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Long-term changes in labor supply and taxes: Evidence from OECD countries, 1956–2004 ☆

Lee Ohanian [a,b,c,*], Andrea Raffo [d], Richard Rogerson [e,f]

[a] University of California, Los Angeles, CA 90024, USA
[b] Federal Reserve Bank of Minneapolis, MN 55401, USA
[c] NBER, Boston, MA 02138, USA
[d] Board of Governors of the Federal Reserve System, Washington, DC 20551, USA
[e] Arizona State University, AZ 85287, USA
[f] NBER, Boston, MA 02138, USA

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ABSTRACT

We document large differences in trend changes in hours worked across OECD countries between 1956 and 2004. We assess the extent to which these changes are consistent with the intratemporal first order condition from the neoclassical growth model, augmented with taxes on labor income and consumption expenditures. We find that the model can account for most of the trend changes in hours worked measured in the data. Differences in taxes explain much of the variation in hours worked both over time and across countries.

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1. Introduction

Macroeconomists have long been interested in understanding time series changes in aggregate hours of work. Much effort has been devoted to understanding changes in hours worked at business cycle frequencies, primarily in the US economy. This paper is motivated by the fact that *trend* changes in hours of work *across countries* are enormous, exceeding cyclical fluctuations in hours by roughly an order of magnitude. Table 1 documents changes in hours of work in 21 OECD countries between 1956 and 2004. The bottom panel of the table aggregates the countries into three groups,

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* Corresponding author at: University of California, Los Angeles, CA 90024, USA. Tel.: +1 310 825 0979.
E-mail addresses: ohanian@econ.ucla.edu (L. Ohanian), andrearaffo@hotmail.com (A. Raffo).

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Table 1
Distribution of hours worked across OECD countries: (A) Summary statistics. (B) Country-specific patterns

(A)			Average		Standard deviation
OECD					
Min (Year)			1069 (1993)		0.10 (1972)
Max (Year)			1365 (1956)		0.16 (1991)
US time series (1956–2004)			1266		0.02
(B)					
Hours worked in 2004 relative to 1956					
$\leqslant 0.75$		(0.75, 0.90)		$\geqslant 0.90$	
Austria	0.74	Japan	0.85	Australia	0.97
Belgium	0.70	Netherlands	0.81	Canada	1.08
Denmark	0.71	Norway	0.82	Greece	0.99
France	0.67	Portugal	0.84	New Zealand	1.05
Finland	0.75	Spain	0.86	US	1.01
Germany	0.60	Sweden	0.80		
Italy	0.74	Switzerland	0.83		
Ireland	0.70	UK	0.79		
Group 1	0.70	Group 2	0.83	Group 3	1.02

Note: Hours worked is the product of total civilian employment and hours per worker, divided by the size of population aged 15–64. Source: OECD, GGDC and The Conference Board.

according to the size of their change in hours. Group 1 consists of countries that experienced at least a 25 percent decline in hours, Group 2 is those countries with declines ranging between 10 and 25 percent, and Group 3 is the remaining countries, that either have small declines or small increases in hours. The table clearly shows the considerable differences in long-run changes in hours across these countries. On average, Group 1 hours worked decline 30 percent, Group 2 hours worked decline 15 percent, while Group 3 hours worked rise 2 percent.[1]

This paper uses the neoclassical growth model to account for these very different long-run changes in hours worked across the OECD. Our analysis focuses on the static first order condition in the model that governs the household's time allocation decision, and assesses the extent to which this condition holds at each point in time in the data.[2] Our main finding is that the standard version of the growth model, extended to incorporate taxes on labor income and consumption expenditures and a moderate level of subsistence consumption, can account for much of these changes. The model broadly accounts for differences in the magnitude of the changes in hours worked between 1956 and 2004, and for the timing of those changes. Most of the changes in hours in the model are due to changes in taxes, and not the other factors in the model impacting hours worked. This paper also presents statistical evidence to show that taxes are important determinants of hours, even after controlling for several other features that have been suggested as important determinants of cross-country differences in hours worked.

It is standard in aggregate analyses to impose preferences that are consistent with balanced growth, motivated by the observation that hours in the postwar US economy have been relatively flat. The large declines in hours worked that this paper documents for many other countries represent a significant challenge to this argument. In fact, Blanchard (2004) uses cross-country hours data to argue that balanced growth preferences are inconsistent with the data, and that the strength of the income effect on leisure is also very different across countries. In contrast, our findings show that once one accounts for taxes, preferences consistent with (asymptotic) balanced growth that are the same across countries are indeed consistent with the large differences in different hours trends across countries.

While the model does a good job of accounting for the broad patterns in the data, there are several episodes that it does not closely account for. Those episodes which are singled out as puzzling relative to the theory indicate where future research efforts should be directed.

The study most similar to ours is Prescott (2004). He uses the growth model with taxes to account for the changes in hours of work for a small set of countries between two particular points in time. This analysis extends Prescott's analysis in four different directions, including a much larger set of countries, a much longer time period, the analysis is conducted for all years in the data set, rather than for two years, and the analysis statistically tests whether taxes are important determinants of hours worked, conditioning on other labor market and institutional variables that are not included in the model economy.

[1] These data, and their groupings, are described in detail in the following section.

[2] This same methodology has been profitably employed in the business cycle literature by Parkin (1988), Bencivenga (1992), Ingram et al. (1994), Hall (1997), Gali et al. (2002), and Chari et al. (2004). Mulligan (2002) uses this method to analyze changes in hours of work in the US over the 20th century, while Cole and Ohanian (2002) use it to shed light on changes in hours worked during the US Great Depression.

The paper is organized as follows. Section 2 documents changes in OECD hours worked in detail. Section 3 describes the model and the methodology. Section 4 presents our findings. Section 5 carries out a statistical analysis of the relative importance of taxes and other institutional/labor market variables factors.

2. Hours worked in 21 OECD countries: 1956–2004

This section describes in detail the distribution of hours worked across 21 OECD countries between 1956 and 2004, and defines the grouping of countries adopted throughout the analysis. Hours worked is the product of total civilian employment and annual hours per worker, divided by the size of the population aged 15–64.[3] One prominent feature of these data is that the dispersion of hours worked across countries is very large at all points in time. In particular, the cross-sectional standard deviation of log hours is between 0.10 (in 1972) and 0.16 (in 1991) during the postwar period. In contrast, the standard deviation of the cyclical component of log hours in the US over the same time period is only 0.02. A second prominent feature is that average hours of work have decreased substantially over time. The highest average hours across OECD countries are in 1956 (the first available year), and are about 20 percent lower at the end of our dataset (2004). This decrease occurred at a roughly constant rate from 1956 until the mid 1980s, at which point average hours stabilize.

The third prominent feature, and the one that is the focus of this paper, is the dramatic difference in the changes in hours of work across countries. At one extreme are Germany and France, which experienced decreases of 40 and 33 percent, respectively, while at the other extreme are Canada and the US, which experienced increases of 8 and 1 percent, respectively. The remaining countries lie between these two extremes: in eight countries, hours decreased at least 25 percent (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, and Italy), in another eight countries hours fall between 10 and 25 percent (Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom), while hours in the remaining five countries decline less than 10 percent or rise (Australia, Canada, Greece, New Zealand, and the US). These are the three groups cited above.

These differences in trend changes in hours are the dominant source of the dispersion in hours. To establish this, a panel regression of log hours is fitted to a common constant term, and a country specific linear time trend:

$$\log h_{it} = a + b_i t + \varepsilon_{it}$$

where h_{it} is hours worked for country i in period t, and t runs from 1 to 49. The R^2 is 0.76.[4] The R^2 from this regression with a common trend coefficient across countries is just 0.26. The following section constructs a neoclassical growth model, augmented with taxes, to analyze changes in hours worked across countries.

3. Model economy and quantitative methodology

The economy consists of a representative household with utility defined over streams of private consumption (C_t), government consumption (G_t), and leisure time ($\bar{H} - H_t$), given by

$$\sum_{t=0}^{\infty} \beta^t U(C_t + \lambda G_t, \bar{H} - H_t) \tag{1}$$

where $0<\beta<1$ is the discount factor. The household is endowed with $\bar{H}$ units of time each period, and works H_t market hours. As is standard, we restrict the utility function U to be consistent with (asymptotic) balanced growth. A standard motivation for this restriction on preferences is the observation that hours in the post WWII US economy have been relatively constant despite large changes in consumption and productivity. Given that the large long-run changes in hours noted in the previous section are clearly a challenge for this class of preferences, our analysis provides a test of whether balanced growth preferences can account for these cross-country patterns in long-run changes in hours worked.

The utility function is specified as

$$U(C_t, G_t, \bar{H} - H_t) = \alpha \log(C_t + \lambda G_t - \bar{C}) + (1-\alpha)\frac{(\bar{H} - H_t)^{1-\gamma} - 1}{1-\gamma} \tag{2}$$

where $\gamma \geqslant 0$, $0 \leqslant \alpha \leqslant 1$, $0 \leqslant \lambda \leqslant 1$, and $\bar{C} \geqslant 0$. The parameter λ measures how households value government consumption, and the parameter $\bar{C}$ is a subsistence consumption term. The parameter γ governs the elasticity of substitution between leisure and consumption.[5]

Technology is given by

$$Y_t = A_t F(K_t, H_t) = A_t K_t^{\theta} H_t^{1-\theta} \tag{3}$$

[3] The Appendix presents information about data sources.

[4] If one adds a country specific intercept the R^2 for this regression increases to 0.89.

[5] Provided that we restrict our attention to balanced growth preferences, the assumption of separability plays no substantive role in the analysis.

where A_t is efficiency and K_t and H_t are capital and labor services. Output is divided between consumption and investment and capital depreciates at rate δ.

The government levies proportional taxes on labor income and consumption given by τ_{ht} and τ_{ct}, respectively. The tax wedge is given by

$$(1-\tau_t)=\frac{(1-\tau_{ht})}{(1+\tau_{ct})} \tag{4}$$

In addition to government consumption G_t, the government also uses its revenues to finance a lump-sum transfer T_t.

3.1. Comparing hours in the model and data

The analysis focuses on the competitive equilibrium allocation for this economy to compare model hours to those in the data. Specifically, the key equation is the first order condition that equates the marginal rate of substitution between consumption and leisure to the tax-adjusted marginal product of labor:

$$\frac{U_2(C_t+\lambda G_t,\bar{H}-H_t)}{U_1(C_t+\lambda G_t,\bar{H}-H_t)}=(1-\tau_t)A_tF_2(K_t,H_t) \tag{5}$$

If the model fits the data accurately, then this equation should indeed hold when actual data are used. The equation can be written as

$$\frac{H_t}{(\bar{H}-H_t)^{\gamma}}=(1-\tau_t)\frac{\alpha(1-\theta)}{(1-\alpha)}\frac{Y_t}{C_t+\lambda G_t-\bar{C}} \tag{6}$$

Given parameter values and actual data for the variables on the right hand side of this equation, the model generates values for hours, which we define as *model hours*. We compare model hours to actual hours in a series of figures, and we then decompose the relative importance of changes in taxes $(1-\tau_t)$, changes in the ratio of total consumption to output $((C+\lambda G)/Y)$, and the subsistence term for changes in hours $(\bar{C})$.[6]

4. Results

To make these comparisons, time series for the tax rates, τ, and the values for $\bar{H}, \gamma, \lambda$, and $\bar{C}$, are specified. The tax rate series are from McDaniel (2006), which cover 15 of the 21 OECD countries considered.[7] The value of $\bar{H}$ is set to $14\times 365 = 5110$ for all experiments. Our benchmark results assume that preferences are log in consumption and leisure, i.e., the limiting case as γ tends to one, which is a standard choice for aggregate analyses. Government consumption is a perfect substitute for private consumption (i.e., $\lambda=1$).

The literature provides little guidance regarding an appropriate value of $\bar{C}$. We therefore specify a conservative value of $\bar{C}$ that is equal to 5 percent of total US consumption in 1956. This is a conservative choice because it is only a small departure from the standard model (i.e., $\bar{C}=0$), and we adopt it to emphasize that only a small departure is required to account for the differences in trend changes across countries. We also conduct the analysis with different assumptions for the values $\lambda, \gamma, \bar{C}$. The sources for data on C, G, and Y are described in the Appendix. 1956 is chosen as the base year for all countries but Australia, for which the base year is 1960 because of data limitations.

4.1. Results by group

Figs. 1a–c show actual and predicted hours for each of the three groups in our benchmark specification. Recall that Group 1 was the group that exhibited the largest decline in hours, while Group 3 was the group with the smallest change in hours.

For Group 1 the path for predicted hours follows that of actual hours quite closely, though the change in model hours is somewhat smaller. In particular, both display a steady decrease until roughly 1990, at which point both the actual and model hours level off. For Group 2 the match is even closer, with model hours matching both the shape and magnitude of the decline in actual hours. In Group 3, the model predicts a slight drop in hours, while actual hours exhibit a modest increase. (We discuss this deviation in detail in Section 4.2 in the context of the US.)

[6] Since α and θ enter the right hand side of Eq. (6) as a constant of proportionality, then the values of these variables are irrelevant for accounting for *changes* in hours relative to a base year. We therefore choose the value of $\alpha(1-\theta)/(1-\alpha)$ for each country so that the model hours are equal to the data for a base year, which we label as period 0. Hence, we can rewrite (6) as

$$\frac{H_t^p}{(\bar{H}-H_t^p)^{\gamma}}=\frac{(1-\tau_t)}{(1-\tau_0)}\frac{Y_t/[C_t+\lambda G_t-\bar{C}]}{Y_0/[C_0+\lambda G_0-\bar{C}]}\frac{(\bar{H}-H_0)^{\gamma}}{H_0}$$

where H_t^p is model hours.

[7] Tax data are unavailable for Denmark, Ireland, Norway, Portugal, Greece, and New Zealand.

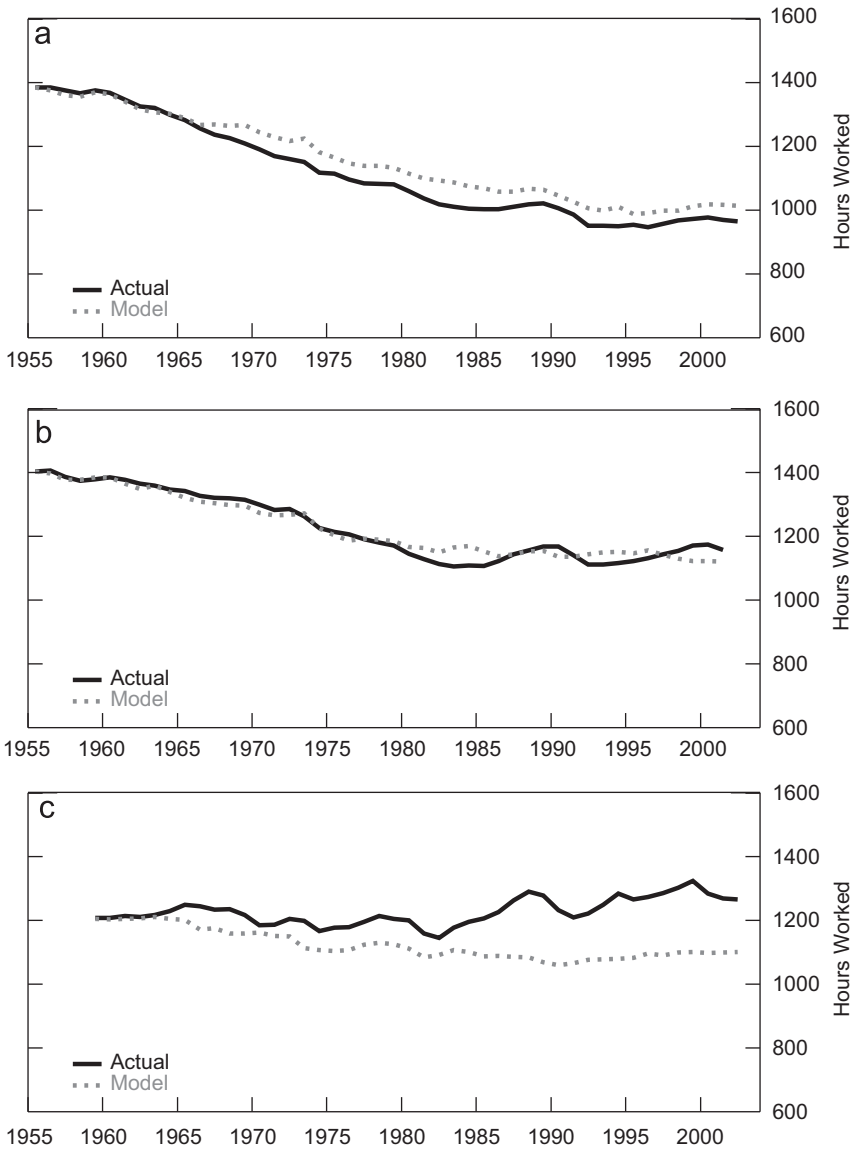

Fig. 1. Groups 1–3 represent an average of the actual and model hours worked for their constituent countries. (a) Group 1 includes Austria, Belgium, Finland, France, Germany, and Italy. (b) Group 2 includes Japan, Netherlands, Spain, Sweden, Switzerland, and the UK. (c) Group 3 includes Australia, Canada, and the US.

In terms of average changes in hours within the groups, the predicted mean percentage changes in hours for Groups 1, 2, and 3 are -27, -20, and -11, respectively, whereas the actual mean percentage changes in hours are -30, -18, and $+1$. This analysis indicates that the standard growth model appended to include taxes and a modest subsistence consumption effect performs quite well in capturing the large differences in trend changes in hours worked across these three groups, both in terms of the overall change in hours, and the timing of the changes.

The analysis is also conducted with the following modifications: (1) households not valuing government consumption ($\lambda = 0$), (2) different subsistence consumption terms ($\bar{C} = 0$ and 10 percent of 1956 US consumption), and (3) different values for the representative worker's labor supply elasticity ($\gamma = 0$ and 2). The results are insensitive to variations in the value of λ, both for group averages and almost all individual countries.

Changing the subsistence consumption term did not impact group average hours very much, though it did matter for countries that were poor at the start of the dataset, such as Japan. As all countries become wealthier over time, however, the impact of the subsistence term declines. Appendix B (available on the website of the journal) presents graphs of model hours for different values of the subsistence term, and shows that the subsistence term is quantitatively unimportant after 1970.

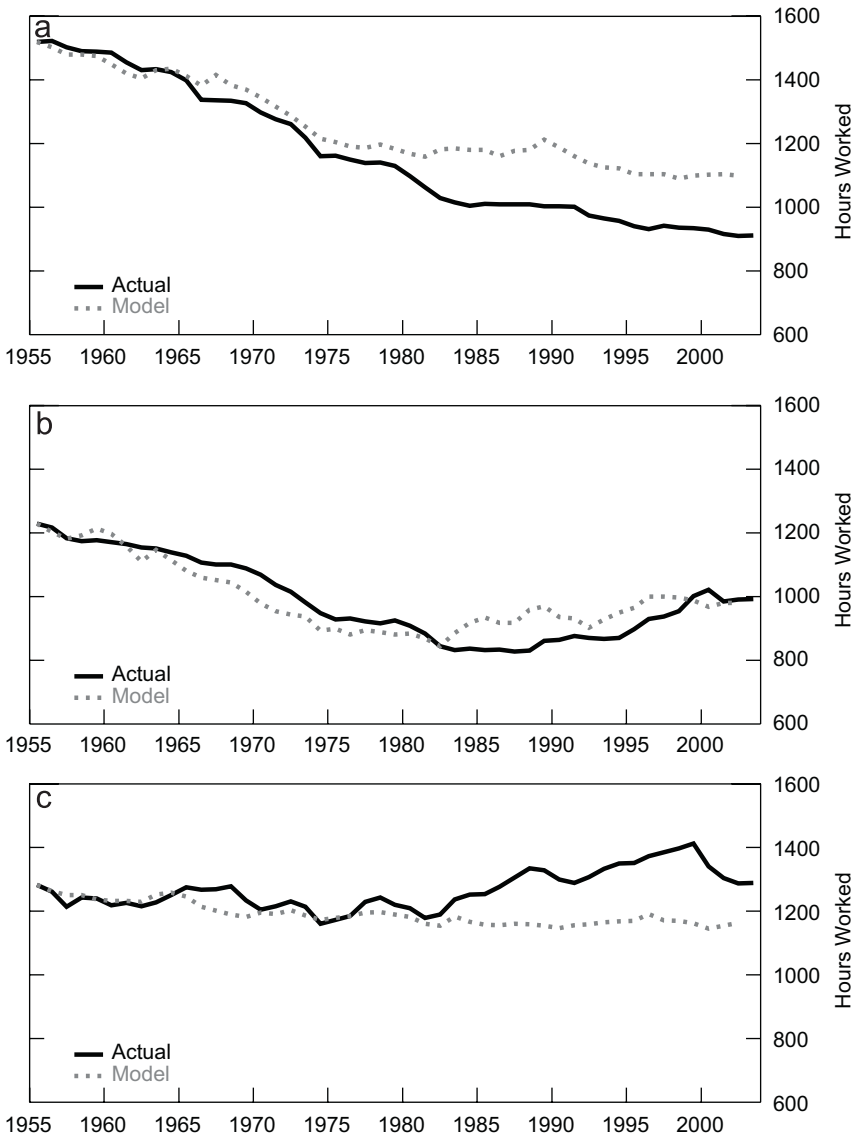

Fig. 2. (a) Germany, (b) Netherlands, (c) United States.

Regarding γ, which governs the labor supply elasticity, the results are robust to the range that is typically used in aggregate analyses, which is roughly $0 \leqslant \gamma \leqslant 2$.[8] Appendix B shows graphs of group model hours averages for the benchmark specification and for these modifications.

4.2. Results for individual countries

This section examines the paths of actual and model hours for selected individual countries in the benchmark specification. To conserve space, we present results for only three countries—Germany, the Netherlands, and the United States—which present patterns that are representative of the different outcomes observed in the data. The time series for these countries are shown in Figs. 2a–c.

The individual country results are consistent with the group results. Predicted hours track actual hours very well in Germany, though in the 1980s model hours do not decrease as much as actual hours. We return on this point in our

[8] It is well known that macro labor elasticities tend to be higher than those estimated in the micro literature. Hansen (1985) and Rogerson and Wallenius (forthcoming) provide different model formulations that can reconcile these differences.

Table 2
Hours worked by decades: actual vs. model

	1960s		1970s		1980s		1990s		1956–2003	
	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model
Group 1	−1.09	−0.70	−1.23	−1.03	−0.60	−0.65	−0.50	−0.66	−0.76	−0.65
Austria	−1.03	−0.70	−1.14	−0.73	−0.22	−0.11	−0.53	−0.68	−0.64	−0.49
Belgium	−1.03	−0.76	−1.64	−1.60	−0.74	−0.09	0.06	−0.25	−0.72	−0.65
Finland	−1.15	−1.03	−0.45	−0.97	0.32	−1.35	−1.31	−0.66	−0.60	−0.79
France	−0.63	−0.29	−1.47	−0.65	−1.53	−0.62	0.11	−0.28	−0.87	−0.38
Germany	−1.09	−0.65	−1.55	−1.43	−1.20	−0.13	−0.74	−0.78	−1.08	−0.68
Italy	−1.60	−0.70	−1.19	−0.70	−0.43	−1.70	−0.16	−1.37	−0.61	−0.92
Group 2	−0.41	−0.59	−1.09	−0.86	−0.21	−0.31	0.00	−0.20	−0.41	−0.48
Japan	−0.39	0.57	−0.47	−0.64	0.14	−0.38	−0.74	−0.65	−0.31	−0.28
Netherlands	−0.65	−1.30	−1.81	−1.59	−0.95	0.80	1.40	0.42	−0.44	−0.45
Spain	0.25	−0.17	−1.67	−1.00	−1.56	−1.25	0.85	−0.21	−0.28	−0.70
Sweden	−1.00	−2.08	−0.36	−1.39	0.54	−1.00	−0.71	0.50	−0.48	−0.76
Switzerland	−0.23	−0.19	−1.26	−0.78	0.31	0.25	0.27	−0.72	−0.39	−0.38
UK	−0.42	−0.68	−1.17	−0.07	−0.22	−0.35	−0.34	−0.06	−0.48	−0.33
*Group*3	0.24	−0.41	−0.16	−0.25	0.64	−0.41	0.10	0.14	0.12	−0.20
Australia	0.11	−0.17	−0.53	−0.87	0.49	−0.33	−0.01	0.14	0.01	−0.31
Canada	0.18	−0.74	0.34	0.08	0.70	−0.58	−0.16	0.21	0.17	−0.24
US	0.29	−0.49	−0.25	0.06	0.73	−0.32	0.46	0.10	0.03	−0.20

Note: Numbers refer to the average percentage change in the decade.

discussion of Table 2. The Netherlands is of particular interest since it is one of a very few countries that exhibits a large trend reversal in hours worked over this period. The figure clearly shows that predicted hours also display the same trend reversal as in the data.

US model hours and actual hours show similar patterns to those in the picture for Group 3, in that predicted hours fall somewhat over time, whereas there is no trend decline in actual hours. Aguiar and Hurst (2006) and Francis and Ramey (2005) provide information that can potentially reconcile the difference between actual and model hours. In particular, they show that in the US there has been a substantial decline in the amount of time devoted to home production. This implies that movements in market hours and leisure are not mirror images of each other.

Specifically, over the period 1956–2003 there has been an increase in leisure time for prime aged individuals in the US, at the same time that time devoted to market work has been relatively flat. The results in Fig. 3 show that the model predicts an increase in leisure time and a decrease in working time. Consistent with this point, in the data one finds that total working time (market plus home) has decreased somewhat over this time period, and that leisure has increased. Lack of cross-country data on time devoted to home production precludes us from incorporating this factor into the analysis, but we note that this factor is not likely to be important for those countries that experienced the largest increases in taxes. Rogerson (2008) shows that the increase in taxes in many European countries created an incentive to substitute home production time for market time, resulting in a relatively flat profile for home production time in these countries.[9]

Table 2 summarizes the actual and model average growth rates of hours worked for each country in each of the four decades in our sample. This table provides information that identifies those episodes (i.e., country-decade pairs) that are most puzzling from the perspective of the theory, and those episodes that are well captured by the theory. For several countries, the model performs very well in tracking total hours worked in all but one particular decade. For example, predicted and actual changes are quite similar in Germany (Group 1) except for the 1980s, and in the UK (Group 2) except for the 1970s. In contrast, Spain (Group 2) is problematic for many periods. Sweden is a case in which the model overpredicts the drop in hours. But recent work by Ragan (2005) and Rogerson (2007) has already offered an explanation for this discrepancy. Specifically, these authors argue that spending programs in Sweden provide subsidies for exactly those activities that higher taxes push out of the market, such as child care and elderly care. In accordance with the earlier discussion, in the case of the US the most problematic decade is the 1980s, since it coincides with the largest increase in hours worked by women (see Rogerson and McGrattan, 1998).

4.3. *The relative contributions of taxes and other model factors*

Eq. (6) shows that model hours change because of changes in taxes, changes in private consumption, changes in government consumption, and changes in output. Absent the subsistence consumption term, the non-tax factors would

[9] Freeman and Schettkat (2005) provide evidence that home production time is currently lower in the US than in many European economies.

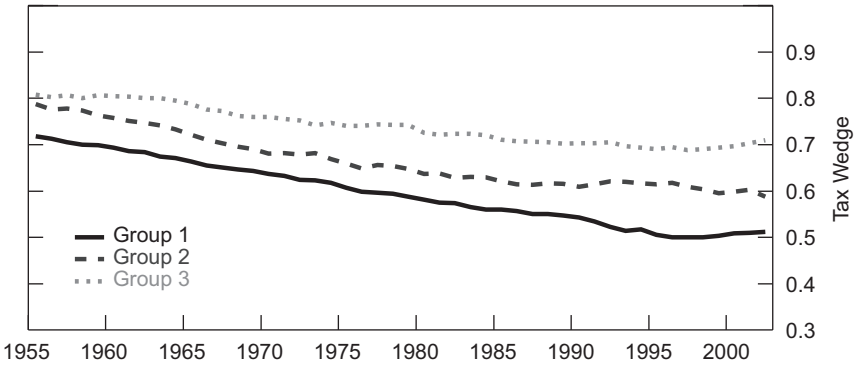

Fig. 3. Evolution of tax wedges, 1956–2003.

affect hours only through changes in the ratios C/Y and G/Y. We now analyze the relative contributions of these different factors. Ohanian et al. (2006) examine this issue in detail, and we summarize those findings here. The main finding is that changes in taxes are by far the dominant factor driving changes in model hours.

Fig. 3 shows why. The figure plots the cross-country average of the tax wedge $(1-\tau_t)$ for each group between 1956 and 2004. There are two striking features in these time series. The first is that taxes rise in all three groups until the mid-1980s/early 1990s, and then stabilize afterwards. This pattern mirrors the fact that hours worked in many countries first decline until the mid-late 1980s, and then stabilize afterwards. The second feature is that the largest tax increase is for Group 1, the second largest for Group 2, and the smallest tax increase is for Group 3. The magnitude of these changes are generally consistent with the magnitude of the changes in hours worked across these three groups.

Regarding the other factors, the consumption–output ratio $((C+G)/Y)$ is not an important factor impacting hours worked, as it changes very little in most countries (for example, it moves by only 0.10 in both Germany and the US). Moreover, the small change in this ratio tends to move hours in the opposite direction relative to the data (see Table 4 in Ohanian et al., 2006). Recall from Section 4.1 that the subsistence term was important only for the poorest countries, and before 1970.

5. Statistical analysis of factors outside the model

There are many institutional, policy, and regulatory factors other than taxes that are considered to influence the determination of hours of work. Incorporating these factors into the theory requires substantial extensions of the model, and thus is beyond the scope of this study. However, we are able to conduct a simple statistical analysis to provide some evidence on the possible importance of these other factors relative to taxes. For this purpose, the *wedge* in the household static first order condition is the percentage deviation between the left and right hand sides of this equation in the model with no taxes:

$$\Delta_t = 1 - \frac{U_2/U_1}{A_t F_2} \tag{7}$$

where all derivatives are evaluated at period t values. A panel regression of this wedge on taxes and institutional factors is fit to assess the relative importance of these variables. Because the wedge is a measure of the extent to which the model without taxes cannot account for the data, this regression provides information about which excluded factors are correlated with the changes not accounted for by the theory. The institutional variables are from Nickell and Nunziata (2001) and include measures of employment protection (EP), union density (UDNET), bargaining coordination (CO and COW), the benefit replacement rate (BRR), and benefit duration (BD). These variables have been used extensively in the literature to capture institutional differences across labor markets and how those differences impact hours worked and unemployment. Our specification is

$$\log(1-\Delta_{it}) = a_i + b\log(1-\tau_{it}) + \gamma' X_{it} + \varepsilon_{it}$$

where Δ_{it} is the time series of wedges, a_i is a country fixed effect, τ_{it} is the tax rate used in our analysis, and X_{it} includes the institutional regressors.[10] Data on the institutional variables are available over 1975–1995 for all 15 countries. The wedge series is calculated using $\gamma = 1$, $\lambda = 1$, $\bar{C} = 0$.[11]

[10] Including a country fixed effect a_i is consistent with the exercise in that we did not impose that the preference and technology parameters α and θ were the same across countries. We also ran the regressions with the variables in levels instead of logarithm. Results are not affected.

[11] Subsistence consumption is mostly relevant in the period 1956–1970, when consumption levels are lower.

Table 3
Regression results

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tax	1.051	1.010	1.101	1.073	1.035	1.076	0.925	1.000
	(0.053)	(0.054)	(0.054)	(0.053)	(0.053)	(0.061)	(0.057)	(0.064)
EP		−0.045						−0.043
		(0.016)						(0.017)
UD			0.239					0.202
			(0.065)					(0.066)
CO				0.075				0.07
				(0.032)				(0.035)
COW					0.028			0.006
					(0.013)			(0.014)
BRR						0.029		0.053
						(0.036)		(0.037)
BD							−0.155	−0.139
							(0.029)	(0.029)
R^2	0.47	0.479	0.485	0.476	0.476	0.471	0.501	0.528

Note: Dependent variable: wedge as defined by Eq. (7). Tax data are from McDaniel (2006). Remaining explanatory variables are from Nickell and Nunziata (2001): EP, employment protection; UDNET, net union density; CO and COW, measures of bargaining coordination; BRR, benefit replacement rate; BD, benefit duration.

Table 3 reports the regression results (HAC standard errors are in parentheses). There are three main findings. First, taxes account for a significant fraction of the statistical variation in the wedge. Second, this finding is robust to the inclusion of the other labor market factors, either individually or collectively. The coefficient on the tax variable changes very little across specifications and is significant at the 1 percent level in all specifications. Third, while several of the other factors are statistically significant at the 5 percent level, they add relatively little marginal explanatory power. For example, the R^2 with only taxes in the regression is about 0.47, and it rises only to about 0.53 with the six additional institutional factors. It is striking that taxes appear to be the most highly correlated of these factors with the wedge.

6. Summary and conclusion

Hours worked per adult in OECD countries have changed considerably over roughly the last 50 years (1956–2004), ranging from a 40 percent decrease in Germany, to small increases in Canada and the US. The neoclassical growth model with (asymptotic) balanced growth preferences, augmented with taxes on labor income and consumption expenditures, broadly accounts for these very different changes in hours worked across OECD countries. Moreover, the vast majority of the changes in hours worked in the model are accounted for by cross-country differences in tax rate changes. The other factors impacting hours worked in the model, including the consumption–output ratio, only have small effects on changes in model hours.

These findings about taxes, using aggregate data, complement the large microeconomic literature on taxes, labor supply, and labor supply elasticities. Blundell and Macurdy (1999) review many microeconomic studies, several of which analyze the impact of taxes on changes in hours, and/or use changes in taxes to infer labor supply elasticities. A number of these studies also find significant effects of taxes on labor supply, which provides additional evidence for the importance of this channel. It is of interest for future research to shed further light on understanding and reconciling the effects of tax changes of hours in both micro and macro data.

While the model closely accounts for changes in hours worked in the countries with the largest hours changes, it tends to underpredict hours in countries with smaller changes in hours, such as the United States, Canada, and Australia. There are also single episodes (consisting of a country-decade pair) that are puzzling from the perspective of the theory. Future work should analyze how additional factors might account for these discrepancies between theory and data.

Appendix A. Data

Data on consumption, government consumption, and GDP are taken from the Penn World Tables (PWT) (Heston et al., 2006). Data on employment and population are from OECD's *Economic Outlook* and *Main Economic Indicators*(OECD, Economic outlook, Main economic indicators). Series for hours worked are from Groningen Growth and Development Centre (GGDC) and The Conference Board (The Conference Board and Groningen Growth and Development Centre, 2008). The adult population include individuals between ages 15 and 64 years old, while hours is the total number of hours worked over the year divided by the average number of people employed.

Appendix B. Supplementary data

Supplementary data associated with this article can be found in the online version at 10.1016/j.jmoneco.2008.09.012.

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