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Toward a Better Measure of Labor Market Capacity: The Role of Work Hours in Aggregate Labor Supply

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Introduction

Most conventional analyses of the labor market rely on the standard unemployment rate as a proxy for labor market capacity. A high unemployment rate is taken to be a clear indication of a labor surplus while a low rate presumably signals a labor supply constraint. By carefully tracking the unemployment rate, economists have for a long time believed that they could tell when labor markets were becoming so "tight" as to lead to both wage and price inflation. By tracing out the location of the so-called Phillips Curve which measures the historical tradeoff between inflation and unemployment, economists thought they had a powerful tool for determining when inflation would emerge in any economy (Phillips 1958; Samuelson and Solow, 1960). The modern variant of the Phillip's Curve, the "Non-Accelerating Inflation Rate of Unemployment" or NAIRU, suggested that there is a "natural rate" of unemployment, below which inflation would not only emerge but accelerate (Friedman, 1968; Phelps, 1968). In virtually all the research undertaken to measure the relationship between tight labor markets and inflation, the common measure of labor supply has been the standard unemployment rate.

Measuring capacity accurately is critical for carrying out macroeconomic policy. The U.S. Federal Reserve Board and other central banks follow developments in the labor market to assess when the economy is likely prone to inflation. Many factors are considered in setting monetary policy, but the level of unemployment has always been one of the most critical. When unemployment rates fall below a certain level, it has been common -- at least until recently -- for the central bank to raise short-term interest rates in a deliberate attempt to slow the economy down, reduce labor demand, and thus limit wage increases and any resulting price inflation.

The intent of this paper is not to take issue with the theory behind the Phillip's Curve or that of NAIRU, although beginning in the mid-1990s, support for the theory deteriorated as

unemployment in the United States fell to very low levels without igniting inflation. Instead, we shall suggest that measuring labor market capacity with the standard unemployment rate is highly problematic. To the extent that labor market tightness does lead to wage and price inflation, it is argued here that the unemployment rate increasingly provides a highly inaccurate signal of when this will occur. The key point is that the unemployment rate, by its inherent construction, fails to take into account changes in labor capacity due to changes in labor force participation and, most importantly, changes in hours worked per worker. Variability in these indicators can offset the impact of unemployment per se as a capacity constraint measure. As a result, the unemployment rate can be a "noisy" signal in terms of measuring labor market constraints.

This paper proceeds by first providing a primer on labor market dynamics and inflation theory. This sets the stage for considering the shifting Phillips Curve revealed in U.S. data and the possible reasons for the improved tradeoff between measured inflation and measured unemployment over the past three business cycles. A decomposition of total labor supply follows, suggesting that increased average hours of work by the experienced U.S. labor force explains why lower unemployment rates did not foster higher inflation in the past two business cycles. Finally, the same decomposition of labor supply into population growth, labor force participation, unemployment, and average hours worked per week is carried out for various developed countries to demonstrate the wide range of labor market supply dynamics that North American and European countries have experienced. Taken together, these results can help explain a number of phenomena: why the U.S. was able to lower its unemployment rate to below 4 percent in the late 1990s without sustaining rapid inflation; how Spain obtained the labor it

needed to achieve among the fastest GDP growth rates in Europe; and what factors led to the actual decline in total working time in France, Sweden, and the United Kingdom.

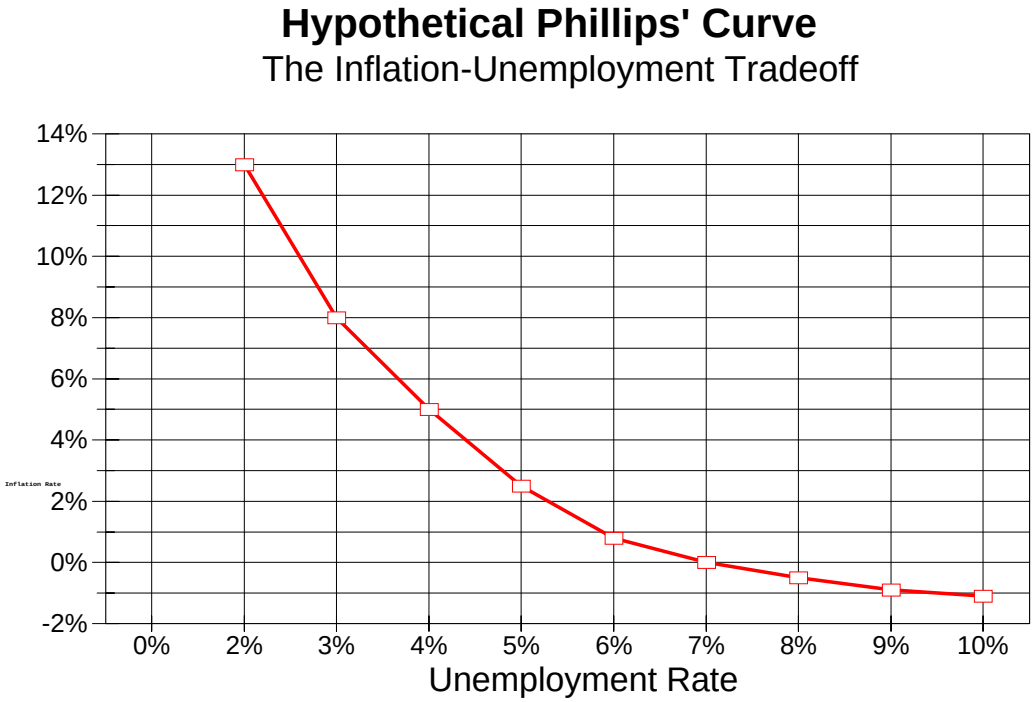
A Brief Primer on Inflation Theory: The Phillips Curve and NAIRU

In the Keynesian conception that first came into its own during the Great Depression, inflation was seen to be mainly a problem whenever aggregate demand grew faster than aggregate supply. When factories were fully utilized, and everyone who wanted work was employed, shortages would become chronic. Prices of inputs and outputs would begin to rise. The idea of crudely estimating a "deflationary gap" between actual and potential output was a popular tool of the Keynesian macroeconomists of the 1960s. It first appeared in the Council of Economic Advisers' *Economic Report of the President* in 1962, and for many years was a staple of college economic principles textbooks beginning with Paul Samuelson's famous volume, *Economics*.

In fact, Samuelson recognized that this supply-constrained explanation for inflation was too simple. The great innovation of Keynes' *General Theory* had been the recognition that a market economy could come to a balance between aggregate supply and demand at levels insufficient to provide full employment. Symmetry would suggest that systematic inflationary pressures could also occur in an economy shy of full utilization of its productive capacity. Together with his M.I.T. colleague, Robert Solow, Samuelson studied the empirical studies of the relationship between unemployment, wages, and prices in Britain then being conducted by A.W. Phillips. What Phillips had found, using nearly a century of British data, was an inverse relationship between changes in the level of wages and the level of unemployment. The lower the unemployment rate, the higher the rate of wage increase. In 1959, just a year after Phillip's

pathbreaking work was published, Samuelson and Solow presented a model reflecting and accounting for Phillips' findings, assuming along the way that wage increases get passed along by firms to customers in the form of proportionately higher prices. Samuelson and Solow's version of the "Phillips curve" -- depicted here in **Figure 1** -- became the profession's dominant tool for explaining the dynamics of inflation and growth. Following the work of Phillips, the horizontal axis for measuring capacity in the labor market was the published unemployment rate.

Figure 1



What Phillips, and Samuelson and Solow, thought they had discovered was that true "full" employment poses inflationary danger in a market economy. The reasoning behind this conclusion is not hard to fathom. As more and more people go back to work, the ranks of the unutilized labor force become depleted, the bargaining power of labor is enhanced, and wages

are forced up. That is fine, at least until labor cost increases begin to exceed improvements in labor productivity. Then firms are forced to raise prices or see their profits erode. Ultimately, if rising prices in a few sectors begin to lead to widespread inflation, interest rates begin to rise. As the cost of credit increases, investment begins to decline. And when that happens, growth slows down and the economy heads for recession. Essentially, an overly tight labor market leads to its opposite: a new bout of high unemployment. Conversely, with rising unemployment resulting from slower growth, the "reserve army" of unemployed workers is replenished, workers with job offers take what they can get, and thus upward pressure on wages and prices recedes. This is what drives the business cycle roller coaster with alternating bouts of inflation and unemployment.

Conservative successors built upon this Phillips' curve legacy and produced an even more potent model of inflation. In 1967, Milton Friedman argued that, at best, the Phillips' trade-off might hold in the short-run. At unemployment rates below some particular level, inflation would not only rise, but keep rising and accelerate explosively. In contrast to the shape of the relationship in Figure 1, Friedman's long-run Phillips' curve becomes a *vertical* line whenever joblessness falls below a certain point, determined by the conditions of the economy and the qualities, skills, and inclinations of its workers. Instead of a ski jump, the Phillips' Curve follows the trajectory of a rocket ship.

Operationally, Friedman and others concluded that an explosion in inflation was inevitable if the unemployment rate remained at less than 6 percent for any length of time. Tighter labor markets would initiate round after round of inflationary expectations which would ignite an upward and never-ending wage-price spiral. The unemployment rate just sufficient to keep this from happening came to be dubbed the "natural" rate, or more precisely the Non-

Accelerating Inflation Rate of Unemployment or NAIRU -- pronounced like Nehru, the former Indian Prime Minister. The theory of the "natural" rate quickly gained currency within the economics profession. In the U.S., President Clinton's Council of Economic Advisers adopted a NAIRU in the range of 5.5 to 5.7 percent for their calculations of potential long term growth and stuck to this belief until late in the 1990s.

Only as the U.S. unemployment rate fell below 6 percent in late 1994 and below 5 percent in mid-1997 without igniting any appreciable inflation did economists begin to question the validity of the natural rate theory -- or at least the belief that 6 percent was approximately the right NAIRU. When the official U.S. unemployment fell to 3.9 percent in 2000 without inflation, the natural rate theorists had to go back to the drawing boards.

Harvard economists Douglas Staiger and James Stock and Princeton's Mark Watson (1997) have offered their own modification of the prevailing view. They find that while both the level and changes in unemployment are certainly correlated with subsequent changes in inflation, estimates of just what threshold rate of unemployment would tip the scales -- that is, just *where* the Phillips curve becomes "vertical" -- are extremely imprecise. They find that the 95 percent confidence interval for the current value of the NAIRU is 4.3 percent to 7.3 percent. In language that policy makers who managed to avoid taking either Economics or Statistics 101 in college can use: we can be sure 95 times out of a hundred that inflation will start to accelerate when the unemployment rate gets as low as a bit over 7 percent, but it might not at jobless rates as low as about 4 percent. If this is the case, the NAIRU exists, but it is an incredibly imprecise policy instrument.

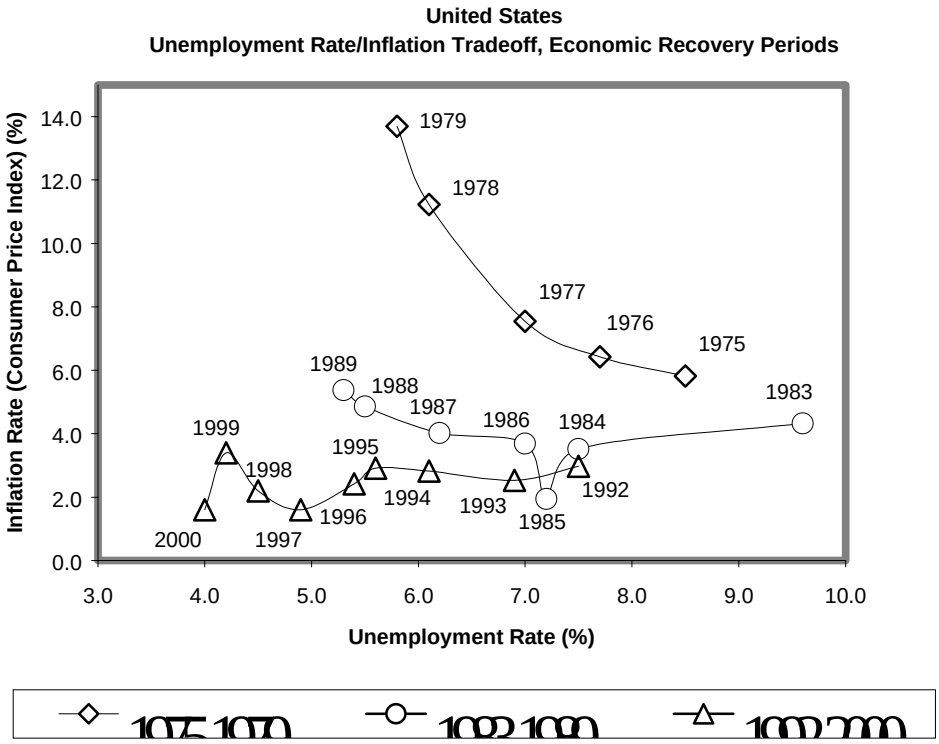
Reconsidering NAIRU Historically

The architects of the original Phillips curve always acknowledged that the strength of the inflation-unemployment trade-off -- the shape and position of the curve, itself -- was dependent on certain underlying institutional norms, regularities, and conditions. And sure enough, data on the past three business cycle expansions suggest that such a regime shift has indeed occurred.

In **Figure 2**, we have plotted the inflation rate, as measured by the Consumer Price Index (CPI), led one period against the current unemployment rate for the past three major economic recoveries. In each case, the data series begins in the year in which the unemployment rate reached a cyclical peak and is followed until the jobless rate bottoms out. Clearly the trade-off between inflation and unemployment has improved remarkably since the 1970's. In each successive recovery, the “Phillips Curve” has shifted down and flattened out. In the first recovery (1975-1979), inflation was running in excess of six percent a year even with 7.5 percent of the labor force unemployed. As the unemployment rate came down, the inflation rate rose sharply. Tightening labor markets on top of pent-up price pressures from the abolition of Nixon era wage and price controls plus the second oil shock of the decade drove inflation to record double-digit levels, even at an unemployment rate as high as 7 percent.

The trade-off during the 1980's recovery was much more benign. During the entire expansionary portion of the cycle, inflation remained below 1970 rates and the Phillips “curve” became a plateau until unemployment fell below 6.5 percent. In the final recovery, from 1992 to 2000, there is hardly any hint of a trade-off at all. Thus, the inflation-unemployment relationship seems to be fundamentally shifting or “time-varying,” with little sign of price pressure in the 1992-2000 period, even at unemployment rates at 4 percent.

Figure 2



Explaining the "New" Inflation-Unemployment Tradeoff

A number of *economic* phenomena can help explain the shift in the locus of the U.S. Phillips Curve. Among these are the trend toward globalization of the economy; weakened social supports for workers and their families; declining union power; and sharp improvements in productivity. The first three put downward pressure on wages and prices while the last permits higher wages without the need for passing these on to consumers in the form of higher prices and thus inflation.

Globalization - The decades-long trend toward "globalization" of trade and investment has increased the actual and potential price competition companies face in a growing number of industries. While free trade is most often trumpeted as a mechanism for increasing a country's exports, its impact on prices is equally powerful. Imports add to domestic competition diminishing much of the oligopoly pricing power that would exist without it. Thus, even as economic growth expands and unemployment declines, imports help to moderate any resulting price pressure, thus flattening the Phillips Curve.

Weakened Social Protections - Changes in government social regulation mark a second type of long-term institutional development likely reshaping the inflation-unemployment tradeoff. Liberal unemployment insurance provisions have allowed displaced workers to hold out for new job assignments at wages closer to what they had previously been earning. Welfare payments and food stamps permit the poor to remain out of the labor force altogether, depriving firms of cheap labor and thereby affecting some modest upward wage pressure on business. Periodic increases in the real value of the minimum wage may have a similar impact on wages, by forcing adjustment in wages throughout a firm in order to maintain historic wage differentials.

During the 1980s under the banner of "Reaganomics" and later under Presidents George Bush, Sr. and Bill Clinton, unemployment insurance benefits were reduced, welfare programs were "reformed" to force more recipients to enter the labor market, and the real value of the national minimum wage declined. All of these regulatory changes could have ameliorated upward pressure on market wages and thus helped flatten out the Phillips' Curve.

The Decline of Union Power - Added to this repertoire of factors that lead to what Europeans call "labor market flexibility" has been a profound change in the power of organized labor. In recent years, the proportion of the labor force covered by a union contract has fallen to

pre-1930s levels. From a peak of over a third in the early 1950s, fewer than one in ten private sector employees in the U.S. now belong to unions (and only a slightly greater fraction are covered by collective bargaining agreements). This decline in union density across the board and in particular industries has reduced the power of organized labor to force higher wages. The result has been an unambiguous inward and downward shift of Mr. Phillips' famous curve.

The Productivity Premium – Yet, by far, the most important factor leading to the flattening of the Phillips curve, particularly in the late 1990s, has been the realization of high rates of labor productivity growth, as measured by real output per worker hour. Rising productivity means that higher wages do not necessarily translate into a higher cost per unit of output since workers are producing more goods and services for each hour they put in at factories, offices, or retail shops. After 1973, the rate of productivity growth fell precipitously from 3.1 percent a year to only 1.3 percent during the rest of the decade (Bluestone & Harrison, 2000). Along with soaring energy costs, faltering productivity contributed to increased inflation. In the 1980s and during he first half of the 1990s, productivity growth slowed even more. But beginning in 1995, output per hour more than doubled, permitting real wage increases without adding to inflationary pressure. As a result, economic growth increased, unemployment declined, but prices remained largely in check. Thus, the United States was able to experience the very low and very flat Phillips Curve we see for the period beginning in 1992.

Measuring Labor Capacity: The Horizontal Axis in the Traditional Phillips Curve

While each of these economic factors can help explain the shift in the Phillips Curve over the past three business cycle recoveries, there is still another factor that might be of great importance. *The standard unemployment rate may no longer be a good*

measure of labor market capacity and therefore cannot be used as a reliable index in the Phillips Curve or in NAIRU analysis. The unemployment rate is only one component in the measure of labor supply. If there are substantial changes in labor force participation or in the number of hours worked per employed worker, changes in the unemployment rate may not provide a true or accurate measure of labor market capacity. In this case, the Phillips Curve and even NAIRU may exist, but the unemployment rate cannot be used to measure the underlying relationship between inflation and the utilization of labor supply.

This possibility was first explored in a series of papers by Barry Bluestone and Stephen Rose beginning in 1997 (Bluestone & Rose, 1997;1998; 1998a). The first was devoted to simply measuring the increase in hours worked by American workers since the early 1980s. Bluestone and Rose found that the typical U.S. worker was spending more hours of the week at work and working more weeks per year. In later papers, they found that the increase in the supply of labor from <u>incumbent</u> workers amounted to as much as *one-sixth* of the total additional labor supply in the U.S. between 1992 and 1995. Thus, they concluded that over time with more hours of work supplied by the average worker, a declining unemployment rate failed to capture the true capacity of the labor market. Indeed, a low unemployment rate might provide policymakers a false signal regarding labor markets, encouraging an overly restrictive fiscal or monetary policy.

Bluestone and Rose reasoned that labor supply is related to both trends in wage rates and job security. In the 1980s and during the first half of the 1990s, the expansion of global markets, the deregulation of key industries, the weakening of labor unions and

corporate downsizing all led to stagnating wages and family incomes and a rising sense of job insecurity. They note (Bluestone & Rose, p. 11):

> In the face of heightened job insecurity and declining income, workers now toil as many hours as possible when jobs are plentiful in anticipation of down-sizing and job loss - and they do so at existing wage rates. Moreover, declining hourly wage rates, even in the absence of job insecurity, have forced millions of families to increase their combined hours of work simply to maintain their annual income. *This relieves a significant labor supply constraint that normally accompanies low official unemployment rates.*

Essentially, a situation was created where an increase in demand for labor is met by an increase in the supply of labor *from incumbent workers*, that is, from workers who are already employed. Thus, as the unemployment rate came down in the late 1990s, labor markets did not tighten as they might have in earlier periods of economic expansion because existing workers increased their own labor supply. In this case, the unemployment rate loses some or even much of its value as a proxy for labor supply – at least in terms of the Phillips Curve relationship.

Why might the unemployment rate no longer be a good proxy for labor market tightness? The answer has to do with the very construction of this statistics. The unemployment rate is merely a head-count of available workers who do not have any job at all and are currently actively seeking work. In a world where incumbent workers are unlikely to vary their hours of work and where those who are outside the labor market are not likely to enter the labor market if a job becomes available (that is, move directly from

being out of the labor force to being employed without moving through a state of unemployment), the unemployment rate would indeed be a reasonable proxy for labor market tightness since it would be the only source of increased labor supply beside normal working age population growth. However, based on the earlier work of Bluestone and Rose, we will demonstrate that changes in the working time of incumbent workers has become an important factor in the labor market suggesting that the amount of labor supply can vary, perhaps significantly, *without* a change in the unemployment rate.

Theories of Labor Supply and Hours of Work

Three theories are currently available to explain why workers might vary their hours of work. The standard theory is based on income and substitution effects. It suggests that as wage rates increase, workers may increase their hours of work since an hour of leisure is now more costly. However, with higher wages, a worker's income increases and therefore he or she might choose to "purchase" more leisure with the "added" income. The actual impact on hours worked is a result of the relative strength of these two effects and this depends on the preference structure of each individual worker.

A variant of this theory is the target income hypothesis. In this case, families or individuals work to obtain a certain level of income. If an individual or family is already at their target income, then any increase in the wage rate will result in a reduction in working hours. The income effect completely dominates the substitution effect. On the other hand, if wages decline over time so that an individual or family's income falls below their target income, they will opt to work more so as to bring their real incomes back up to the target level. This is a plausible model of behavior where families are

constrained by such fixed expenditure requirements as home mortgages and car payments.

The third notion as to why incumbent workers may choose to work greater or fewer hours has to do with changes in the level of job insecurity. If workers fear that sometime in the near future they may be laid off or otherwise lose their jobs, they may be willing to work additional hours if they are currently offered. Unlike the traditional income and substitution effect theory, such behavior will occur without necessarily a change in the wage rate. In the extreme case, workers will work all the hours they are offered in the labor market in order to insure against a future loss of income due to layoff. They will work overtime or take a second job if available. Even if a worker never actually loses his or her job, he or she can still exhibit this behavior since it is based on the fear of layoff, not the actual event taking place.

Bluestone and Rose demonstrated that during much of the 1980s and the early 1990s, real wages stagnated or actually fell and the probability of losing one's job increased. This, in combination with the increase in working time, provides some prima facie evidence consistent with the stagnating wage/growing insecurity thesis.

New Estimates of Trends in U.S Working Time: 1975-2000

Bluestone and Rose's original research covered the period up to 1995, before the dramatic increase in economic growth in the U.S. and before the unemployment rate dipped much below 5.6 percent. Whether the trend toward increased working time continued throughout the 1990s is important to ascertain because it was during this time that the unemployment rate fell to 4 percent. If the working time trend continued, this would suggest that the inward movement and flattening of the Phillips Curve in the post

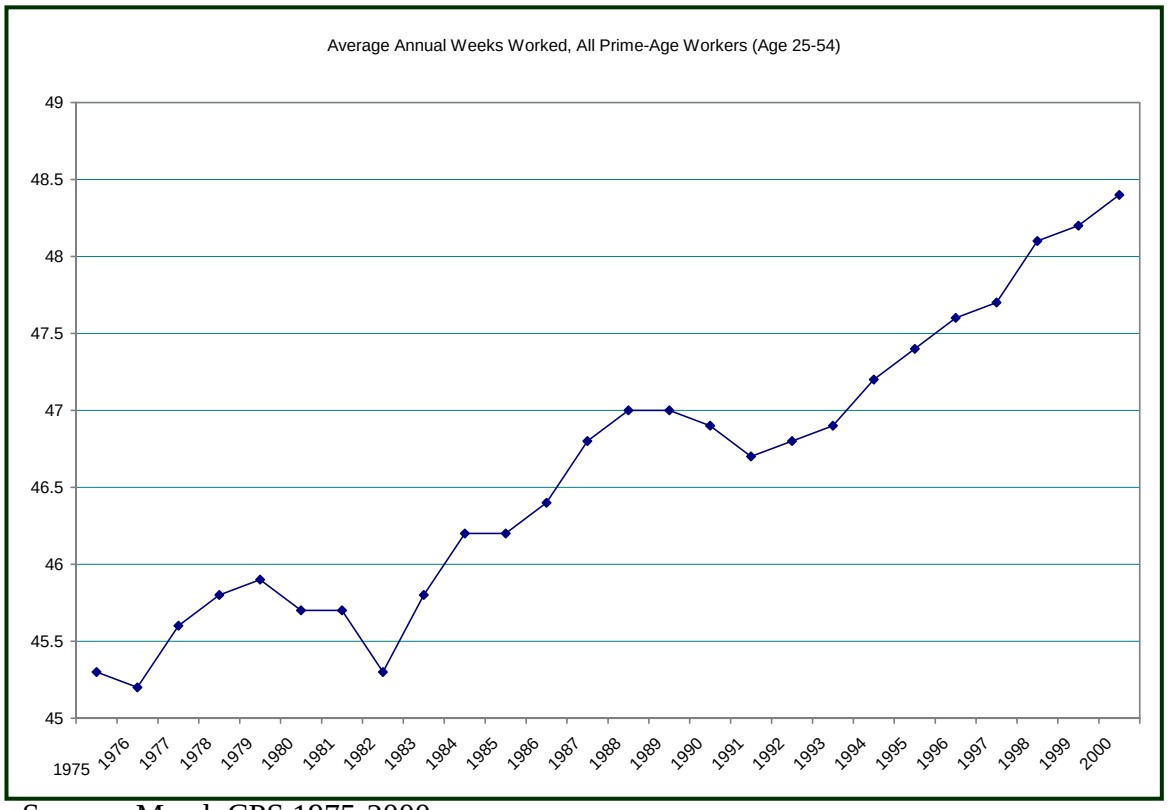
1992 period was at least conceivably due to this trend. If, on the other hand, average hours worked leveled off or declined (as in many other countries), then the more benign inflation-unemployment rate tradeoff depicted in Figure 2 would have to be related exclusively to other factors.

An analysis of annual March *Current Population Survey* data for 1995 through 2000 provides the evidence we need to extend the earlier Bluestone/Rose data series. The focus here is on the prime age workforce – those aged 25-54. We exclude younger and older workers from this analysis in order to concentrate on the labor force with the highest incidence of "full-time" work. What we want to know is whether this workforce is increasing its hours over time.

Average Weeks Worked per Year

Annual hours of work can be divided into two distinct components: (1) average weeks worked per year, and (2) average hours worked per week. In Figure 3, we display the average weeks trend for all prime age workers who worked sometime during the year. As the figure demonstrates, the upward trend first found for the 1982-1995 period continued right on through to 2000.

Figure 3



Source: March CPS 1975-2000

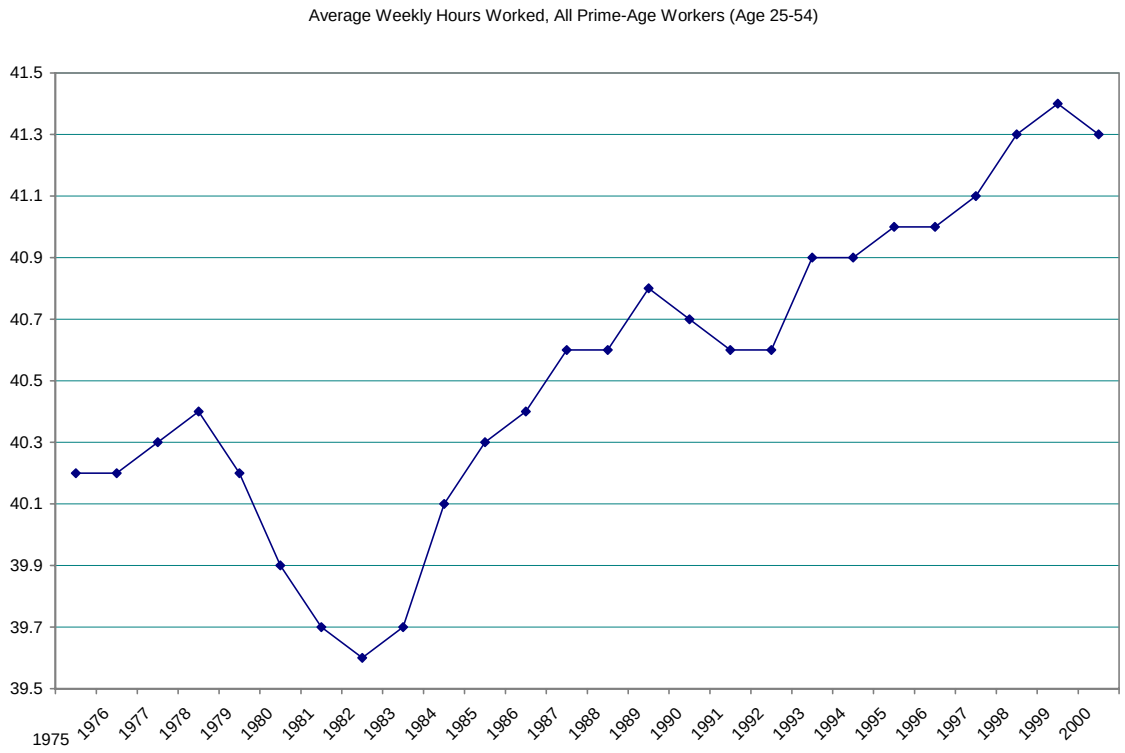
By the year 2000, the typical worker in the U.S. was averaging nearly 48.5 weeks of work per year, up more than 2.5 weeks a year from the level in 1979 when the economy was also experiencing rapid growth. Presumably some of the increase in the average number of weeks worked per year is due to the decline in unemployment especially during the late 1990s. But the underlying trend toward more work weeks is clear. Note that in 1979, when the unemployment rate was 5.8 percent, prime age workers averaged 45.9 weeks of work per year. In 1987, when the jobless rate was 6.2 percent, the average work year was actually longer -- 46.8. Thus, already by 1987 a portion of the overall labor supply "lost" to unemployment was being made up for by the increased time those

who were working were contributing to the labor market. On average, there was a shift away from seasonal work and other forms of part year work.

Average Weekly Hours

Figure 4 displays the trend in Average Weekly Hours for all prime age workers. Again, it shows a distinct upward trend since 1982 with the exception of the 1989-1992 period when the economy slipped into recession. From 1994 to 1999, weekly hours increased. Only in 2000 was there a slight falloff of about one-tenth of an hour. Between 1978 and 1999, the average workweek for prime age workers increased by a full hour -- or 2.5 percent. Real wages reversed their decline after 1994, but hours of work continued to increase. This could be due to either a strong substitution effect or a continued supply response to perceived job insecurity despite falling unemployment and rising wages.

Figure 4

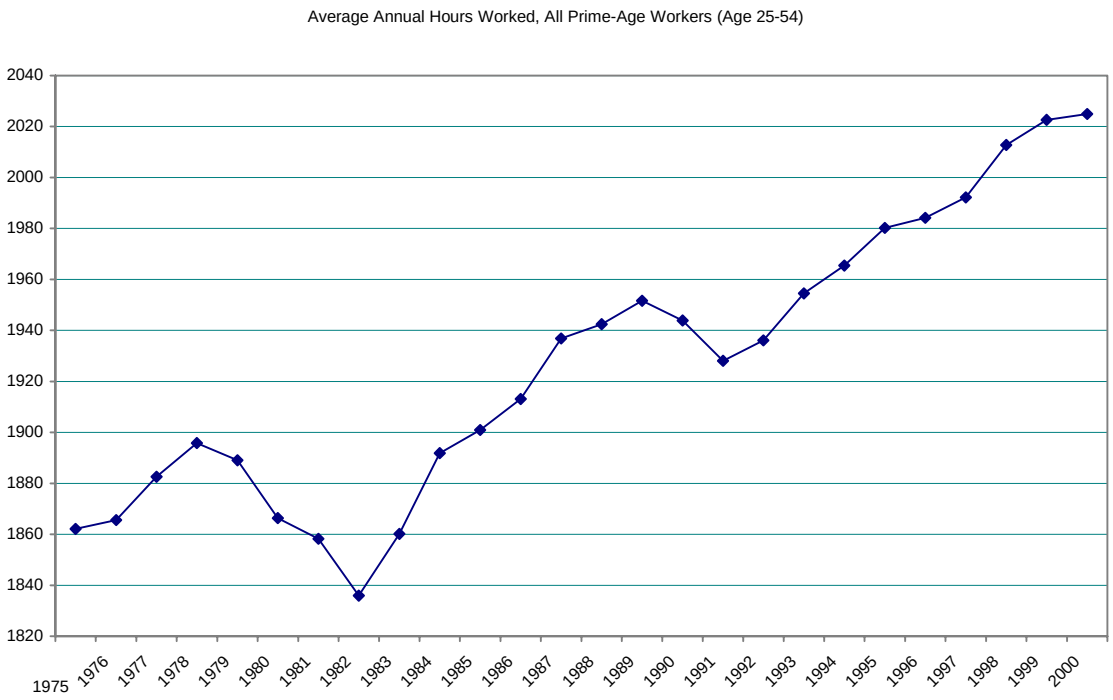


Source: March CPS 1975-2000

Average Annual Hours Worked

Combining weeks worked and hours worked per week for each individual in the March CPS survey provides an estimate of annual hours worked over time. This trend is displayed in Figure 5.

Figure 5



Source: March CPS 1975-2000

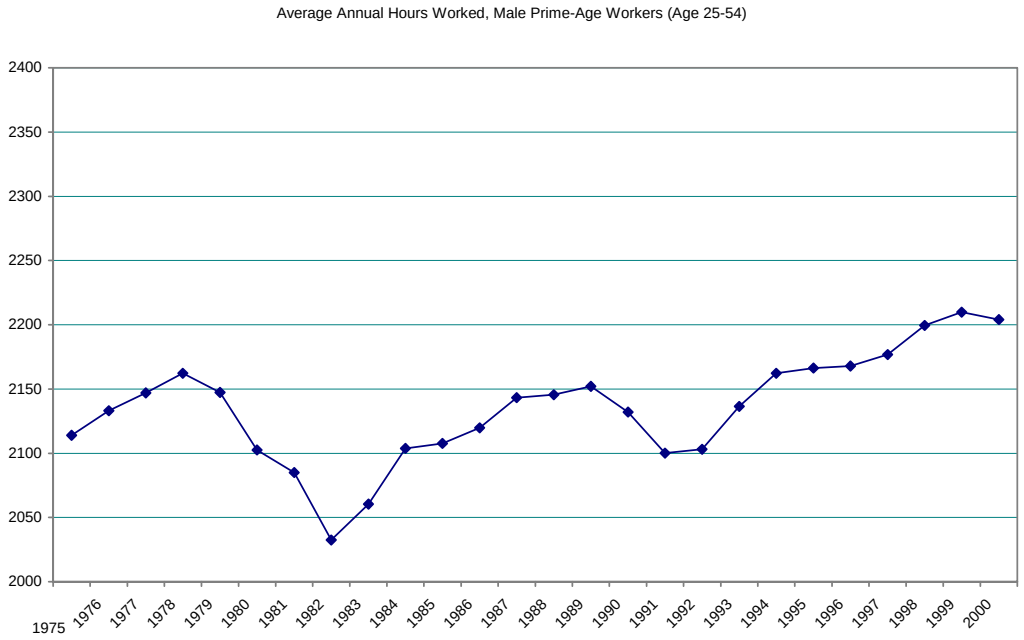
We can see from the above figure that there was a decline in average annual hours worked for all prime age workers from 1978 through 1982. Although it is not shown here, this decline is part of a general downward trend beginning in the late 1960's illustrated in Bluestone and Rose's previous work (Bluestone & Rose, 1998, p. 32). However, we can see that since 1982, there has been a clear upward trend in average annual hours worked for all prime age workers. Commenting on the data through 1995, Bluestone and Rose noted "Since the last business cycle peak in 1989, annual hours have increased by another 32 hours [to 1,979] …. The upward trend in working time shows no sign of easing" (Bluestone & Rose, 1998, pg. 32). Now, with additional years of labor force experience, we can see that the trend did not show any sign of reversing at least

through 2001. In fact, it grew at an accelerated rate. Bluestone and Rose reported that from 1989 to 1995 there was a 1.6 percent increase in hours from incumbent workers (Bluestone & Rose, 1989, pg. 32), which averages out to an annual percentage point increase of .24 percentage points. Our new calculations show that from 1989 to 2000 there was a 3.8% increase in hours from incumbent workers, averaging out to an annual percentage point increase of .34 percentage points from 1989 to 2000. Clearly, this means that the period from 1995-2000 should have had an annual percentage point increase even higher than the period from 1989 to 2000. It did. It averaged .45 percentage points per year, nearly double the 1989-1995 trend rate.

Thus, as the unemployment rate declined after 1995, there was a substantial increase in hours worked which reflected not only more weeks of work per year (partially captured by the unemployment rate) but more hours of work per week (which is not captured by the unemployment rate).

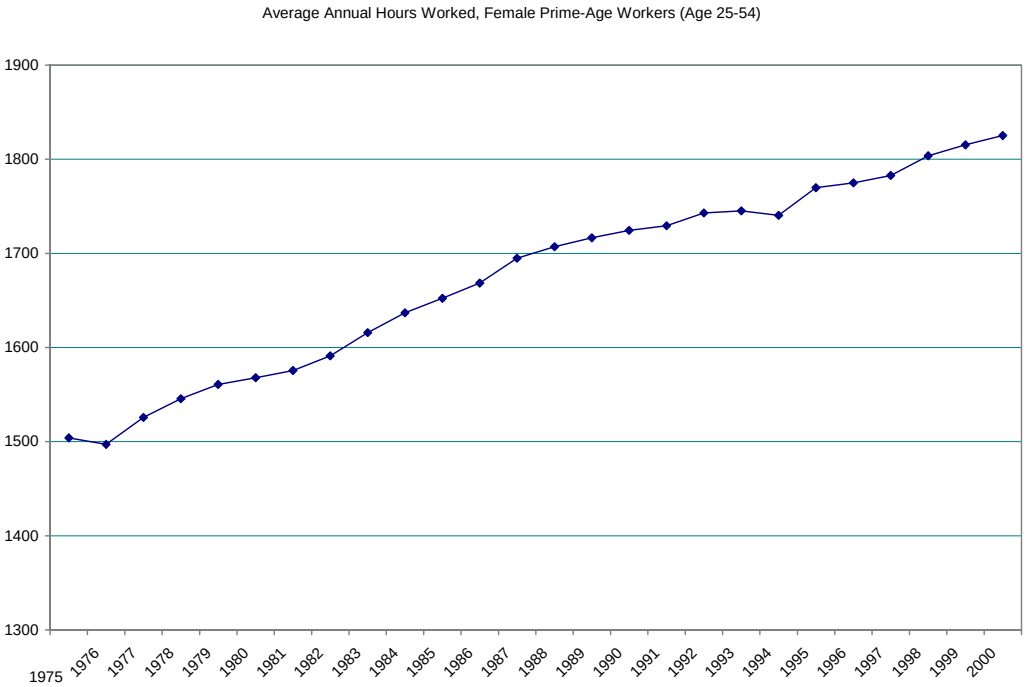
We can also see that the increase in annual working time was experienced by both prime age men and women (see Figures 6 and 7). Male hours have trended slightly upward since 1982 while female hours have risen sharply. What is not shown in these figures is the period prior to 1975. Bluestone and Rose demonstrated in their 1967-1995 data analysis that male hours had been trending downward and female hours had been trending upward consistently. Since 1989, the average work year for males has increased by 52.1 hours and the average work year for females has increased 108.7 hours, or 1.3 FTE weeks and 2.7 FTE weeks, respectively. No one can deny that this is a substantial increment in labor supply.

Figure 6



Source: March CPS 1975-2000

Figure 7



Source: March CPS 1975-2000

The Sources of Total Labor Supply in the U.S. Labor Market

The trend lines shown above suggest that at least some portion of added labor supply in the U.S. has been due to increased hours. But how much? To provide an estimate of the impact of hours on labor supply, Bluestone and Rose developed an hours decomposition routine to determine what proportion of added hours during business cycle recoveries can be attributed to changes in:

- the size of the working age population
- the proportion of this population in the labor force
- the proportion of the labor force employed, and
- the number of hours worked per employed worker.

This can be summarized in the following algorithm for total annual hours of work:

Total Annual Labor Hours = Pop x (pr (LFP)) x (1- pr(UR)) x H/Wk x 52

where:

Pop = population of the group

pr (LFP) = probability of Labor Force Participation

(1- pr(UR)) = (1 - probability of being Unemployed)

H/Wk = mean hours worked per week (x 52)

Total hours supplied by any group is equal to the number of individuals in the working age population (Pop) times the probability of each member participating in the labor force (pr (LFP)) times one minus the unemployment rate (1-pr(UR)) times the average number of hours worked per week by the employed members of the group (H/Wk) times 52 weeks per year.

Writing the hours algorithm even more compactly than above, we have the following identity:

$$TH = P*LFPR*(1-UR)*HRWK*52$$

Where

TH = Total Hours
P = Population
LFPR = Labor Force Participation Rate
(1-UR) = 1- Unemployment Rate
HRWK = Average Hours of Employment Per Week

The above equation is multiplicative. In order to assess the impact of each right hand side variable on total hours (TH), we can rewrite the equation in an additive form. To do this, we take the natural log of both sides of the equation:

$$\ln(TH) = \ln(P) + \ln(LFPR) + \ln(1-UR) + \ln(HRWK) + \ln(52)$$

To operationalize this equation, the population is measured in terms of thousands and represents the working age population. The labor force participation rate is calculated as the civilian labor force divided by the working age population. The unemployment rate is calculated as the number of unemployed civilian workers as a proportion of the civilian labor force. Finally, average hours per week are calculated from CPS survey data. All of the data for the initial U.S. estimates came from official Bureau of Labor Statistics sources.

Table 1 presents the results from the original U.S. analysis (Bluestone & Rose 1998). In the late 1970s (1975-79), less than 20 percent of total additional working time was due to workers being called back to work from unemployment. By the 1990s (1992-96), this one factor accounted for nearly 30 percent of additional labor supply.

The increased contribution from longer work weeks of incumbent workers was even more significant. In the 1970s growth cycle, practically none (2.2%) of the total increase in work time came from existing workers putting in more hours. But in the next two business cycles recoveries, in the 1980s (1982-89) and in the 1990s, more than one-eighth of the additional labor supply came from the longer work weeks of incumbent workers (14.2% and 12.4% respectively). None of these additional hours of work per week, of course, are captured in changes in the official unemployment rate -- yet they are a significant addition to overall labor supply and therefore represent an important contribution to labor market capacity. The authors concluded from their analysis that "Together, the combined contribution of unemployed workers returning to work and incumbent workers putting in longer work weeks accounted for *over two-fifths* of the increased labor supply, helping to sustain non-inflationary economic growth in the early 1990s." (p. 437) Back in the 1970s, these two factors accounted for only about one-fifth of the total increase in hours supplied -- the rest coming from new labor force participants. Hence, the source of labor supply has changed dramatically over time with the impact of working time on total supply much higher in the two later business cycle recoveries.

Table 2 The Sources of Additional Hours of Work in the United States

Period	Changes in Population	Changes in Labor Force Participation Rate	Changes in the Unemployment Rate	Changes in Average Hours Worked per Week	Change in Total Hours Worked
1975-79	51.0%	**27.2%**	**19.7%**	**2.2%**	100%
1982-89	41.4%	**19.7%**	**24.6%**	**14.2%**	100%
1992-96	51.2%	**7.6%**	**28.8%**	**12.4%**	100%

Data source: Economic Report of the President (1987; 1997); Special tabulations on hours from *Current Population Survey* data. Table reprinted from Bluestone and Rose (1998)

The Sources of Labor Supply: An International Comparison

Using this approach, we can now estimate the sources of labor supply across countries and update the U.S. data through 2000. Using the log equation above and OECD data, we have decomposed total hours of work for six countries: the U.S. and Canada in North America; the United Kingdom; and France, Germany, Spain, and Italy in Europe. The results show a wide variety of labor supply trends.

Canada

From 1990 to 2000, total annual hours worked in Canada increased by about 3.7 billion or by 16 percent (see Table 2). This represents a substantial increase in labor supply, averaging 1.5 percent per year. A large part of this growth in total hours was due simply to the increase in the size of the working age population. The number of potential workers age 15+ in Canada increased during the decade by a little more than 2 million or 11.6 percent. Meanwhile, the country's labor force participation rate grew only slightly -- by a mere .01 percentage point or 0.7 percent. More important was the decline in unemployment and therefore the growth in the employment rate. The percentage of the

labor at work rose from 91.9 to 94.2 percent, consistent with a decline in the standardized unemployment rate from 8.1 percent in 1990 to 5.8 percent a decade later. Average weekly hours increased by .25 (15 minutes) or 0.7%. All four of the explanatory variables increased, meaning that each of them contributed to an increase in total annual hours.

Taking natural logarithms and then decomposing the change in total hours, we can see that nearly three-quarters (74 percent) of the total increase in hours was due to an increase in working age population. Increased labor force participation and the small increase in weekly hours were each responsible for another 5 percent of the total. The remaining 17 percent of added hours was due to the decline in unemployment.

While the increase in average weekly hours is modest, the added 182 million annual hours due to the lengthened workweek is equivalent to adding nearly 88,000 full-time, full-year workers to the Canadian workforce. A sixth of the total increase in hours came from unemployed workers going back to work while another five percent came from experienced workers working longer. Still, the overwhelming reason for Canada's increased labor supply was simple population growth.

Table 2

CANADA Decomposition of Hours Worked

	Total Hours	Population	LFPR	1-UR	Hrs/Wk
1990	**23,378,353**	**18,847**	**0.75**	**0.919**	**34.38**
2000	**27,110,589**	**21,029**	**0.76**	**0.942**	**34.63**
Change	3,732,236	2,182	0.01	0.023	0.25
% Change	15.96%	11.58%	0.66%	2.50%	0.73%
LN(1990)	16.97	9.84	-0.28	-0.08	3.537
LN(2000)	17.11	9.95	-0.27	-0.07	3.545
Change in LN	0.148	0.110	0.006	0.025	0.007
% of TCH		**74.0%**	**4.5%**	**16.7%**	**4.9%**
Change in Total hours	**3,732,589**	**2,762,116**	**167,967**	**623,342**	**182,897**

(Total Hours and Population in 000's)

France

The situation in France was quite different (see Table 3). Aside from a minor difference in the time period under examination (1990 to 1999), we find the factors leading to changes in labor supply differ significantly from those for Canada. Unlike Canada, France did not experience an increase in total annual hours at all. Instead, over the decade of the 1990s, France experienced a 2 percent decline in annual total hours worked -- a decrease of 712 million hours. How is this decline in total labor supply related to changes in population, labor force participation, unemployment, and average weekly hours?

By itself, an increase in the working age population of 897,000 should have led to an increase in annual work time of 861 million hours, ceteris paribus. Similarly, the increase in the French labor force participation rate from 65 to 68 percent would have also led to an increase in annual work time -- nearly 1.5 billion hours. Together, if there had been no increase in the French unemployment rate and no decline in average weekly hours worked, France would have enjoyed an increase of over 6 percent in the amount of labor supplied to its economy.

However, the potential increase in labor supply due to population growth and increased labor force participation was more than offset by a sharp increase in the nation's unemployment rate (from 9.1% to 11.2%) and a sharp decline in weekly hours of work. While rising unemployment cost France nearly 900 million hours of work, the decline in the average work week cost it more than twice as much -- a huge 2.1 billion hours per year -- as the average work week declined by almost two hours. Thus, the total hours impact of France's decline in average weekly hours was, in absolute terms, three times larger than the total change in annual hours worked. If the working age population had not grown by nearly 900,000 and the labor force participation had not increased by a full three percentage points, the loss in aggregate labor supply would have been enormous -- the equivalent of France losing the services of nearly 1.5 million full-time, full-year workers or 6 percent of its labor force of 26 million. This swamps the impact of increased unemployment alone.

Table 3

FRANCE Decomposition of Hours Worked

	Total Hours	Population	LFPR	1-UR	Hrs/Wk
1990	**36,591,537**	**37,297**	**0.65**	**0.91**	**31.87**
1999	**35,879,136**	**38,194**	**0.68**	**0.89**	**30.04**
Change	-712,401	897	0.03	-0.02	-1.83
% Change	-2.0%	2.4%	4.1%	-2.4%	-5.7%
LN(1990)	17.42	10.53	-0.43	-0.10	3.46
LN(1999)	17.40	10.55	-0.39	-0.12	3.40
Change in LN	-0.02	0.02	0.04	-0.02	-0.06
% of TCH		**+120.9%**	**+204.6%**	**-125.2%**	**-300.3%**
Change in Total hours	**-712,401**	**861,125**	**1,457,508**	**-891,699**	**- 2,139,334**

(Total Hours and Population in 000's)

Spain

Like Canada and unlike France, Spain experienced an overall increase in total annual hours of 14 percent between 1990 and 2000 (see Table 4). However, unlike Canada, an increase in population was responsible for only 30 percent of the total increase in working time. *What really mattered was the country's increase in its labor force participation rate.* Well over half (56 percent) of the increase in total hours worked (1.8 billion) can be attributed to the 5 percentage point increase in labor force participation from 58 to 63 percent during the decade. A decrease in the unemployment

rate of 2 percentage points was also important, but accounts for only one-third as much as the increase in labor force participation -- 624 million hours. The overall increase in labor supply in Spain helps explain the rapid increases in aggregate GDP this country experienced during the latter part of the 1990s. In Spain's case, the change in average weekly hours was small, and had a relatively negligible effect on total hours.

Table 4

SPAIN Decomposition of Hours Worked

	Total Hours	Population	LFPR	1-UR	Hrs/Wk
1990	**22,942,267**	**25,849**	**0.58**	**0.84**	**35.08**
2000	**26,176,150**	**26,892**	**0.63**	**0.86**	**34.85**
Change	3,233,883	1,043	0.04	0.02	-0.23
% Change	14.1%	4.0%	7.6%	2.6%	-0.7%
LN(1990)	16.95	10.16	-0.54	-0.18	3.56
LN(2000)	17.08	10.20	-0.47	-0.15	3.55
Change in LN	0.13	0.04	0.07	0.03	-0.01
% of TCH		***30.0%***	***55.7%***	***19.3%***	***-5.0%***
Change in Total hours	**3,233,883**	**970,082**	**1,801,111**	**624,564**	**-161,874**

(Total Hours and Population in 000's)

Sweden

Like France, Sweden also experienced a decrease in total annual hours between 1990 and 2000 (see Table 5). The overall decline of 2 percent in total working time came despite an increase in the working age population of 3.7 percent and a substantial

increase in the average workweek from 29.7 to 31.2 hours. What was responsible for the decline in hours was a sharp decrease in labor force participation from 83 to 77 percent and a 4 percentage point increase in the unemployment rate. Indeed, the decline in the participation rate was so severe that by itself it was responsible for a total loss in hours *three times greater* than the overall net decline. Increased unemployment also did substantial damage -- itself reducing working hours by *twice as much* as the total net decline. This massive decrease in hours was mitigated by the increase in average weekly hours of 1.5 hours, which, all else equal, compensated for nearly half (45%) of the decline due to changes in the participation rate and rising unemployment.

Table 5

SWEDEN Decomposition of Hours Worked

	Total Hours	Population	LFPR	1-UR	Hrs/Wk
1990	**6,902,890**	**5,501**	**0.83**	**0.98**	**29.73**
2000	**6,754,216**	**5,705**	**0.77**	**0.94**	**31.23**
Change	-148,674	204	-0.05	-0.04	1.50
% Change	-2.2%	3.7%	-6.3%	-4.1%	5.1%
LN(1990)	15.75	8.61	-0.19	-0.02	3.39
LN(2000)	15.73	8.65	-0.26	-0.06	3.44
Change in LN	-0.02	0.04	-0.07	-0.04	0.05
% of TCH		**+167.2%**	**-300.4%**	**-192.8%**	**+226.1%**
Change in Total hours	**-148,674**	**248,639**	**-446,662**	**-286,747**	**336,097**

(Total Hours and Population in 000's)

United Kingdom

Like France and Sweden, the UK did not experience growth in total hours worked over the time period -- actually even losing a little ground (see Table 6). A 1.7 billion increase in total hours that would have been brought about by the 3.7 percent increase in population was virtually wiped out by the 1.6 billion hours lost as a result of a decline in the average workweek of 1.1 hours. The 876 million reduction in work hours caused by a decrease in the labor force participation rate was nearly offset by the 1 percentage point decrease in the unemployment rate. Thus, after these offsetting factors, total hours changed by only 0.2 percent or a net decline of 115 million total hours. Essentially population growth and an improved unemployment rate offset the impact of declines in both labor force participation and weekly hours.

Table 6

UNITED KINGDOM Decomposition of Hours Worked

	Total Hours	Population	LFPR	1-UR	Hrs/Wk
1990	**47,387,408**	**37,603**	**0.77**	**0.93**	**33.98**
2000	**47,272,309**	**38,976**	**0.75**	**0.94**	**32.85**
Change	-115,099	1,373	-0.01	0.01	-1.13
% Change	-0.2%	3.7%	-1.8%	1.4%	-3.3%
LN(1990)	17.67	10.53	-0.27	-0.07	3.53
LN(2000)	17.67	10.57	-0.29	-0.06	3.49
Change in LN	0.00	0.04	-0.02	0.01	-0.03
% of TCH		**+1,474.7%**	**-761.1%**	**+582.9%**	**-1,396.5%**
Change in Total hours	**-115,099**	**1,697,354**	**-876,022**	**670,902**	**- 1,607,332**

(Total Hours and Population in 000's)

United States

Finally, we return to the U.S. case. Of the six countries we have studied, the U.S. experienced the largest percentage increase in total work hours (see Table 7). Even larger than Canada and Spain, the United States experienced a 17.5 percent increase in total hours worked between 1990 to 2000 -- a grand total of nearly 38 billion annual hours. A full 62 percent of the increase was due to an increase in population, 8 percent was due to a one percentage point increase in the labor force participation rate, 10 percent was due to a decrease of 2 percentage points in the unemployment rate, and a remarkable 20 percent of the increase in total hours came about because the average work week increased by 1.1 hours. *This increase in the average work week provided the equivalent of an additional 3.5 million full-time, full-year workers to the U.S. labor market.*

Further calculations suggest just how important this additional work effort is. The addition of the equivalent of 3.5 million full-time, full-year workers provides the same boost to labor supply as would a decline in the overall unemployment rate from 6.6 percent to 4.0 percent. *Put differently, the increase in weekly hours supplied by incumbent workers provided enough labor supply such that the economy had just as much "slack" at a 4 percent unemployment rate as at a 6.6 percent rate.* In this case, it is not surprising that the U.S. was able to reach unemployment rates well below the accepted "natural rate" without seeing a spike in inflation or worse yet, accelerating price levels. Not recognizing this increase in labor supply may have been at least partly responsible for the Fed's actions n 2000 to raise interest rates in false anticipation of labor market induced inflation. In raising interest rates, the Fed contributed to a slowdown in growth and recession in 2001.

Table 7

UNITED STATES Decomposition of Hours Worked

	Total Hours	Population	LFPR	1-UR	Hrs/Wk
1990	**216,084,465**	**164,619**	**0.76**	**0.94**	**34.98**
2000	**253,785,387**	**181,954**	**0.77**	**0.96**	**36.10**
Change	37,700,922	17,335	0.01	0.02	1.12
% Change	17.5%	10.5%	1.3%	1.7%	3.2%
LN(1990)	19.19	12.01	-0.27	-0.06	3.55
LN(2000)	19.35	12.11	-0.26	-0.04	3.59
Change in LN	0.16	0.10	0.01	0.02	0.03
% of TCH		***62.3%***	***7.9%***	***10.4%***	***19.5%***
Change in Total hours	**37,700,922**	**23,471,166**	**2,967,027**	**3,904,507**	**7,358,222**

(Total Hours and Population in 000's)

Summarizing the Diverse International Labor Supply Story

As we can see from this analysis, the factors contributing to increased labor supply vary dramatically across countries (see Table 8). In each country, an increase in the working age population is one of the two most important sources of additional labor supply. But in two of these countries (France and Spain), rising labor force participation is also important. In two others (Canada and the United Kingdom), second place in the labor supply story goes to falling unemployment rates. In the remaining two (Sweden and the United States), increases in the length of the work week are critically important.

Table 8

Major Source of Labor Supply Growth (1990-2000)

	Population	LFPR	1-UR	Hrs/Week
Canada	X		X	
France	X	X		
Spain	X	X		
Sweden	X			X
United Kingdom	X		X	
United States	X			X

Moreover, to the extent that some countries actually experienced a decline in total working time over the decade, this analysis suggests the factors responsible (see Table 9). In France, both rising unemployment and a declining work week led to a decline in total labor supply. In Sweden, the important factors were a lower labor force participation rate and rising unemployment. In the United Kingdom, both labor force participation and weekly hours fell.

Table 9

Major Source of Labor Supply Decline (1990-2000)

	Population	LFPR	1-UR	Hrs/Week
Canada	NONE			
France			X	X
Spain				X
Sweden		X	X	
United Kingdom		X		X
United States	NONE			

Conclusion

All in all, this analysis suggests that any discussion of labor market capacity must take into consideration not only changes in the unemployment rate, but changes in labor force participation and the length of the workweek. For the past two decades, there has been a growing divergence in hours of work across countries. While the U.S. has experienced a significant increase in working time, many European countries have had an explicit policy to reduce daily, weekly, and yearly hours. For starters, this suggests that the standard unemployment rate is no longer a robust measure of capacity. Its binary character fails to capture significant differences in labor supply.

Once we venture beyond the unemployment rate, we find that we are in a better position to comprehend fundamental changes in the nature of labor markets and better able to distinguish between the labor supply trajectories of various countries. This permits us to gain a better understanding of the variance in national economic growth rates. From a theoretical perspective, gaining a better handle on the measurement of labor supply can help explain changes in the locus of the Phillips Curve and NAIRU. From a policy perspective, it should give central bankers pause when they consider the level of labor market tightness in assessing the potential for inflation.

For all these reasons, it seems high time to consider making hours of work a more central labor force measure. This, in turn, requires a careful look at how to measure both actual hours and preferred hours of work. Getting this right could readily improve the labor market statistics we use to gauge and guide economic success.

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