Tax Rates and Labor Supply in OECD Countries

Jon Bakija, March 2011¹

An approach to investigating how taxes affect labor supply that has recently received much attention from economists involves looking at how changes in hours worked match up with changes in tax rates across countries over long periods of time. This approach has some advantages and some disadvantages.

As we'll see below, there are large differences in tax rates across OECD countries, and tax rates have changed in rather different ways over time across these countries as well. The magnitude of these differences across countries and over time may make it possible to detect responses of economic behavior to tax incentives that are difficult to detect in the short run, or that fail to show up when examining the response to more subtle differences across people in the time paths of tax rates within a country. Raj Chetty (2009), for example, has emphasized that people are busy and have limited attention, that paying attention to changes in tax law is costly in terms of time and effort, and that the costs in terms of sub-optimal utility from ignoring subtle and complicated changes in tax law are plausibly small. In the presence of such frictions, economic behavior might not respond to relatively subtle changes in tax incentives, and the behavioral response to taxation would only reveal itself in reaction to very large changes in incentives and over long periods of time as people have a chance to learn and adapt. Moreover, in the short-run, people may have limited flexibility to adjust their hours of work in response to incentives because of constraints put on them by employers. One explanation for this is that workers might be more productive when they work at the same time as other workers, for instance because each worker's effort is a complement to the efforts of co-workers. This gives employers an incentive to coordinate, limiting workers' freedom to work whenever they want. Similarly, leisure may have more value to you when other people that you want to share your leisure time with (family, friends) have leisure at the same time; otherwise, it would be more efficient for people to work staggered hours, so that plant and equipment wouldn't sit idle for long periods of time. The institution of the weekend is one piece of evidence that this is an important consideration. Again, there's a coordination problem, and societal institutions like the weekend may evolve slowly over time to achieve coordination on an optimal outcome. As a result, the long-run response to changes in incentives could be very different from the short-run response. Because of the coordination problems, labor market institutions exist that shape and constrain workers' work and leisure schedules, and these institutions may only evolve slowly over time to adapt to workers' and employers' preferences in response to changing incentives. As such, evidence on how hours work change over long periods of time in response to big changes in tax rates might yield evidence on the behavioral response to taxes that would not show up in a short-run analysis.

Another potential advantage of the cross-country approach is that it gives us a plausible treatment group, people who live in countries that experienced large changes in tax rates over time, and a plausible control group, people who live in otherwise similar countries that experienced relatively small changes in tax rates over time. Evidence based on such a comparison may be more convincing than other approaches used in the

¹ Some parts of this paper are excerpted from Slemrod and Bakija (2008).

labor supply literature, such as comparing hours worked across people with high and low after-tax wages within the same country (who may differ in unobservable characteristics that are correlated with both after-tax wages and hours worked, such as inherent motivation to work), or comparing changes over time in hours worked for high income people within a country who received large cuts in marginal tax rates versus middleincome people who experienced small tax cuts (since other factors influencing labor supply may have been changing in different ways over time for the two groups).

On the other hand, a disadvantage of the cross-country approach is that the kind of data that is available on a consistent basis across countries for a large number of years is highly imperfect. For example, ideally we would like a measure of how marginal tax rates (which are what matter for the incentive to work) have changed over time in different countries, but in general we usually only have measures of average tax rates constructed using national accounts data on tax revenues and tax bases. There are a variety of non-tax factors that may influence labor supply, that are changing in different ways over time in different countries, and that are correlated with tax rates, and it is difficult to construct data on many of these other factors in a way that is consistent across countries and covers many years.

In a provocative 2004 paper, Nobel Prize winning economist Edward Prescott highlighted the fact that average hours worked per person in major European economies are now typically much lower than in the U.S., and presented an empirical case that almost all of the difference in hours worked across these countries could be explained by taxes. Figure 1 shows the cross-sectional relationship between average hours worked per person aged 15 to 64, and average tax rates (including income taxes, employment taxes such as the social security tax, and consumption taxes) for 17 OECD countries in 1995. It reveals a striking negative relationship between tax rates and hours worked. The simple cross-sectional correlation in 1995 suggests that a one percentage point increase in tax rates reduces average hours worked per year by 12.7 hours, with a standard error of 3.0. Based on this relationship, we'd predict that the 25.6 percentage point difference in tax rate between the U.S. and France, for example, would lead to 25.6*12.7 = 325 fewer hours worked per person in France, which is close to the actual difference of 372 hours.

The variation in average annual hours worked across countries shown in Figure 1 reflects differences in many different components of labor supply -- weeks of vacation, hours worked per week, labor force participation rates among working age men and women, years spent in school, the prevalence of early retirement, unemployment (which is particularly high among younger people in many European countries), and paid absences for illness and maternity. Taking all of these factors into account, the variation in average annual hours worked per person aged 15 to 64 across OECD countries is quite pronounced, ranging from less than 900 hours per year in Belgium to over 1400 hours per year in Japan, and matches up quite well with differences in tax rates.



Figure 1 -- Tax rates and average annual hours worked per person aged 15-64, selected OECD nations, 1995

Of course, there are many other differences among these countries besides taxes that might explain the differences in hours worked. One possible alternative explanation could be that there is a greater cultural taste for leisure and "the good life" more generally in the highest-tax countries with the lowest hours worked, which are predominantly in Continental Europe. Prescott contends that the "cultural taste for leisure" argument has a hard time explaining why hours worked were so similar between the U.S. and Europe in the 1970s, and were actually higher in many European countries in the 1960s, since such cultural tastes would presumably be fairly persistent over time. As shown in Figure 2, as of 1960 average hours worked per person aged 15 to 64 were considerably higher in France and Germany than in the U.S., but hours worked fell sharply over the next few decades in France and Germany while staying relatively stable and even increasing a bit in the U.S. Rather, Prescott blames the fact that tax rates have gone up more over time in Europe than in the U.S., illustrated for France, Germany, and the U.S. in Figure 3.



Figure 2 -- Average annual hours worked per person aged 15 - 64, United States, France, and Germany, 1960 - 1995

Year



Figure 4 -- Change in tax rates and change in average annual hours worked per person aged 15-64, selected OECD nations, 1960-1995

Figure 4 illustrates the change in hours worked between 1960 and 1995, plotted against the change in average tax rate on labor income between 1960 and 1995, for the fifteen OECD nations for which data is available on tax rates and hours worked for both years. There is something of a negative relationship – countries with smaller increases in tax rates also tended to have smaller reductions in hours worked. The relationship is a lot less tight than that illustrated in Figure 1, however. A simple regression estimating the effect of change in tax rates on change in hours worked using the data in Figure 4 suggests that a one percentage point increase in tax rate reduces average annual hours worked per person by 16.8 hours, but with a relatively large standard error of 10.9.

Prescott's article sparked much controversy. For example, Alberto Alesina, Edward Glaeser, and Bruce Sacerdote (2005) argue that it is impossible to empirically distinguish the effects of rising taxes on changes in hours worked across OECD countries from the effects of unions, which grew in power and changed their strategies in Europe relative to the U.S. at the same time as taxes were going up in Europe. European unions have pushed hard for laws imposing mandatory vacation time, mandatory paid leave, and mandatory restrictions on the maximum number of hours an individual can work in a week (achieving, for example, the well-known 35-hour work week in France) under the slogan "work less, work all," on the (apparently misguided) theory that reducing hours worked for each worker would open up more jobs. Alesina *et al* further hypothesize that mandatory hours reductions in Europe might have been partly motivated by the plausible notion that leisure time is more valuable to each individual when there are more other people to share it with, a coordination problem that might be ameliorated by regulations mandating vacation time, for instance. It's at least possible that the unions' actions could have been motivated by workers' desire to reduce hours worked in response to taxes, but the rhetoric used by the unions as they fought for these changes suggest the other motivations noted above predominated. Furthermore, many other non-tax policies and institutions in Europe, such as public pension rules, generous unemployment insurance, and high minimum wages, also discourage work and/or hiring, further weakening the case that taxes alone are to blame.

To investigate this question econometrically, Alesina, Glaeser and Sacerdote estimated the effects of tax rates on average annual hours worked per person aged 15 to 64, using a panel of OECD countries for the years 1960 through 1995. Their measure of tax rates was constructed by Nickell and Nunziata (1991), and is essentially an average tax wedge on labor, including the effects of personal income taxes on labor, employment taxes such as those for social security, and consumption taxes such as the value-added tax, measured in percentage terms (on a scale from 0 to 100). Their regression included country fixed effects, to control for differences between countries that are persistent over time (such as cultural tastes for leisure), and year fixed effects to control for any influences on labor supply that are changing in the same way over time in all countries. They also controlled for "union density" (the share of workers who belong to unions), and an index of employment protection regulations – laws in many European countries make it very difficult to fire a worker, which in turn may make employers reluctant to hire workers in the first place (this index goes from 0 to 2, with 2 representing the most stringent employment protection regulations). Their regression is replicated, using a slightly larger data set, in column (3) of Table 1 (we'll revisit the other columns later).

The regression suggests that a one percentage point increase in tax rates actually led to a very small *increase* in average annual hours worked of about 3 hours per year. This strongly contradicts Prescott's claim, which was based on data from a smaller number of countries and years, that countries with the largest increases in tax rates over time experienced the largest relative declines in hours worked.² Increasing the share of workers belonging to a union from 0% to 100% is estimated to reduce hours worked by a statistically significant 121 hours per year, while employment protection has no statistically significant effect.

Subsequent research by Ohanian, Raffo, and Rogerson (2007), however, suggests quite different conclusions. They also estimated the effects of tax rates on hours worked in a panel of 15 OECD countries from 1960 through 1995, and controlled for measures of union density and employment protection, but constructed a different reasonable measure of the tax rate which is conceptually similar but relies on different data. They included country fixed effects, but excluded year fixed effects. They also used a different functional form, where the dependent variable is the log of hours worked, and the key explanatory variable is the log of the tax rate. The coefficient on the tax rate in such a regression represents the percentage change in hours worked caused by a one percent change in the tax rate, also known as the elasticity of hours worked with respect to the tax rate. This has a useful interpretation -- it tells us the fraction of revenue that we would have otherwise raised from a tax increase that is lost due to the resulting decline in hours.

 $^{^{2}}$ In the original Alesina, Glaeser, and Sacerdote article, the estimated coefficient on tax rate was a very small negative (-0.682) and statistically insignificant (with a standard error of 0.814); the estimates change slightly here due to the use of a somewhat more complete set of data.

To see this, note that tax revenue from labor income can be expressed as t^*w^*H , where t is the tax rate, w is the before-tax wage, and H is hours worked. Mathematically, the percentage change in revenue caused by a tax rate increase, $\%\Delta(t^*w^*H) = \%\Delta t + \%\Delta w + \%\Delta H$. So for example, if we increase tax rates by 1% (e.g, from 30% to 30.3%), and this causes hours worked to decline by 0.4%, and there is no change in pre-tax wages, then tax revenue only goes up by 0.6%; we lose 40% of the revenue we would have otherwise gained from the tax increase due to the resulting reduction in hours worked. The coefficient on the log of the tax rate in Ohanian, Raffo, and Rogerson's regression is an estimate of $\%\Delta H / \%\Delta t$, so it tells us the $\%\Delta H$ for a one percent increase in tax rates, and thus how much of the revenue that would otherwise be raised by a tax increase is offset by the decline in work hours. If $\%\Delta H / \%\Delta t \leq -1$, then an increase in tax rates would cause more than a one percent decline in the size of the tax base. We would be on the wrong side of the Laffer curve; so this elasticity also tells us how close we are to the peak of the Laffer curve.

	(1)	(2)	(3)	(4)
VARIABLES				
Tax Rate (Nickell	-10.30***		3.315***	
Nunziata)	(0.948)		(1.027)	
Tax Rate (Ohanian,	(0.5 10)	-17.47***	(11027)	-9.381***
Raffo, Rogerson)		(0.748)		(1.472)
Union Density (Nickell	126.6	203.3***	-120.7*	160.7**
Nunziata)	(81.47)	(60.95)	(66.77)	(64.45)
Employment protection	-58.94***	-1.873	-13.59	22.65
measure (Blanchard	(20.48)	(15.42)	(16.06)	(15.17)
Wolfers)				
Country dummies?	Y	Y	Y	Y
Year dummies?	Ν	Ν	Y	Y
Observations	526	526	526	526
R-squared	0.705	0.825	0.845	0.854

Table 1 -- Effect of Tax Rate on Average Annual Hours Worked Per Person Aged 15-64 in 15 OECD Nations, 1960-1995

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The Ohanian, Raffo, and Rogerson regression is approximately replicated, using slightly different data, in column (2) of Table 2. This regression suggests that a one percent increase in the tax rate causes hours worked to decline by 0.462 percent.³ This is a fairly big effect, implying a fair amount of deadweight loss from taxation. It also suggests that taxes explain a good portion of the difference in hours worked across countries. For example, in 1995, the average tax rate was 25.6 percentage points higher in France than in the U.S. The regression predicts that average annual hours worked in France would be 0.462*25.6 = 12.4 percent lower in France than in the U.S. The actual difference was 27.6 percent, suggesting that taxes explain almost half of the difference in hours worked between the two countries.

	(1)	(2)	(3)	(4)
VARIABLES		. ,	. ,	
Log Tax Rate (Nickell	-0.389***		0.0433	
Nunziata)	(0.0310)		(0.0363)	
Log Tax Rate (Ohanian,		-0.462***		-0.123***
Raffo, Rogerson)		(0.0222)		(0.0470)
Union Density (Nickell	0.0855	0.0876	-0.0494	0.0172
Nunziata)	(0.0648)	(0.0533)	(0.0551)	(0.0542)
Employment protection	-0.0628***	-0.0356***	0.00610	0.00226
measure (Blanchard	(0.0155)	(0.0130)	(0.0133)	(0.0133)
Wolfers)	, , , , , , , , , , , , , , , , , , ,		. ,	. ,
Country dummies?	Y	Y	Y	Y
Year dummies?	Ν	Ν	Y	Y
Observations	526	526	526	526
R-squared	0.716	0.799	0.830	0.832

Table 2 Effect of Log Tax Rate on Log of Average Annual Hours Worked	I
Per Person Aged 15-64 in 15 OECD Nations, 1960-1995	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

What accounts for the large difference in conclusions between Ohanian, Raffo, and Rogerson and Alesina, Glaeser, and Sacerdote? One important reason why the estimates are so different is that Alesina, Glaeser, and Sacerdote included year dummies to control for any factors that are changing in the same way over time for all countries, while Ohanian, Raffo, and Rogerson did not. Column (4) of Table 2 shows what happens if we add year dummies to Ohanian, Raffo, and Rogerson's regression – a one percent increase in tax rates is now estimated to reduce hours worked by 0.123 percent. The estimate is still highly statistically significant, but much smaller. So which estimate one should believe depends a lot on whether you think there are other important omitted factors that affect labor supply and that were changing in similar ways over time for the countries in the sample. The other source of discrepancy arises from the different tax rate

³ This is very similar to the estimate in Ohanian, Raffo, and Rogerson's original paper, despite a slightly different sample and set of control variables.

measures used by each set of authors. In general, in both Table 1 and Table 2, the tax rate measures used by Ohanian, Raffo, and Rogerson lead to larger estimates of the tax effects. The different tax rate measures don't lead to widely different conclusions in the specifications without year dummies, but in the specifications with year dummies, the Ohanian, Raffo, and Rogerson tax rate measure suggests a modest and statistically significant negative effect of taxes on hours worked, whereas the Alesina, Glaeser, and Sacerdote tax rate measure does not. Both tax rate variables are supposed to be measuring the same thing (the effect of taxes on the incentive to work, including personal income taxes, employment taxes, and consumption taxes), and there are no obvious reasons to prefer one measure over the other, although that bears further investigation. So the bottom line is that in a "difference-in-differences" type cross-country panel regression that controls for both country fixed effects and time fixed effects, under at least one reasonable measure of tax rates we find that countries that had larger increases in tax rates over time had modestly larger declines in hours worked. Of course, these regressions include a very small set of control variables. For example, there are questions about how much of this might be explained for example by other government policies that went along with higher tax rates, or by differences in trends in pre-tax wages or nonwage income across the countries. There are also questions about how well the union density variable controls for the complicated story Alesina, Glaeser, and Sacerdote tell about European unions' efforts to push for laws mandating vacations, maximum hours of work per week, and paid leave of various sorts. But there is at least suggestive evidence here that hours worked may be somewhat responsive to large changes in tax incentives over the long run.

Appendix: notes on Tables 1 and 2:

Union density is the ratio of union members to all wage and salary workers, and employment protection is measured on a scale from 0 to 2, with 2 being the strictest employment protection. Both are taken from Nickell and Nunziata (2001) and are the same variables used in Alesina, Glaeser, and Sacerdote (2005, Table 1.9), and Ohanian, Raffo, and Rogerson (2007). The Nickell Nunziata tax rate is the same variable used in Alesina, Glaeser, and Sacerdote (2005, Table 1.9). The Ohanian, Raffo, and Rogerson (2007) tax rate is based on data from McDaniel (2007). Both tax rates are measured in percentage points (i.e., scaled from 0 to 100), and include income taxes, employment taxes (e.g., social security tax), and consumption taxes (e.g., value-added tax). They are essentially measures of average tax rates, computed by dividing tax revenues by the tax base (e.g., income or consumption). The estimation sample includes the following fifteen OECD countries from 1960 through 1995 unless otherwise noted: Australia (1960-1985), Austria, Belgium, Canada, Finland, France, Germany, Italy, Japan, Netherlands, Spain (1964-1995), Sweden, Switzerland, United Kingdom, and United States. This is the set of countries and years for which both Nickell Nunziata and Ohanian Raffo Rogerson tax rates are available. Average annual hours worked per person aged 15-64 is computed as average annual hours worked per employed person, from Conference Board (2010), multiplied by the share of the population aged 15-64 that is employed, from Nickell and Nunziata (2001).

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