Variable Mismeasurement in a Class of DSGE Models: Comment

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Abstract

This comment points out mismeasurement of three of the variables in the DSGE model in Smets and Wouters (2007) and in models that use the Smets-Wouters model as a benchmark. The mismeasurement appears serious enough to call into question the reliability of empirical results using these variables.

In studies using the DSGE model, the model in Smets and Wouters (2007) (SM) is often used as a starting point, from which various extensions are made. This is true of the models in Edge and Gürkaynak (2010), Kolasa, Rubaszek, and Skrzypczyński (2012), Wolters (2013), Del Negro, Giannoni, and Schorfheide (2015), and Anzoategui, Comin, Gertler, and Martinez (2019). There are seven observable variables in the SM model, which the other models also use: consumption, investment, output, hours, inflation, real wage, and interest rate. This comment points out that three of these variables—consumption, investment, and hours—are mismeasured.

Real consumption is measured in the models as nominal consumption divided by the GDP deflator, and real investment is measured as nominal investment divided

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by the GDP deflator.[1] However, nominal consumption should be divided by the consumption deflator, and nominal investment should be divided by the investment deflator.

Let C denote nominal consumption divided by the consumption deflator and CZ denote nominal consumption divided by the GDP deflator. Figure 1 plots the ratio of CZ to C for the 1966:1–2018:3 period.[2] As can be seen, there is considerable variation in this ratio. It ranges from 0.947 in 1972:4 to 1.006 in 2008:3. The variation is particularly large in the 2007–2009 period. The mean of the ratio is 0.983 with standard deviation 0.016.

Let I denote nominal investment divided by the investment deflator and IZ denote nominal investment divided by the GDP deflator. Figure 2 plots the ratio of IZ to I for the 1966:1–2018:3 period. There is also considerable variation in this ratio, with a large downward trend. It ranges from 0.979 in 2017:4 to 1.425 in 1980:1. The mean is 1.208 with standard deviation 0.146.

The hours variable in the models is measured as average weekly hours of all persons in the nonfarm business sector (H) times total civilian employment (E). The first is from the Bureau of Labor Statistics (BLS) establishment survey and the second from the household survey.[3] The total number of hours in the economy

[1]These are quarterly variables from the national income and product accounts. Consumption is total personal consumption expenditures, and investment is total fixed private investment. The latter includes both nonresidential and residential investment, but not inventory investment.

[2]The data for Figures 1 and 2 were taken from the Bureau of Economic Analysis website on Feburary 6, 2019. They are from Tables 1.1.5 and 1.1.9. They were collected from 1948:1 through 2018:3, although Figures 1 and 2 begin in 1966:1, which is the first quarter of the models' estimation periods. The estimation periods end before 2018:3, but data through 2018:3 have been presented in the figures for completeness. None of the conclusions in this comment depend on the last few observations.

[3]In the BLS notation H is CES0500000007 and E is LNS12000000. The data are monthly seasonally adjusted. Quarterly variables are constructed by summing the relevant three months and dividing by 3.

(LZ) is then taken to be the product of the two: $LZ = H \times E$. There are two problems with this measurement. The first is that weekly hours excludes farm workers and government workers (both federal and state and local). The implicit assumption is that average weekly hours for farm workers and government workers is the same as for private nonfarm workers, which is not true. The second is that civilian employment measures the number of people employed, not the number of jobs. Some people have two jobs and so are counted twice in the establishment survey but only once in the household survey. I will call the difference between the total number of jobs and the total number of people employed the number of "moonlighters," although there are a few other differences between the two surveys.

One can get from the BLS quarterly data on the number of hours in the total economy and various subsectors.[4] Ideally the hours should include all workers in the economy, including military workers, since the services of military workers are in GDP. However, LZ above does not include military workers, and so for comparability I have subtracted military hours, which are available on the BLS website, from total hours. Let L denote the total number of hours in the economy less military hours.

The unit of LZ is thousands of hours per week, and the unit of L is billions of hours per year. To make the units comparable, let LZ now denote the old LZ multiplied by 52 and divided by 1,000,000. Figure 3 plots the ratio of this new LZ to L for the 1966:1–2018:3 period. There is again considerable variation. The ratio ranges from 0.951 in 1999:3 to 1.030 in 1976:3. The mean is 0.992 with standard deviation 0.017. One of the reasons for the fluctuations is that that the number

[4]The BLS site is *https://www.bls.gov/lpc/tables.htm*. Click the XLSX spreadsheet for "Total U.S. Economy - all workers." The hours are seasonally adjusted in billions.

of moonlighters fluctuates. In my macroeconometric model—Fair (2018)—I have an equation explaining the number of moonlighters, where the number depends in part on the state of the economy—there are more moonlighters in tight labor markets. The ratio in Figure 3 is low in the late 1990s, which in part reflects the fact that the number of moonlighters was large because of the booming economy (so L is large relative to LZ).

One last issue concerns population, which the models use to put the variables in per capita terms. Monthly population data are available from the BLS, which are converted to quarterly data by summing the three relevant monthly values and dividing by 3.[5] The problem is that these data are revised (rebenchmarked) each January, and the revisions are not carried back. There are thus spikes, either positive or negative, each January, or for the quarterly variable each first quarter. Figure 4 shows the percentage change in quarterly population for the 1994:1–2018:4 period (at quarterly rates). The spikes in the first quarters are evident. This problem was first pointed out in Edge and Gürkaynak (2010, p. 218). They discovered this problem too late to revise the results in their paper, and the other models also do not adjust for this.[6] The variables that are divided by population in the models to put them in per capita terms are real output, real consumption, real investment, and hours. Aside from the mismeasurement problems discussed above, the per capita variables are more variable than they should be.

I first pointed out the SW measurement problems for consumption, invest-

[5]The BLS notation for civilian noninstitutional population ages 16 and over is LFU800000000 before January 1976 and LNS10000000 from January 1976 on.

[6]In private correspondence Marco del Negro has informed me that the population data are now smoothed using the HP filter in the New York Fed DSGE model. In my macroeconometric model I have always adjusted for this, not using the HP filter, but linearly interpolating the January adjustments back for 40 quarters.

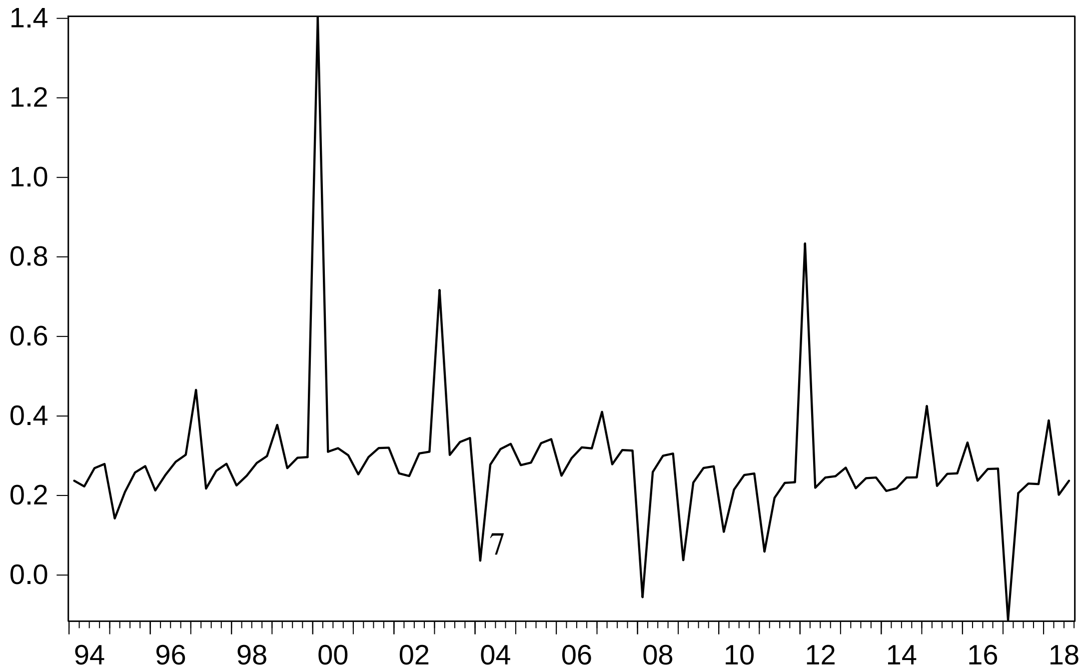
ment, and hours in a paper in 2009, which was eventually published as Fair (2012). Unfortunately the problems remain. The plots in Figures 1–4 show that the measurement problems are quantitatively large. It's not just that the variables are off by a constant amount; there are fluctuations in the measurement errors. And at least some of these fluctuations are correlated with business cycle fluctuations, and some show considerable noise in the 2008-2009 recession. It is thus not clear that empirical results using these variables are trustworthy.

Figure 1
Real Consumption Mismeasurement
Ratio of CZ to C
1966:1--2018:3

Figure 2
Real Investment Mismeasurement
Ratio of IZ to I
1966:1--2018:3

Figure 3
Hours Mismeasurement
Ratio of LZ to L
1966:1--2018:3

Figure 4
Percentage Change in Population, Quarterly Rate
1994:1--2018:3



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