $\pm i\%$. Oppositely, if the above condition does not exist, another one is called blending formula.

$$1 \pm w\% = \frac{1 \pm p_r\%}{1 \pm i\%} \quad \text{Or} \quad 1 \pm w\% = \frac{1 \pm P_r\%}{1 \pm gnp\%} \quad (\text{no blending formula})$$

$$1 \pm w\% = \frac{1 \pm p_r\%}{1 \pm gnp\% \pm i\%} \quad (\text{Blending formula})$$

The meaning of positive and negative symbols in formulas is as follows:

The symbol + and - for $\pm p_r\%$ indicate respectively the increase and the decrease in price.

The symbol + and - for $\pm w\%$ indicate respectively the increase and the decrease in wage.

In the term of $\pm gnp\%$, the symbol + indicates GNP decrease and production efficiency decrease. So, labor time increases. Labor time and the value of GNP are positively relevant. Oppositely, symbol - indicates GNP increase and production efficiency increase. So, labor time decreases. Here is labor time and the value of GNP negatively interrelated.

$\pm i\%$ is the percentage change in interest rate (I), the change in the exchange efficiency will be expressed by the change in interest rate in a stable society and in a period.

The symbol + indicates the increase in interest rate and the decrease in exchange efficiency. Therefore, the labor time increases. On the contrary, the symbol – indicates the decrease in interest rate and the increase in exchange efficiency. So, the labor time decreases.

Let us take the following example:

In a country in 2003, GNP negatively increases 0.2% and inflation and wage increases 3.0%, 2.5% respectively. What would be a reasonable interest rate increase?

Since GNP increases negatively, production efficiency decreases and labor time increases. So, the value of $gnp\%$ is positive. Inflation means that price increases and $p_r\%$ is positive. Wage increase means $w\%$ is positive.

Putting $gnp\% = +0.2\% = +0.002$, $p_r\% = +3.0\% = +0.030$, $w\% = +2.5\% = +0.025$ into Four-Rate Formula, we have:

$$\begin{aligned} 1 \pm i\% &= \left(\frac{1 \pm p_r\%}{1 \pm w\%} \right) - (\pm gnp\%) = (1 + 0.030 / 1 + 0.025) - (+0.002) \\ &= 1.004878 - 0.002 = 1.002878 = 1 + 0.002878 = 1 + 0.2878\% \end{aligned}$$

Therefore, $i\% = +0.2878\%$, i.e. the reasonable interest rate is 0.2878% in this country in 2003.

Another example:

In a country in the third season, the statistics show that the increase in GNP is 5%, and that inflation and wage are 1.8%, 1.2% respectively comparing with the second season. What would a reasonable interest rate change be in this season?

Since GNP increases positively, production efficiency increases and the labor time decreases. So, the value of $gnp\%$ is negative.

Putting $gnp\% = -5\% = -0.05$, $p_r\% = +1.8\% = +0.018$, $w\% = +1.2\% = +0.012$ into Four-Rate Formula, we have:

$$\begin{aligned} 1 \pm i\% &= \left(\frac{1 \pm p_r\%}{1 \pm w\%} \right) - (\pm gnp\%) = (1 + 0.018 / 1 + 0.012) - (-0.050) \\ &= 1.00593 + 0.05 = 1.05593 = 1 + 0.05593 = 1 + 5.593\% \end{aligned}$$

$i\% = +5.593\%$, i.e. the reasonable interest rate is 5.593% in this country in this season.

Obviously, if the symbol of interest rate and GNP in Four-Rate Formula is opposite, the effect of change in interest rate and that in GNP would cancel each other. Contrarily, if the same, they would strengthen their effect each other.

For example, if the symbol of them is positive, the value of denominator would be bigger than 1. For a region where the GNP increase is very low or negative, too high a common rate set by central bank will farther decrease the effect of GNP. In this case, the change tendency of denominator is the same as the above. Under these conditions, hold price, numerator, constant, wage artificially decrease. Hold wage constant, price artificially

increases. So, runaway inflation may happen. Then, spending in investment and growth may be restricted.

If the symbol of them is negative, the value of denominator would be smaller than 1. For a region where the GNP increase is very high, too low a rate would further increase the effect of GNP on wage and price, and then the value of denominator will be smaller than 1. Under this condition, hold wage constant, price artificially decreases, which may bring about a deflation. Hold price, numerator, constant, wage artificially increases.

The different price and wage between different regions in a big country and area with differences in competitiveness and living standards are certainly accompanied by different GNP and interest rate. If a common interest rate set by central bank is needed to make the difference be reasonably small between them, then, the price and wage would artificially change very intensively in some region.

The different change in interest rate and GNP are accompanied by corresponding different change in wage and price. The common interest rate set by the central bank for a big country and area is bound to be wrong for at least some if not a majority of member at any one time. Economy that is an artificial thing apt to be influenced by politics, policy and social being is very complex. If an individual region finds it hard enough to get it right for its economy, how can a central bank hope to get it right for many different economies by a single currency with common interest rate?

Exchange Rate Formula is as follows:

$$\frac{M_{aA}}{M_{aB}} = R_{pB} \cdot \frac{W_{aA}}{W_{aB}} = \frac{W_A}{W_B} \cdot \frac{(R_{pB})^2}{R_{pA}}$$

W_A and W_B stand respectively for wage of country A and B with different productivity. Similarly, R_{pB} and R_{pA} stand respectively for referential product price in country A and B.

Let us take an example for demonstrating why single currency may manifest different value in different region in a big country or area.

For only example, taking rice as a reference product, the average wage for one producer in Germany is hourly about 12 €uro ($W_a = 12$), and the reference average price for rice is about one €uro a kilogram ($R_{pA} = 1$). In Spain, the average wage for a producer is hourly about 6 €uro ($W_B = 6$), and the reference average price for rice is 0.6 €uro a kilogram ($R_{pB} = 0.6$). The reference material amount of wage for a producer in Germany is hourly 12 kilogram rice, while that in Spain is 10 kilogram rice. That is to say, the consumption contents and volume and the living standard of German is 1.2 times that of Spanish.

The ratio of the exchange rate between €uro of Germany and €uro of Spain is as follows:

$$\frac{M_{aA}}{M_{aB}} = \frac{W_A}{W_B} \cdot \frac{(R_{pB})^2}{R_{pA}} = \frac{12}{6} \cdot \frac{(0.6)^2}{1} = 0.72$$

Because of that the consumption contents and volume and the living standard of German is 1.2 times that of a Spanish, and the price of a unit of the referential product in Germany is one €uro and $\frac{1}{1.2}$ €uro in Spain. If the reference average price of rice in Spain is 0.6 €uro a kilogram, 0.6 €uro of Spain is equivalent to $\frac{1}{1.2}$ €uro of Germany, which means that the ratio of the exchange rate between €uro of Germany and €uro of Spain is 1:0.72.

The result means that 1€uro of Germany in Spain is only worth 0.72€uro, and vice versa.

From the Four-Rate Formula, we can understand the following points:

The change in price and wage caused by that in GNP is a real change. Otherwise, it is an artificial change.

There are two phenomena. The first should be called a negative or contrary effect of interest rate on GNP, if they symbol are opposite ($G \uparrow - , I \uparrow +$ or $G \downarrow + , I \downarrow -$). The second should be called positive or mutual effect of interest rate on GNP, if they symbol are the same ($G \uparrow - , I \downarrow -$ or $G \downarrow + , I \uparrow +$). See figure 1.

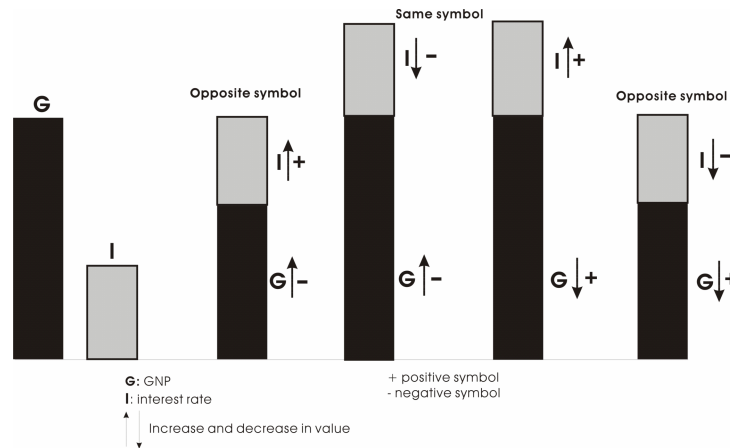


Figure 1: the relation between GNP and interest rate

The percentage change in the interest rate has the following characters:

The inert of interest rate is smaller than that of GNP, because GNP is decided by productivity. So, the change in interest rate is often employed by economist as a flexible lever in order to adjust and balance the relationship between price and wage.

The relationship between price and wage would be fully harmonious if the percentage change in GNP and in interest rate are equal, but their symbols are opposite.

The positive change in interest rate (increase rate) often indicates that the speed of change in wage is slower than that in GNP or the speed of change in price is quicker than that in wage, which brings about an artificial decrease in production efficiency. On the contrary, the negative change in interest rate (reduce rate) often indicates that the speed of change in wage is quicker than that in GNP or the speed of change in price is lower than that in wage. So, there is also an artificial increase in production efficiency.

2 Discussions

Macroeconomics is highly controversial. We focus on the relationship among price, wage, GNP (or GDP) and interest rate. Price, wage and employment are major macroeconomic issues. The denominator of Four-Rate Formula represents the change rate in labor time. In fact, labor time is just equivalent to employment. Four-rate formula makes us easily to understand the relation between employment and four main factors.

The higher quantity of production and GNP means higher Employment and higher average income in a society (John Sloman 1991), as the efficiency of production and exchange is seen as constant in a stable society. In the other words, the high average income and the high employment in a society are synonym under this theory. According to Four-Rate Formula's theory, the percentage change in GNP is only seen as the percentage change in production efficiency. So, a positive increase in GNP will cause the decrease in the denominator of the Four-Rate Formula, and then a real increase in wage or a real decrease in price will be obtained. These two theory and two cases are not different. So, the high employment could be obtained by increase GNP.

The change in interest rate can not directly create a real change in employment. But, that interest rate reduces may create a good environment for employment.

Wage is directly related to the level of price. Wage would also be stable, if price are stable. The inert of wage is often lower than price. This is reason why wage increase is often obtained by worker's unremitting struggle, for example, strike. The adjustment on interest rate could make wage change, but this change is artificial one. The increase in production efficiency and in exchange efficiency is only one way to have a real increase in wage.

Interest rate consists of four elements ($I = r + \pi + \theta + \sigma$) that are the return that lenders require (Peter Howells 1998). This is a special theory of interest rate. From this theory, interest rate is practically seen as a fiscal and monetary tool in the money market. According to Four-rate formula's theory, interest rate is seen as an indicator of the change in exchange efficiency. The interest rate has multiplied effects on economy and social. This is a general theory of interest rate. The change in interest rate has a great impact on wage, price and employment, just as we has discussed above. Interest rate has positive and negative effect on GNP. This effect will first bring about artificial changes in price or wage, and then probably lead to a real change in employment.

Different regions with different productivity in a big country or area have their corresponding and suitable interest rate and exchange rate. Single currency cannot benefit it. In a word, the hope of price stability, sound public finances, low interest rates, incentives for growth, investment and employment can not surely obtained. The increase of productivity or of the efficiency of production and exchange is an only way to improve economy. Of course, single currency could fully benefit to import and traveling with it for the region or area with low productivity, because its low value money is equivalent to the high value money in the world money market.

Exchange Rate Formula tells us that the decisive factor in exchange rate is the amount of reference product represented by a unit currency, not of gold or foreign reserve.

3 Conclusions

Seeing the name of Four-Rates Formula and Exchange Rate Formula, one may think of their function. Even though the Four-Rates Formula is not 100% accurate (because the change in GNP and interest rate do not in 100% represent production and exchange efficiency respectively), its advantages well outweigh its shortcoming. Considering the complexity of a country's economy, Four-Rate Formula that is such a small that can let us understand the main issue in the macroeconomics is inspiring and worth reading. Politic leader and economic plan-maker can very easily use this formula in guiding their economic policy.

Similarly, the precision of Exchange Rate Formula is determined by how to select reference product and how to make a criteria of reference product.

The general theory of interest rate opens a new way to study macroeconomics. Interest rate is a best lever to keep balance on price, wage and employment.

Four-Rates Formula and Exchange Rate Formula are very good for practice, because they can give a conclusive data evidence to demonstrate that single currency, for example, single European currency, can not certainly benefit price stability, sound public finances, low interest rates, incentives for growth, investment and employment.

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