on a chosen 4% URATE, not zero, was not the maximum possible production. Nevertheless, the actual fluctuations in the above chart mostly take place *below* the estimated potential GNP level of Okun. This is a crucial fact to note about his analysis.[35] His approach to potential GNP played a vital role in the policies followed in USA a few years later.

In this book, we will develop and use a different concept of potential GDP than that of Okun. In our approach which is classical, potential GNP will, *on an average,* be equal to actual GNP and fluctuate around it. The justification for doing so will become clear based on the historical events and analysis of the evidence. Also note that Okun's approach to estimating potential GDP is based on short-run variations in unemployment and related labour market variables, taking for granted the level of technology, capital stock, educational skills, etc.[36]

1.8.2 The Algebra and Economics of Okun's Law

Okun's findings were summarised in the rough rule of thumb that a 3% *fall* in GDP growth leads to a 1% rise in URATE. This rule of thumb came to be called Okun's Law.[37] The estimated coefficient mostly reflects *cyclical* changes in productivity, hours of work, etc. Explaining this requires some algebra.

To begin with, assume that average hours of work and labour force participation rate are constant. Note that Labour Productivity = Output/Total Hours.

And Total Hours = Average Hours × # Employed

Hence, Output = Average Hours × # Employed × Labour Productivity.

Converting the above equation into growth rate we get,

$g_y = g(\text{Total Hours}) + g(\text{Labour Productivity})$

$= g(\text{Average Hours}) + g(\text{Employed}) + g\,(\overline{\text{Labour Productivity}})$

Further, assuming that Average Hours and Labour Force Participation rate are constant,

$$g_y = g(\text{E}) + g\,(\overline{\text{LP}}).$$

This corresponds in the labour supply chain example in Section 1.6, to 4% g(E) and 2% g(LP), a total of 6% potential growth.

Suppose, now employment grows by 3%, not 4%. Thus, $g(y)$ = 5%. Note that the starting URATE of 5% implies that the starting employment rate or ratio (E/L) = 95%. Then the employment rate (E/L) will roughly fall by 1% to 94% and the URATE will roughly rise to 6%.[38] Thus, if the trend productivity grows by 2% and the GDP grows by 5%, then the URATE falls by 1%. In this case, all the change in hours corresponding to a lower growth is reflected one for one in the URATE and the corresponding employment rate or ratio.

[35] In his Figure, it can be seen that actual GNP for most quarters is below both estimates of potential GNP. While exceeding potential GNP during 1955–56, it is only slightly higher.

[36] For India, the box titled "Potential Output" in the *RBI Annual Report* (2006-07) provides a good discussion of the concept of potential GDP, the factors that go into it, and different methods of estimation, as well as 'real time' estimates of potential GDP growth.

[37] The coefficient was around 3 when Okun estimated it. With post 1973 data, it is lower, around 2 to 2.5.

[38] In the labour supply chain example, if E grows below trend by 3%, then E in period t+1 is 978.5 and U is 61.5. The strict E rate is 94.1% and the URATE is 5.9%. However, we can use the approximations of 94% and 6%. In this labour supply chain example, we have chosen the benchmark rate to be 5%, unlike elsewhere where it is chosen as 6%.

Alternatively, it takes at least 6% GDP growth to prevent the URATE from rising. Increasingly, policymakers and a demanding public, especially the young entering the labour force across the world, ask the question, "How fast should GDP grow to prevent unemployment from rising?" Answering this question requires applying this Okun framework.[39]

In practice, all the three variables, average hours, labour force participation rate and labour productivity, are what is called *pro-cyclical*. They rise during an expansion as the URATE falls, and vice versa. Firstly, hours are strongly pro-cyclical, sharply reduced by employers during a recession. Secondly, during a recession, productivity declines since existing workers and other resources are not fully utilised. This is called labour hoarding in macroeconomics and 'benching' in India's Information Technology industry. Thirdly, as the economy weakens, many workers drop out of the labour force instead of looking for jobs, and so labour force participation falls. This is called the discouraged worker effect. The sub-field of labour macroeconomics deals with these connections. The cyclical variations in hours, productivity and labour force participation can be seen in Figure 1.h.

Since these variables rise during an expansion and vice versa, the GDP growth changes *more* than the URATE (the 3 to 1 coefficient). Okun's analysis incorporates the impact of these cyclical variations into the direct GDP–URATE link. This assumption was central to his analysis:

> "..the basic technique I am reporting consists of a leap from the unemployment rate to potential output. Strictly speaking the leap requires the assumption that, whatever the influence of slack economic activity on average hours, labour force participation, and man-hour productivity, the magnitude of all these effects are related to the unemployment rate."

The cyclical change in the other labour supply variables are built into the Okun coefficient.

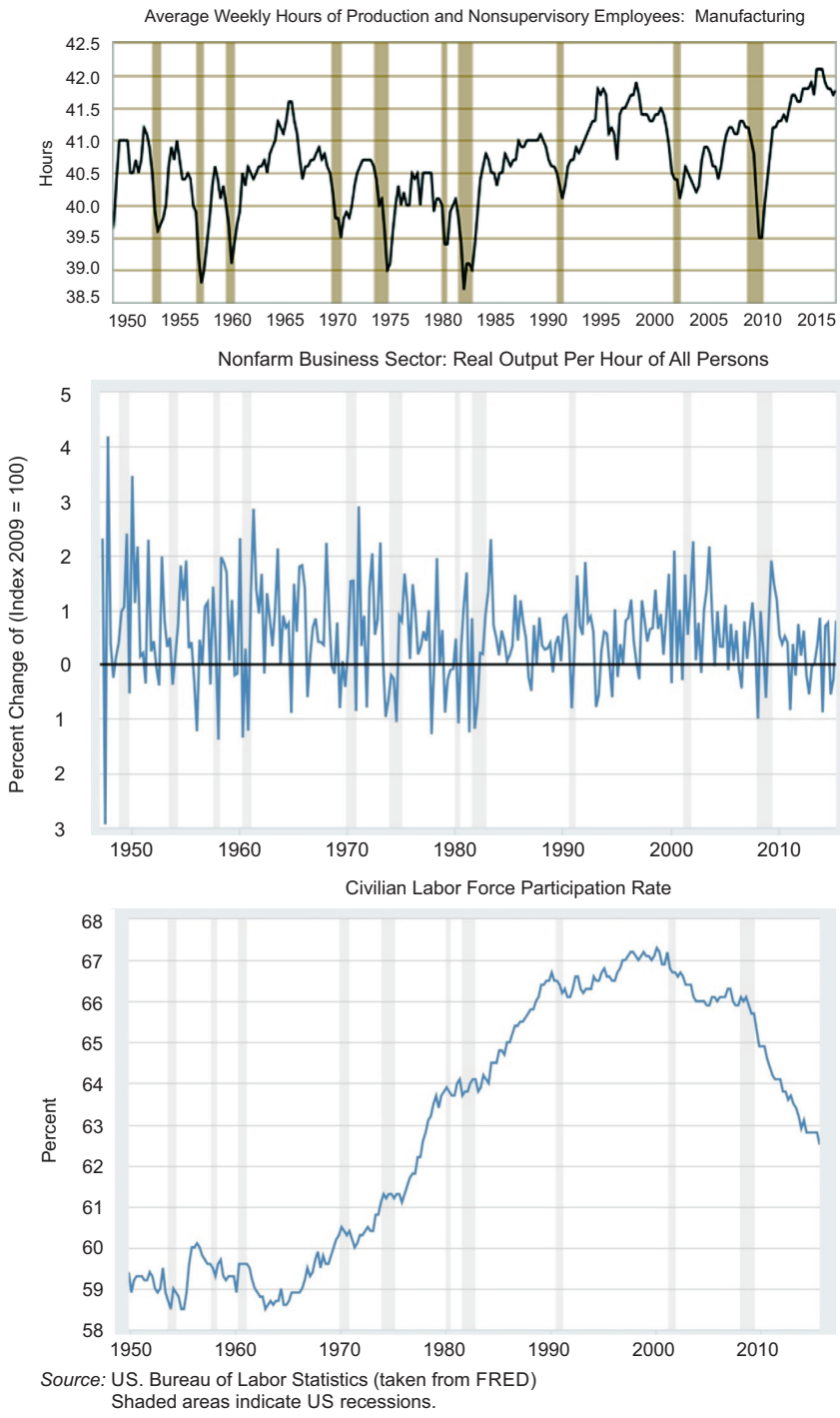
The reason for getting into all this detail is to provide the justification for the simplified EAPC model in the next chapter. We will thus assume a fixed coefficient linking aftOR and URATE, i.e., URATE = U* − λ ADSGAP, where λ is the linking Okun coefficient, hence called Lokun coefficient. In practice, there is some variation in λ over the business cycle, but we will ignore that.

Cyclical versus Structural Changes in Labour Force Participation

In USA, although the labour force participation rate was cyclical earlier, there has been a structural change since the late 1990s, with a trend decline. During the *expansion* phase, from December 2001 to December 2007, it has dropped from 67 to 66% and has continued to fall sharply to below 63% as of end 2014, during the latest expansion post 2010. This can be clearly seen in the Figure 1.g. This is contrary to the normal pro-cyclical behaviour manifest in Okun's Law. This major drop clearly shows the role of *labour supply choices* in determining potential GDP, one important aspect of classical macroeconomics.[40] In macroeconomic data, there is always both the need and the difficulty in identifying whether a given change is cyclical or structural. The drop in labour force participation after 2000 has been structural.

[39] The growth-unemployment link is increasingly being emphasised for India. Similarly, the former Prime Minister was quoted as saying, "there is a broad consensus that we need a growth rate of 8–9% a year to create 1.2 million jobs" (Business Standard, 2014).

[40] Some evidence indicates that the drop in labour force participation in the USA has been largely in upper income groups. Those women who can easily afford to do so, quit their jobs for family reasons (Hall & Petrosky-Nadeau, 2016).



Source: US. Bureau of Labor Statistics (taken from FRED)
Shaded areas indicate US recessions.

Figure 1.h Okun's Law Related Labour Market Variables