Analysis on macro economic factors affecting working hour and consumption in Korean economy

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Ⅰ. Introduction

This paper analyzes that which Macroeconomic factors give effects on working hour and the consumption with the time variables. To do this, I relatively set the simple economic structural model and applied it to the methodology conducted by Robert Hall in 1997 so that what kind of structure factors in Korean economy had impacts on working hour and the consumption.

Ⅱ. Methodology

Assuming that the representative household not only chooses consumption and leisure on a quarterly basis and seeks to maximize its utility but also excludes any investment for the future and utility increment through the real liquidity.
The utility function of the representative household is as below.

$$U(C, N) = X\log C - \frac{N^{1+\phi}}{1+\phi} \qquad (1)$$

In this equation (1), C is consumption, N is working hour. A parameter $\phi^{-1} > 0$ means elasticity of substitution between consumption and labor. X is kind of weight on consumption and can be regarded as preference shock that the household have. Calculating the marginal rate of substitution about consumption and labor from the above equation and using an optimal condition, equation (1.1) is derived as followings.

$$\frac{CN^{\phi}}{x} = w \text{ (w is real wage)} \qquad (1.1)$$

$$Y = \frac{Z}{\alpha} N^{\alpha} K^{1-\alpha} \qquad (2)$$

Y is final output, $\alpha > 0$ means labor income share and K is capital stock. From equation (2), Z is total factor productivity which is an efficiency parameter and means technology shock which the enterprises have. Calculating the marginal product of labor from the production equation (2) and using an optimal condition, equation (3) is derived as below.

$$Z\left(\frac{K}{N}\right)^{1-\alpha} = w = \frac{CN^{\phi}}{X} \qquad (3)$$

Equation (3) indicates the balance of labor market, which means the left side of equation (3) is related to the labor demand of enterprise and the right side of equation (3) is involved in the labor supply of the household.

$$y = z + \alpha n + (1-\alpha)k - \log\alpha \qquad (2.1)$$

$$z + (1-\alpha)(k-n) = -x + c + \phi n \qquad (3.1)$$

For the market clearing, $Y = C + I + G + EX - IM$ (4)

In this equation (4), G, I, EX and IM mean government expenditure, investment, export and import abroad respectively. Robert Hall (1997) conducted his research by adding net export ($EX - IM$) to investment, while I considered investment and net export separately for this analysis because Korean economy predominantly relies on export over GDP. Transforming the equation (4.1) to log and it can be expressed as a small letter individually.

$$y = c + i + g + ex - im \quad (4.1)$$

By combining the production function equation (2.1), the balance equation of labor market (3.1) and the balance equation of product market (4.1), Equations of labor hours(n) and consumption(c) can be represented.

$$y = z + \alpha n + (1-\alpha)k - \log\alpha \quad (2.1)$$
$$z + (1-\alpha)(k-n) = -x + c + \phi n \quad (3.1)$$
$$y = c + i + g + ex - im \quad (4.1)$$
$$n = \frac{1}{1+\phi}(x + i + g + ex - im + \log\alpha) \quad (5)$$

Substituting the equation(5) of working hour to the equation(2.1), Output equation (6) which consists of exogeneous variables can be derived.

$$y = z + \alpha n + (1-\alpha)k - \log\alpha$$
$$y = z + \frac{\alpha}{1+\phi}(x + i + g + ex - im) + (1-\alpha)k - \left(1 - \frac{\alpha}{1+\phi}\right)\log\alpha \quad (6)$$

$$c = z + \frac{\alpha}{1+\phi}x + \left(\frac{\alpha}{1+\phi} - 1\right)(i + g + ex - im) + (\alpha - 1)k + \left(\frac{\alpha}{1+\phi} - 1\right)\log\alpha \quad (7)$$

In order to set the investment function, Suppose that the representative enterprise do not borrow any capital from the household as one of production factors and do not reinvest a certain percentage of previous profit.

$$I_t - im_t = \beta_x(L)x + \beta_z(L)z + \beta_g(L)g + \beta_{ex}(L)ex + u_t \quad (8)$$

Equation(8) is defined as the enterprise's empirical investment function. The investment factor consists of personal preference from the household, technology shift from the enterprise, government expenditure, exports shock and the rest effect that is not explained by shocks mentioned above. And all of factors are comprised of a lag polynomial including the lag operator. Accordingly, Proper time lag can be identified by Vector Autoregression model which is generally used for model estimation in this study. The decompositions equation of working hour and consumption are as follows.

$$n = \frac{1}{1+\phi}\left(x + \beta_x(L)x + \beta_z(L)z + g + \beta_g(L)g + ex + \beta_{ex}(L)ex + u_t\right)$$
$$c = z + \frac{\alpha}{1+\phi}x - \left(1 - \frac{\alpha}{1+\phi}\right)[(\beta_x(L)x + \beta_z(L)z + g + \beta_g(L)g + ex + \beta_{ex}(L)ex)] - (1-\alpha)k - \left(1 - \frac{\alpha}{1+\phi}\right)u_t$$

Therefore, the macroeconomic driving forces used in the analysis are as followings; 1) preference shift derived from the consumption-leisure choice, 2) technology shift from firms, 3) government expenditure shock and 4) export shock.

Ⅲ. Empirical analysis

Using the economically active population survey and population projections from Statistics Korea and making the number of population on a quarterly basis, the number of economically active population and working hour per capita, from the data from Bank of Korea I compiled real GDP per capita, private final consumption per capita, government final consumption per capita and the amount of exports and imports per capital. I took quarterly data from 1980 to 2012 and all variable used were transformed with the form of log. And then parameter α's value of the labour income share and parameter $1/\phi$'s value of elasticity of substitution between consumption and labor are defined as 0.5 and 1.7 respectively.

Estimating the Vector Autoregression model and testing the proper time lag with a variety of testing methods such as AIC(Akaike Information Criterion) and SBC(Schwartz Bayesian Criterion), final decomposition equations of labor hours and consumption are as followings.

$$n = \frac{1}{1+\phi}\left(x + \sum_{i=0}^{q} x_{t-i} + \sum_{i=0}^{q} z_{t-i} + g + \sum_{i=0}^{q} g_{t-i} + ex + \sum_{i=0}^{q} ex_{t-i} + u_t\right)$$

$$c = z + \frac{\alpha}{1+\phi}x - \left(1 - \frac{\alpha}{1+\phi}\right)\left(\sum_{i=0}^{q} x_{t-i} + \sum_{i=0}^{q} z_{t-i} + g + \sum_{i=0}^{q} g_{t-i} + ex + \sum_{i=0}^{q} ex_{t-i}\right) - (1-\alpha)k - \left(1 - \frac{\alpha}{1+\phi}\right)u_t$$

1) Analysis and Decomposition of driving force

From the empirical analysis, factors affecting structural changes(macroeconomic driving forces) are factors which give shocks on consumption, working hour and other endogenous variables. Since they play significant roles in the Korean economy, their movements are very important.
Figure 1 is derived from the decomposition method of frequency by Hall(1997) and shows driving force at high frequency. The factor of personal preference is not only very sensitive to the business cycle unlike other factors but also has a huge business fluctuation. The factor of personal preference plunged dramatically in particular in depression such as oil shock in the early 1980s, Asian financial crisis in 1997 and global economic crisis in 2008 and it picked up in booming economic cycle. Other factors except the preference shock didn't fluctuate sharply and remained roughly consistent in their movements. Productivity which is technology shift from firms decreased temporarily in Asian financial crisis in 1997 and then was coincident with business cycle. Government expenditure shock contributed to reducing the business fluctuation by going up during the economic contraction and this means government expenditure can play a role in stimulating the economic activity during the period of the economic contraction as one of stimulus measures.

Figure 2 shows the fluctuation of driving forces at medium frequencies. Other factors except the government expenditure shock are symmetrical in the middle of the 1990s as a centre. I think preference shock is especially worthy of notice since it went down from 1995 and plummeted dramatically from the 9th business cycle reference data and then its effect has kept going continuously.

Figure 1

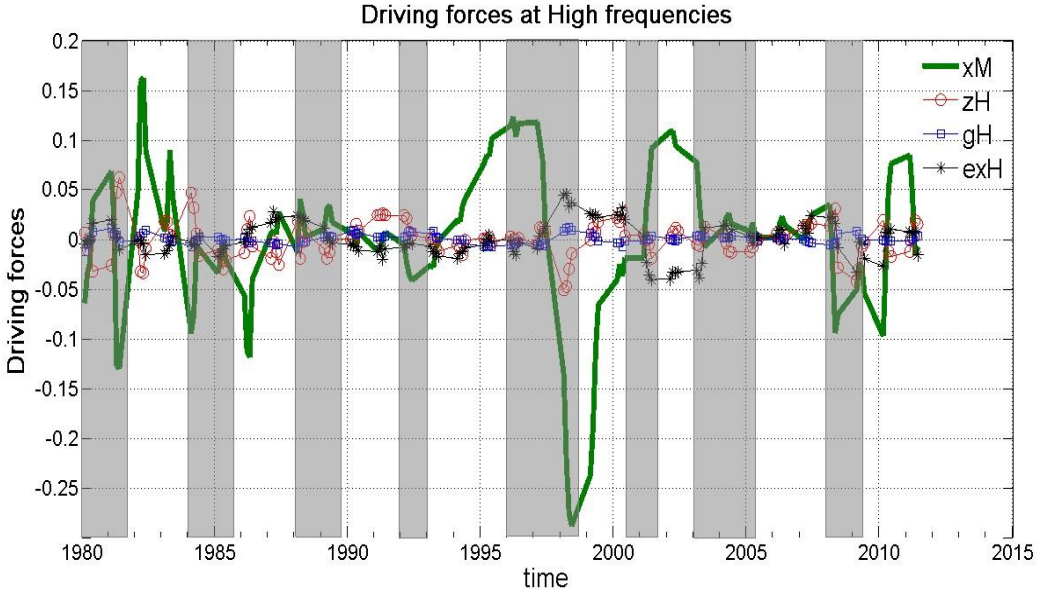
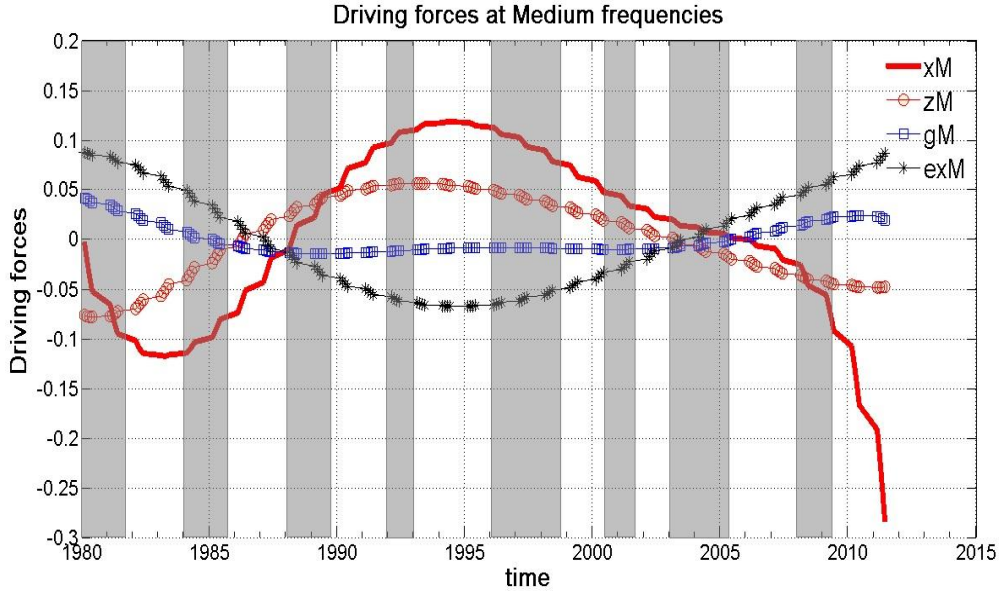


Figure 2



2) Analysis and Decomposition of working hour and consumption

Changes of working hour and private consumption from 1980 to 2012 are mainly explained by labor supply shock that the representative household produces during the same period. In addition, the productivity factor also has an impact on consumption. In other words, Income effect has extremely limited impact on working hour and consumption and government expenditure has little leverage on working hour and consumption.

Table 1 indicates how much driving force factors contribute to the change of working hour, which means the driving force factor from the representative household can be major cause of changing working hour since personal preference shock(labor supply shock) is dominantly high compared to other factors.

Table 1. Level of contribution to the change of working hour by factors

Driving forces	Normalized Covariance	Standard Deviation(%)
x	114.7	2.9
$\beta_x(L)x$	14.2	0.4
$\beta_z(L)z$	-5.2	0.5
g	-2.9	0.2
$\beta_g(L)g$	2.9	0.2
ex	-7.8	0.0
$\beta_{ex}(L)ex$	1.4	0.2
u_t	0.6	0.4

Table 2 shows how much driving force factors bring influence to bear the change of consumption and make it possible to compare and analyze its leverage on the change of consumption. From the point of view of normalized covariance, personal preference shock is the higher than in any other factors which implies demand side is much more important than supply side in the product market when it comes to supply and demand problem in the product market. On top of that, the value of productivity factor and export factor are relatively high. In this case, it is a little difficult to understand what normalized covariance means since it shows different movements in huge economic crises twice. However, it is possible to interpret how significantly productivity factor has influence on the change of consumption during the economic contraction because it fluctuated slightly in economic crises.

Table 2. Level of contribution to the change of consumption by factors at high frequency

Driving forces	Normalized Covariance	Standard Deviation(%)
x	58.7	6.2
$\beta_x(L)x$	12.0	1.7
z	28.8	3.8
$\beta_z(L)z$	12.6	1.8
g	-5.6	0.3
$\beta_g(L)g$	-4.9	0.3
ex	-21.2	1.3
$\beta_{ex}(L)ex$	4.0	0.5
k	-1.7	0.8
u_t	-1.4	0.8

Ⅳ. Conclusions

The working hour and the consumption can be mostly explained by the direct shocks of labour supply and the productivity is giving effect slightly on the consumption. However the export and government expenditure really have significant effects on neither working hour nor the consumption.

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