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The Size of Government and U.S.-European Differences in Economic Performance

Gerwin Bell and Norikazu Tawara

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The Size of Government and U.S.–European Differences in Economic Performance

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Abstract

An influential strand of recent research has claimed that large governments in European countries explain their weaker long-term economic performance compared to the U.S. On the other hand, despite these alleged costs, large governments have been popular with electorates. This paper seeks to shed light on this apparent inconsistency; it confirms an adverse effect of taxes on labor supply, but also finds evidence of efficiency-increasing government intervention. However, and especially in the core "Rhineland-model" European countries, actual government policies often depart from such efficient interventions, pointing to the possibility that voters prefer redistribution even at the cost of allocational efficiency.

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[1] Nori Tawara was an intern at the IMF when the paper was written. We thank participants in the IMF-EUR seminar, Javier Arze, Robert Arezki, and Werner Schule for very helpful comments and suggestions. All remaining errors are ours.

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I. INTRODUCTION

How much of a drag is the modern welfare state on economic performance? Many studies have weighed in on this question, mostly focusing on particular elements of government activity, e.g. tax distortions, crowding out, or expenditure effects. One standard approach has been to estimate the disincentive effects of taxes and deduce that lower taxes would imply higher welfare. However, in the context of modern democracies, this argument begs the question why voters prefer an inferior economic outcome (a higher tax burden) instead of voting for parties that would minimize taxes. One obvious answer to this question stems from the fact that taxes are not levied out of malice, but—with a binding government budget constraint—reflect the need to pay for desirable and arguably beneficial government expenditure. Methodologically, a comprehensive framework that ties together the revenue and expenditure effects of government is needed.

The academic debate over the long-term failure of European countries to catch up with U.S. economic performance also points to the need for a better assessment of the economic effects of large governments. Over the last three decades, European countries have not made inroads in closing a gap in per capita income vis-à-vis the US. One line of inquiry has stressed that inherent measurement issues may be presenting a misleading picture (Mahoney and van Ark, 2004). Alesina et al. (2005) point to the role of labor market institutions, while Blanchard (2004) emphasizes the role of differences in tastes. Yet another approach has pointed to the importance of the size of government (Prescott, 2002, 2004).

This paper focuses on the latter, i.e., the role of the size of the public sector, for a number of reasons. First, measurement issues are unlikely to explain the *divergence* in the growth of per-capita GDP between the US and most of Western-Europe over the last 30 plus years. While data revisions based on sectoral accounts do paint a less bleak picture of European performance (Mahoney and van Ark, 2004), they are subject to their own shortcomings (Bell, 2004); also, more detailed micro data on firm productivity tend to support the more vibrant growth of productivity in U.S. firms (Bartelsman, 2004). Similarly, a strong role for labor market institutions, while intuitively plausible, is not supported by the inconclusive empirical evidence (Rogerson, 2005). Finally, an explanation based on tastes is even more problematic as tastes are—almost by definition—unobservable. At best, their relevance as an explanatory variable is assessed as a residual item after having explained the contribution of other factors, such as the size of government.

The literature studying the impact of government on economic performance is large. Theory has focused on welfare effects—stressing the distortionary impact of taxation and government spending on the one hand, and market failures on the other—but is typically less concerned with analyzing macroeconomic aggregates. In contrast, empirical work (reviewed, e.g., in Garcia-Escribano and Mehrez, 2004) has offered insights into this matter, but has only imperfectly addressed the direction of causality.[2] Moreover, owing to the non-

[2] For example, work in the early 19th century posited a positive relation between per capita income and public expenditures (the so-called “Wagner’s Law”).

stationarity of the relevant time series data, most econometric work has looked at the effects of government on economic *growth* rather than income *levels*.

This paper has two broad parts. First, sections II and III, employ a general equilibrium cross-country quasi-accounting framework based on Prescott (2002), which explicitly tracks the effects of the size of government on the *level* of national income. These predicted effects are then contrasted with data from a much wider, but contemporaneous, sample than considered by Prescott. It turns out that Prescott's model offers a surprisingly good description for key euro zone economies, but does not perform well elsewhere. The second part of the paper steps out of Prescott's setting and explores several richer partial-equilibrium specifications that produce some evidence that government spending can raise economic efficiency. However, observed government sizes generally tend to be too large, thus depressing welfare in many countries, or actual policies depart from allocationally optimal ones, especially in the "Rhineland-model" European economies. Recent policy reforms in these countries have centered on redressing these shortcomings.

II. The Basic Model

Following Prescott (2002), we assume a perfectly competitive world economy. Countries are indexed by i and time periods by t. Each consumer derives utility from consumption and disutility from work according to the following utility function, which is added over the entire working-age population:

$$(1) \qquad U = \sum_{t=0}^{\infty} \beta^t N_{it} \left(\log c_{it} + \alpha \log\left(T - h_{it}\right)\right)$$

where T>0 is a time endowment per period,[3] $\beta \in (0,1)$ is the discount factor, N_{it} is the working-age population, c_{it} is a representative individual's consumption, h_{it} is that individual's hours worked, and $\alpha > 0$ is a parameter capturing the preference for leisure.

Overall output Y is either consumed (C = c*N) or invested (Y-C = I). Investment is added to the capital stock K, which depreciates at a constant rate δ. Production is constant returns Cobb-Douglas with inputs K and aggregate hours (H=h*N) and a country specific production efficiency parameter A. In what follows, it is assumed that A is determined by policies. Hence, the resource constraint (technology) is given by:

$$(2) \qquad C_{it} + K_{i,t+1} - (1-\delta)K_{it} = \left(A_{it}\gamma^t\right)^{(1-\theta)} K_{it}^{\theta} H_{it}^{(1-\theta)}$$

[3] With time endowment T, T-h measures leisure. The representative agent's time endowment may be thought of as the total amount of time in a given period (say, a week) minus time needed to meet the basic human biological requirements for rest and nutrition. For example, Prescott assumes the weekly time endowment to equal to 100 hours, so that a work week of 40 hours would imply 60 hours of leisure.

By assuming a constant population growth rate η (such that $N_t = N_0\eta^t$) and a constant country specific productivity parameter A, the economy's growth path will also be constant and all economic variables (expressed in per-capita, or more precisely, per working-age-population-member terms) will grow at the technological rate of growth γ, except for hours worked, which will remain *constant*.[4] Let lowercase letters denote variables per working age population. These results permit a simple accounting framework, based on per working-age-population quantities by taking logs for every country i:

(3) $$\log y_t = \gamma * t + \log A_t + \left(\frac{\theta}{1-\theta}\right)\log\left(\frac{k_t}{y_t}\right) + \log h_t$$

In other words, the log of output can be decomposed into four factors:

trend (technological) growth:	$\gamma * t$
productivity:	$\log A_t$
capital:	$\frac{\theta}{1-\theta}\log\frac{k_t}{y_t}$
and labor:	$\log h_t$

These elements form the basis of an accounting framework. In steady state, per working-age-population output will grow at the exogenous long-run rate of growth γ and all other factors will remain constant. In what follows, it is assumed that the long-run growth rate (or technological progress) is exogenous to policies and is set at its US 20th-century average of 2 percent. Under this assumption, Table 1 shows the deviation of these factors from the US levels over 1970–80 and 1990–2002 periods.

[4] This latter result is due to the specification of the utility function. It is well known that a balanced growth path is consistent with utility functions of the form:

$$U = \frac{c^{1-\gamma}}{1-\gamma}$$

of which the above log-utility function is a special case (in which $\gamma \rightarrow 1$). This utility function implies that the income and substitution effects exactly offset each other (see Appendix I). Models have adopted this assumption in order to reconcile the historical patterns of (sharply) rising real wages and not very varying per-capita hours worked (see Hall, 1997). With this utility function underpinning most equilibrium macro models, it is unsurprising that so far no formalization of the Blanchard argument, that stresses the importance of income over substitution effects, has been forthcoming.

Table 1. GDP Level Accounting Relative to the U.S.
(In percentage point deviation from the U.S.)

		GDP per working-age person	Labor Factor	Capital Factor 1/	Productivity Factor
Belgium	1970-80	-26	-21	-3	-3
	1990-2002	-26	-51	-4	28
Finland	1970-80	-43	-1	4	-47
	1990-2002	-39	-23	18	-33
France	1970-80	-23	-10	3	-17
	1990-2002	-30	-35	23	-18
Germany	1970-80	-17	9	4	-30
	1990-2002	-32	-43	16	-5
Italy	1970-80	-39	-10	-6	-23
	1990-2002	-39	-29	9	-19
Japan	1970-80	-42	38	-12	-68
	1990-2002	-26	16	10	-52
Netherlands	1970-80	-22	4	4	-29
	1990-2002	-32	-25	19	-25
Norway	1970-80	-32	4	7	-43
	1990-2002	-16	-15	21	-23
Spain	1970-80	-60	9	2	-70
	1990-2002	-63	-24	25	-64
Sweden	1970-80	-23	11	-4	-30
	1990-2002	-32	-4	4	-32
Switzerland	1970-80	12	22	12	-21
	1990-2002	-13	7	16	-36
U.K.	1970-80	-39	23	2	-64
	1990-2002	-39	4	-2	-41

Source: Authors' calculations.

1/ Measured by net capital stock, without correcting for degree of utilization.

The labor factor explains the bulk of lower incomes in Europe of the last decade. Indeed members of the euro zone, rather than "Europe" *per se*, appear most associated with depressed labor supply. For example, of the Nordic countries, only Finland has depressed labor supply (unfortunately data deficiencies prevent the accounting for Denmark). Conversely, the U.K.'s underperformance is due to large productivity deficiencies, similar to those observed in Japan, while labor supply is actually higher than in the U.S.

The next step is to model government policies in this framework. For the purposes of the current analysis, it is convenient to specify policies as affecting such factors as productivity,

capital and labor and thereby the steady state level of per capita GDP: regulation (e.g., in labor and product markets) will impact productivity while taxation will affect the capital and labor factors. The latter is also particularly affected by the disincentive effects of marginal income taxes on labor supply, which will be explicitly modeled in the following.

III. The Economic Effects of Government

In a basic macroeconomic model, "government" may be decomposed into two elements: spending and revenues.[5] With respect to the latter, and taking account of the respective tax bases, one may distinguish consumption taxes, labor income taxes, and capital (income) taxes (conceptually both on the capital stock and investment). In a similar vein, government spending may be on public goods, substitutable for private consumption (or alternatively transferred back to households), or straightforward waste.

A. The Base Case

In the first instance, we assume that government consumption is a perfect substitute for private consumption, or as in Prescott (2002) that all government revenue is instantaneously transferred back to households. The representative household's (inter-temporal) budget constraint is then:

$$(4) \qquad \sum_{t=0}^{\infty} p_t N_t \left((1+\tau_{ct})c_t + (1+\tau_{it})i_t - (1-\tau_{ht})w_t h_t - r_t k_t + \tau_{kt}(r_t - \delta)k_t - TR_t\right) \leq 0$$

where p_t is the inter-temporal price faced by the household; r_t is the rental price of capital; w_t is the wage rate; τ_c, τ_i, τ_h, τ_k are the tax rates on consumption, investment, labor income and the capital income, respectively, and TR_t is the lump sum transfer from government to households.

Alternatively, one could assume that part of government consumption is not substitutable, but either wasted or spent on public goods. Unfortunately, the present model does not permit distinguishing waste from public goods. Moreover, given the arbitrariness involved in specifying un-substitutable government consumption, the following analysis adopts the baseline case.[6]

Within any time period, optimal allocation implies that the marginal rate of substitution between leisure and consumption is equal to the marginal product of labor. Dropping the time subscripts:

[5] The current analysis is concerned with long-run equilibrium and therefore adopts a steady-state specification in which deficits will not be possible.

[6] In an alternative quantification, Prescott (2004) subtracts military expenditure from current expenditure.

(5) $$(T-h)=\frac{\alpha c}{w}\left[\frac{1+\tau_c}{1-\tau_h}\right]$$

with the last term in square brackets interpreted as the (*intra*-temporal) tax wedge:[7]

From the constant returns to scale production function, the share of labor income out of output is $1-\theta$:

(6) $$w=(1-\theta)\frac{y}{h}$$

Combining equations (5) and (6), one obtains the following *key condition*:

(7) $$h=\left[T+\frac{c}{y}\frac{\alpha}{(1-\theta)}\frac{1+\tau_c}{1-\tau_h}\right]^{-1}$$

This condition for optimum labor supply can also be expressed in terms of the effective marginal labor tax rate, defined as:

(8) $$\tau\equiv\frac{\tau_h+\tau_c}{1+\tau_c}$$

Thus equation (7) may be expressed as:

(9) $$h=T\times\frac{1-\theta}{1-\theta+\frac{c}{y}\frac{\alpha}{1-\tau}}$$

In this form, hours worked are a function of the intra-temporal tax wedge, the labor share in the production function, preferences, and the consumption share. The term c/y captures all *inter*-temporal optimization decisions of households (as they relate to savings and investment). What matters for an analysis of the impact of government then is the effect of the tax wedge.

The Tax Wedge

Equation (9) implies that a higher tax wedge results in lower hours worked. Moreover, the equation can be used to predict hours worked as a function of the tax wedge. By comparing the difference between the predicted and actual hours worked, one can then obtain a measure of the actual relevance of the proposed theoretical model, that avoids many of the data and

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[7] This is the fraction of additional labor income that is claimed in taxes, if investment is held fixed. It is important to note that the tax wedge is thus not limited to income taxes alone, as consumption taxes also affect the labor-leisure choice, a fact at times overlooked in discussions of employment-friendly tax reforms.

methodological pitfalls in macro-econometric work (in addition to Prescott's work, see Mulligan (1998) and (2002), for example).

In a first step, the actual tax wedge needs to be calculated. As the analysis aims at a cross-country perspective, and because it is important to include the impact of consumption taxes (see footnote 6), the relevant tax rates will have to be estimated from national accounts data (following Mendoza, Razin, and Tesar, 1994) instead of—what would at least theoretically be more attractive—deriving them from detailed tax assessment data. In order to adhere as closely as possible to Prescott's (2002) framework:

(10) $$IT_C \equiv \left(\frac{2}{3}+\frac{1}{3}\frac{C}{C+I}\right)IT$$

Consumption taxes are defined as (net) indirect taxes, (indirect taxes minus subsidies) i.e. adjusted for the possibility of some indirect taxes being levied on investment (I and C denote the national account aggregate levels of investment and consumption, respectively, with consumption including government consumption, but excluding indirect taxes and subsidies). The estimated consumption tax is thus:

(11) $$\tau_c \equiv \frac{IT_C}{C-IT_C}$$

Labor income taxes are more problematic and constitute the sum of the *marginal* tax rates for social security contributions τ_{ss} and the personal income tax τ_{pi}. Social security contributions are treated as a tax[8] and, given that they are usually set at a flat rate, the marginal tax rate is defined to equal the average tax rate (i.e., social security tax revenue (SST) divided by economy-wide labor income):

(12) $$\tau_{ss} \equiv \frac{SST}{(1-\theta)(GDP-IT)}$$

The *average* personal income tax rate is similarly defined as the ratio between direct taxes (DT) and income (GDP, excluding net indirect taxes and depreciation):

(13) $$\bar{\tau}_{inc} = \frac{DT}{GDP-IT-Dep}$$

[8] There is some debate as to whether PAYGo pension contributions instead constitute savings. If there is some actuarial component to the contributions, it should indeed be perfectly substitutable to private savings. Disney (2004) estimates internal rates of return of PAYGo systems between *minus* ½ percent for Switzerland and positive 3.6 percent for Spain, with the OECD average at only 1.2 percent, thus adding support for the treatment of social security contributions as a tax, albeit not in all countries.

With progressive tax schedules, marginal tax rates will be higher than average ones. Based on US data, Prescott (2002) assigns a multiplier of 1.6 to account for this difference so that the marginal labor tax rate is defined as:

$$(14) \qquad \tau_h = \tau_{ss} + 1.6 * \bar{\tau}_{inc}$$

The Preference for Leisure and the Labor Share

Next, a value for the leisure preference parameter α needs to be chosen. Again, in order to facilitate a comparison with Prescott's (2004) analysis, we adopt his choice, $\alpha = 1.54$.[9] Note, that this parameter is assumed to be the same across countries. We calibrate the capital share at 0.3.

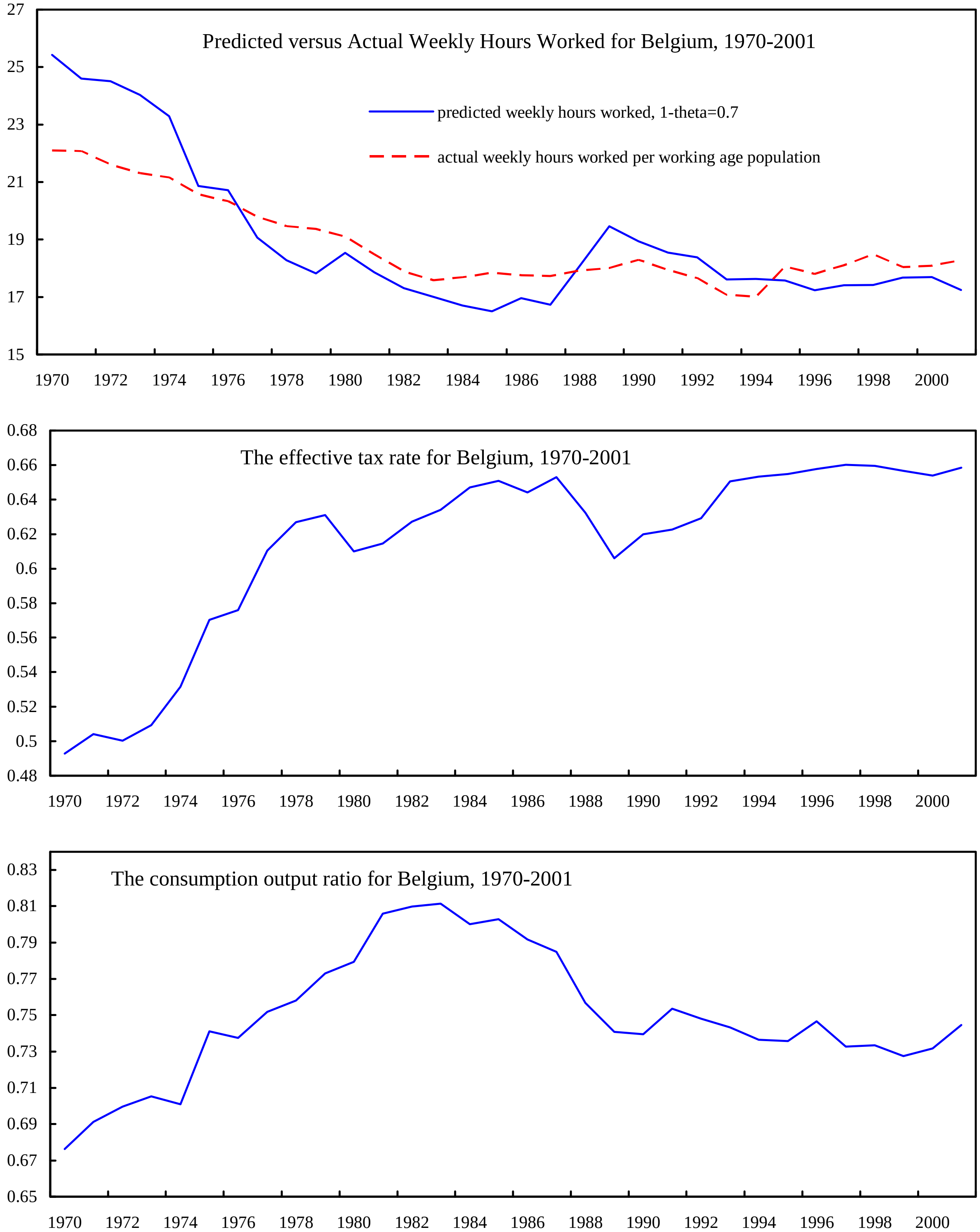
B. The Welfare Effect of Government in International Perspective

With the tax wedge, leisure preference and technology defined, equation (9) can be used to predict labor supply. To make real world data correspond to the model economy, the hours-worked measure is defined as annual hours worked in the business sector, divided by 52 and multiplied by the employment rate of the population aged 15–64. For all countries in our sample, Figure 1 depicts actual and predicted hours worked, the marginal effective tax rate, and the consumption share. In general, the model appears to fit reasonably well, especially for France and Germany, while it appears clearly mis-specified for the U.K., Denmark, Sweden, Switzerland, i.e., the very countries whose labor supply does not appear particularly depressed based on the accounting framework in Table 1, and—perhaps surprisingly—the U.S. In addition, the model describes observed behavior better in the more recent past, as evident in Italy, Greece and the US.[10]

[9] Prescott (2004) chose this number so that an average of predicted hours worked over *his* sample matches its observed counterpart. Note, though, that the analysis in the current paper adopts a different definition of consumption from Prescott's, excluding military expenditure from government consumption (to broaden the sample to countries, where data on defense spending are not available). Thus, it can be argued that a different value for the leisure preference parameter should have been selected for the current analysis, as with higher government (and by, virtue of perfect substitutability, lower private) consumption, labor supply would be lower. On the other hand, choosing a different parameter would have made a comparison of our results with Prescott's harder. To gage the magnitude of the difference, it is, of course, possible to compare our predictions to Prescott's for any country that is present in both samples, i.e., France. In the event, predicted hours worked for France in our sample are only slightly below Prescott's.

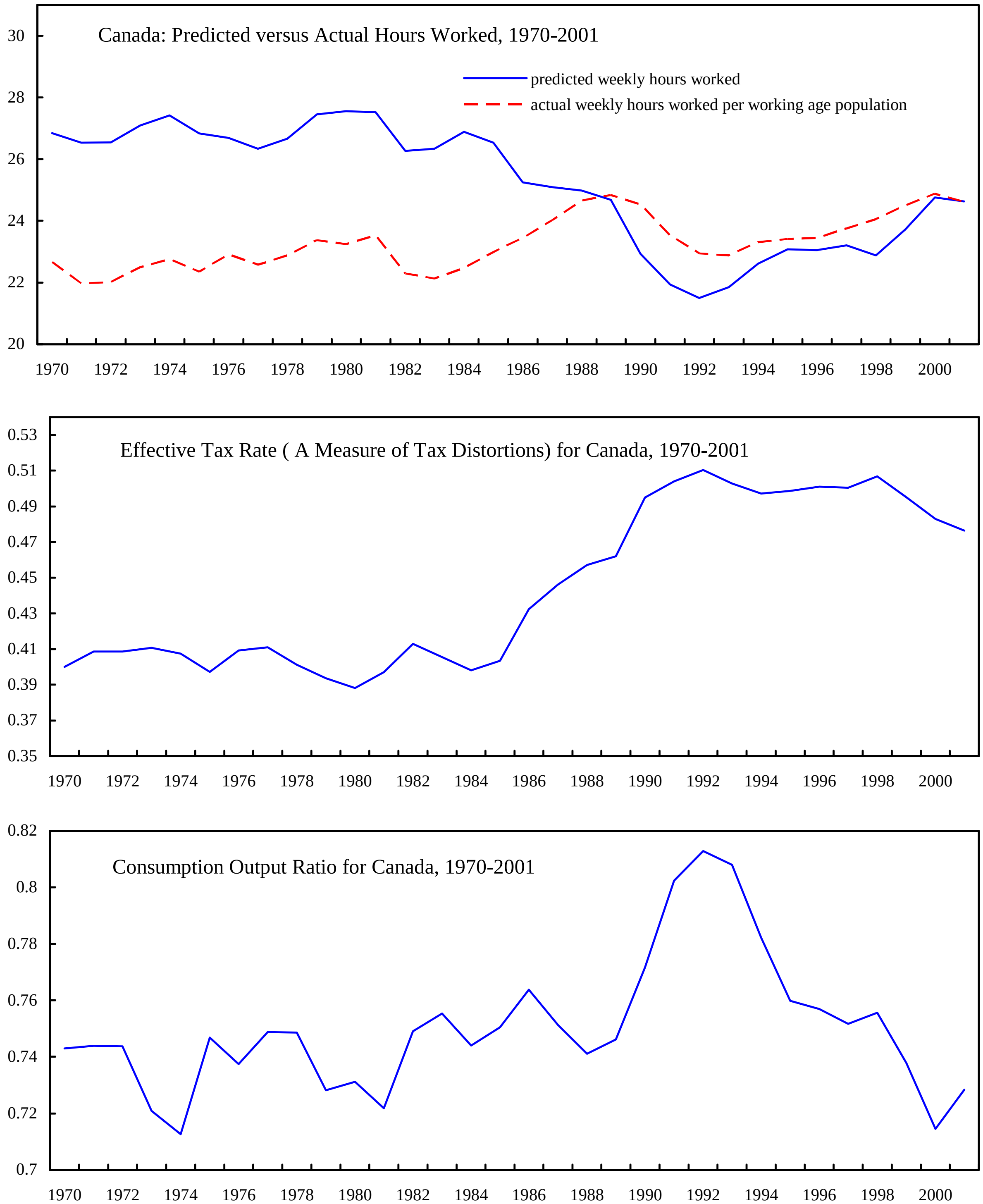
[10] The improving fit of the model over the 1980s for the U.S. appears somewhat at odds with Mulligan's (2002) analysis, which, to the contrary, finds labor supply during the 1980s to have become too high to be explained by taxes. This points to a problem underlying such calibration exercises, where structural parameters—in the current context, notably the leisure preference parameter and the labor share—are chosen to fit different samples (in our case, OECD countries 1970-2000, in Mulligan's more than a century of US data).

Figure 1a. Belgium



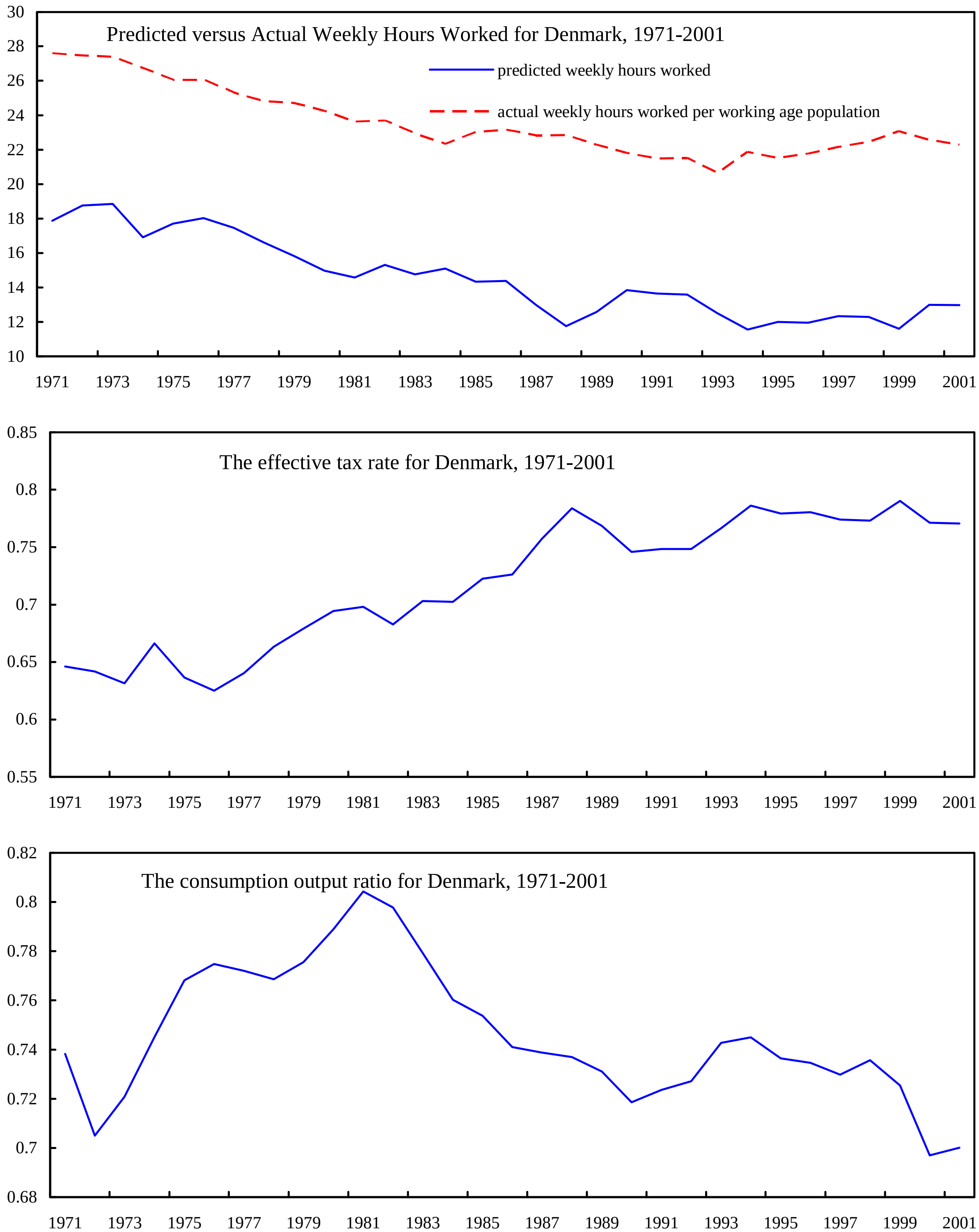
Source: Authors’ calculations.

Figure 1b. Canada



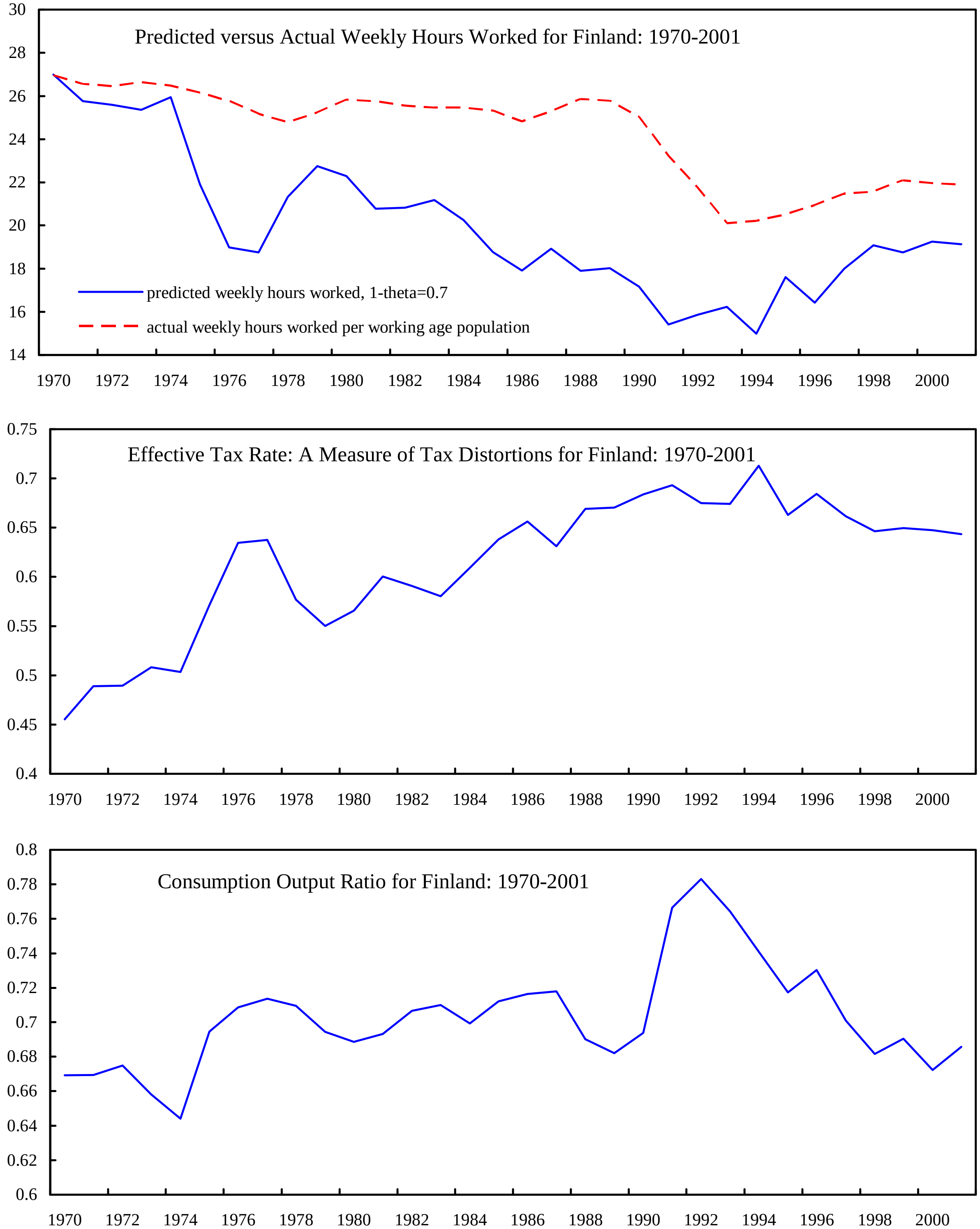
Source: Authors' calculations.

Figure 1c. Denmark



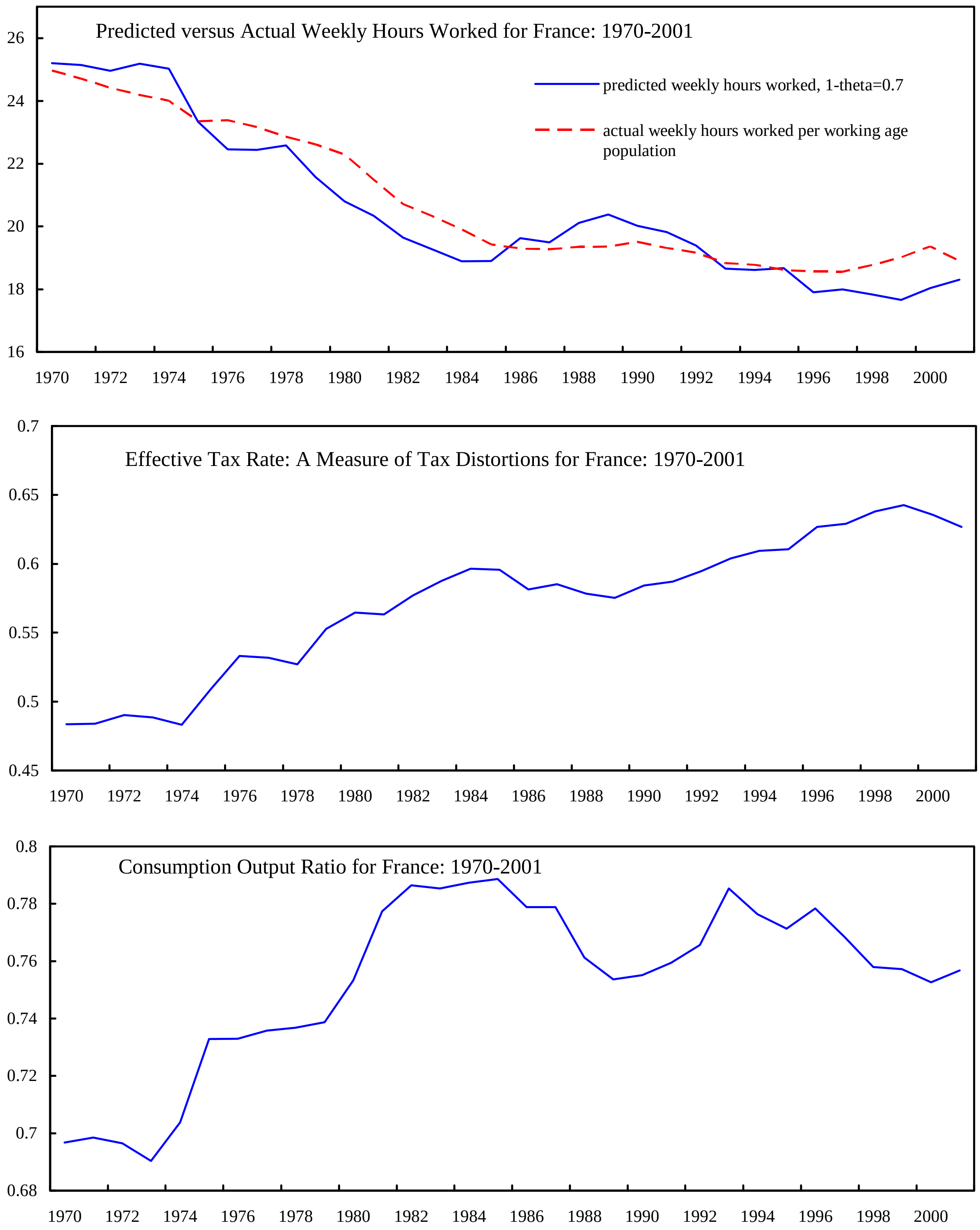
Source: Authors' calculations.

Figure 1d. Finland



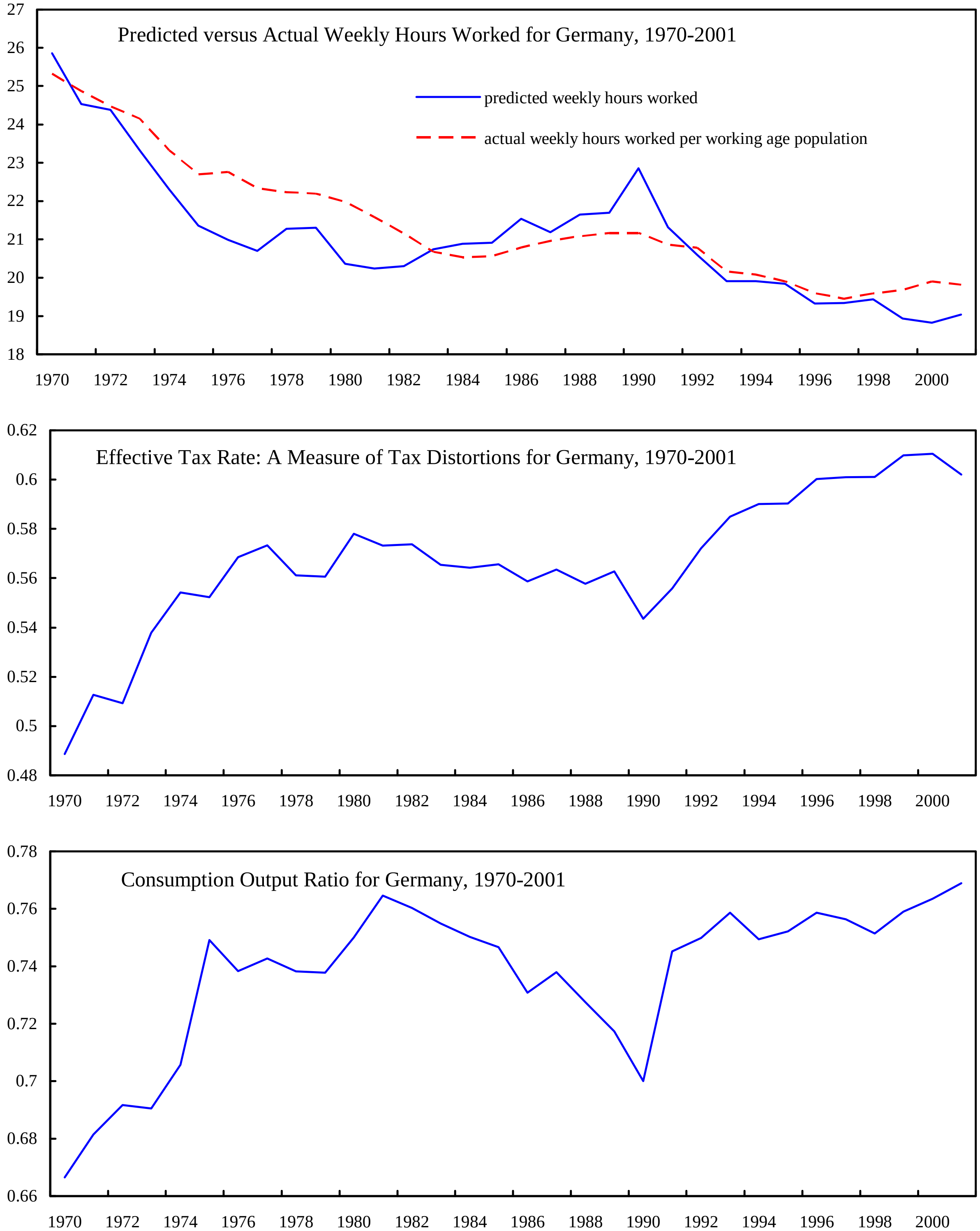
Source: Authors' calculations.

Figure 1e. France



Source: Authors' calculations.

Figure 1f. Germany



Source: Authors’ calculations.

Figure 1g. Greece

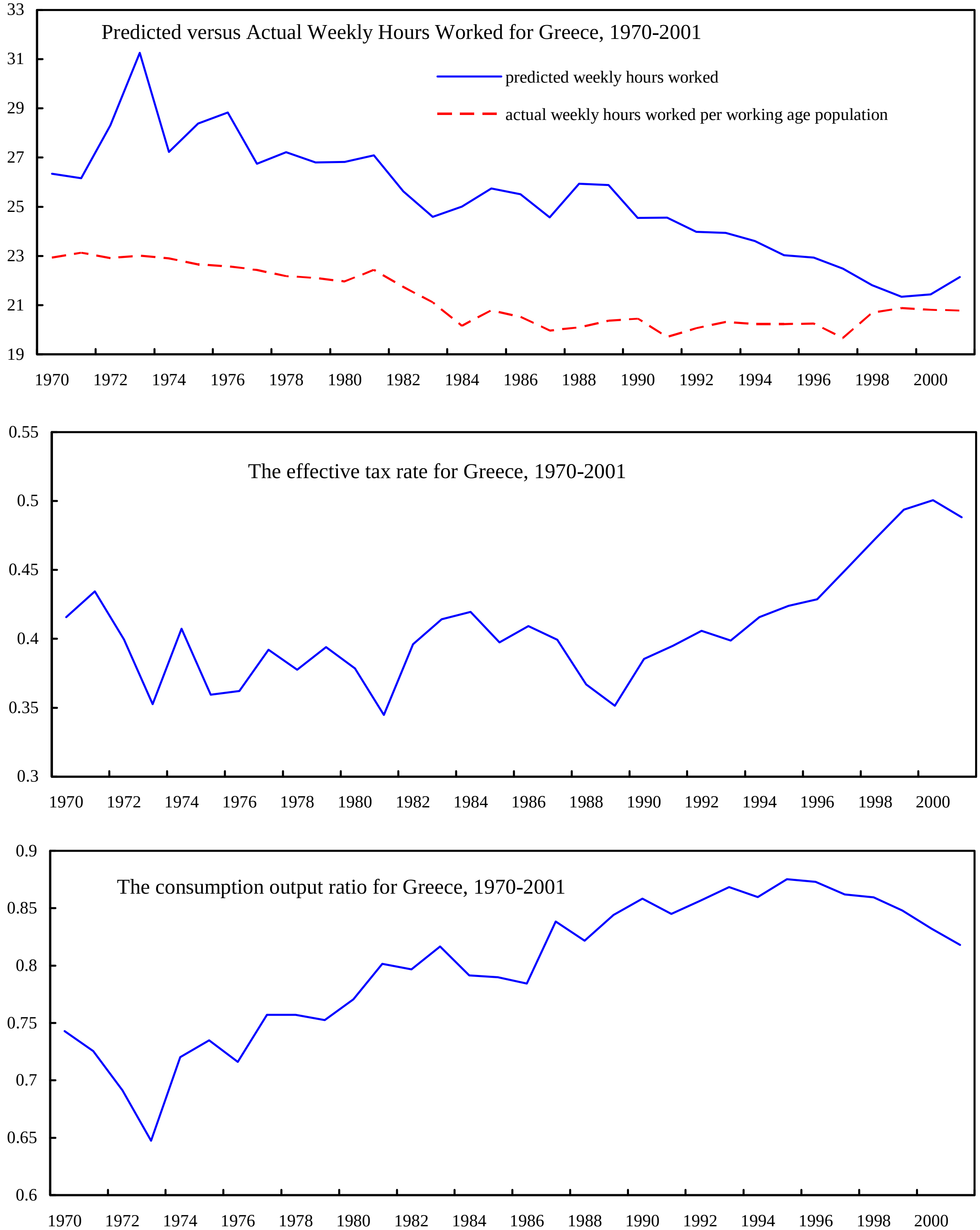


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Figure 1h. Italy

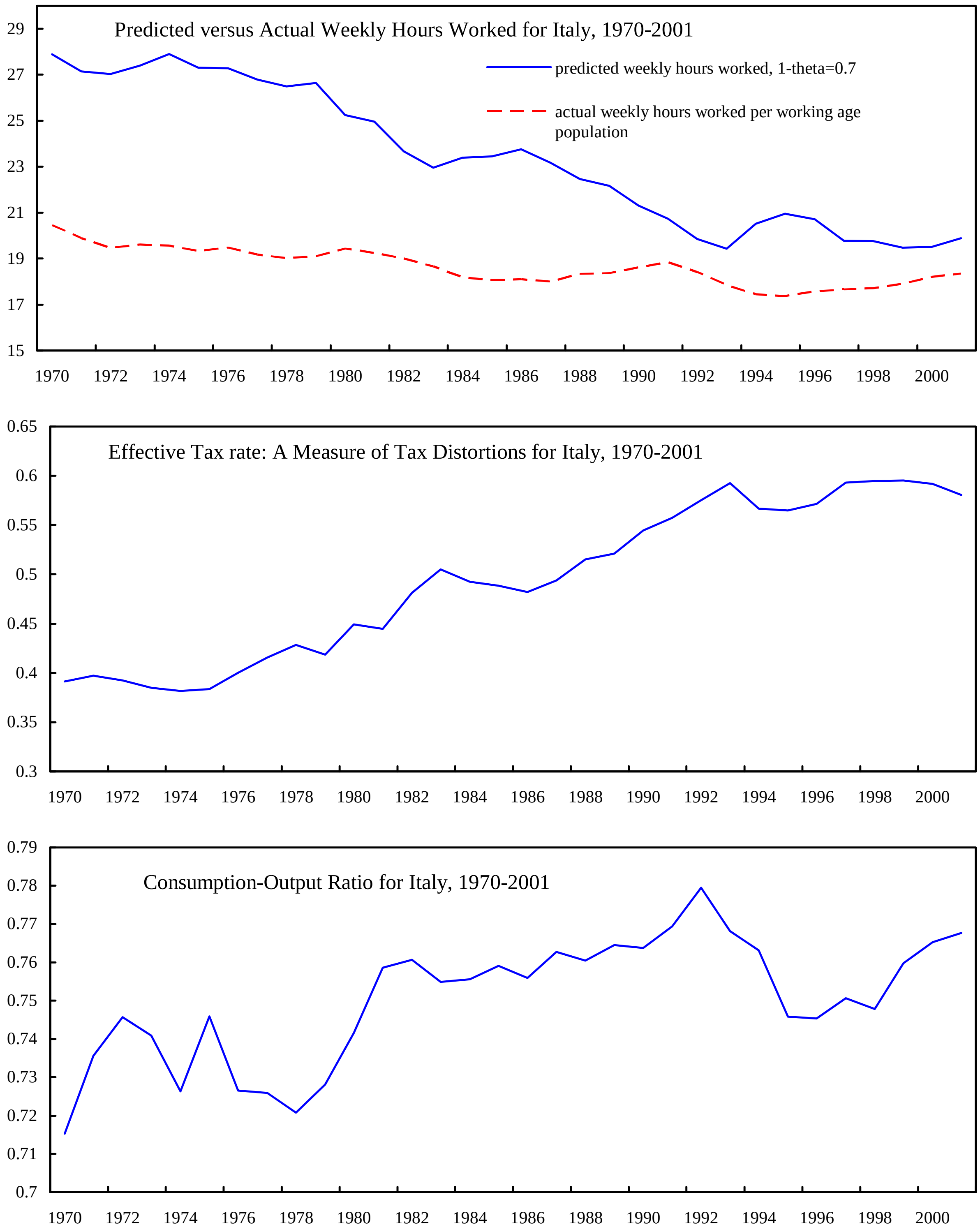

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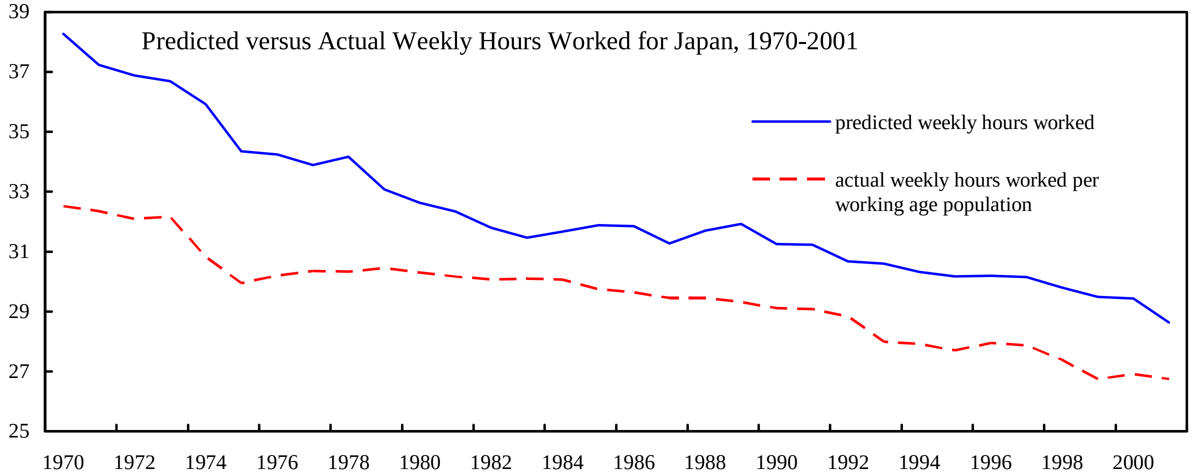
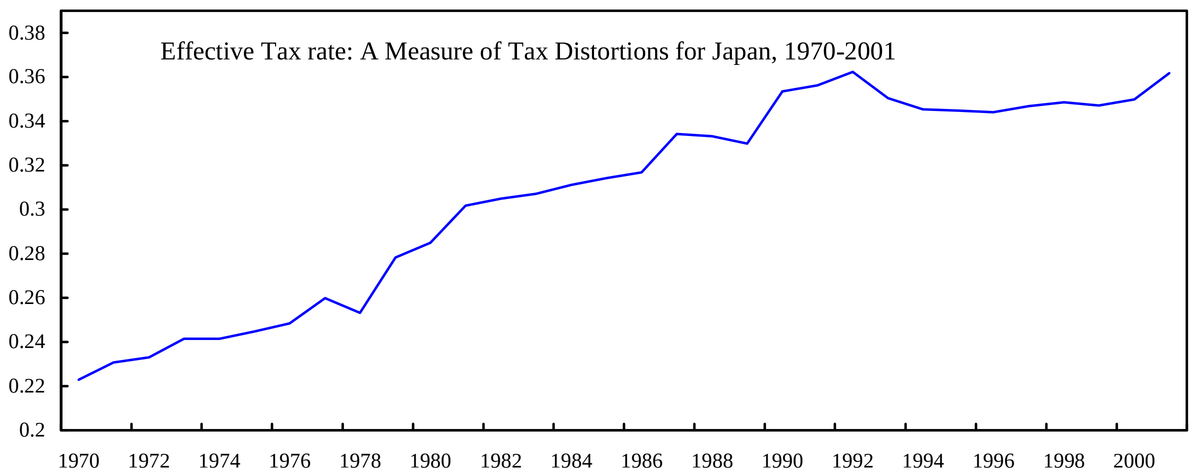
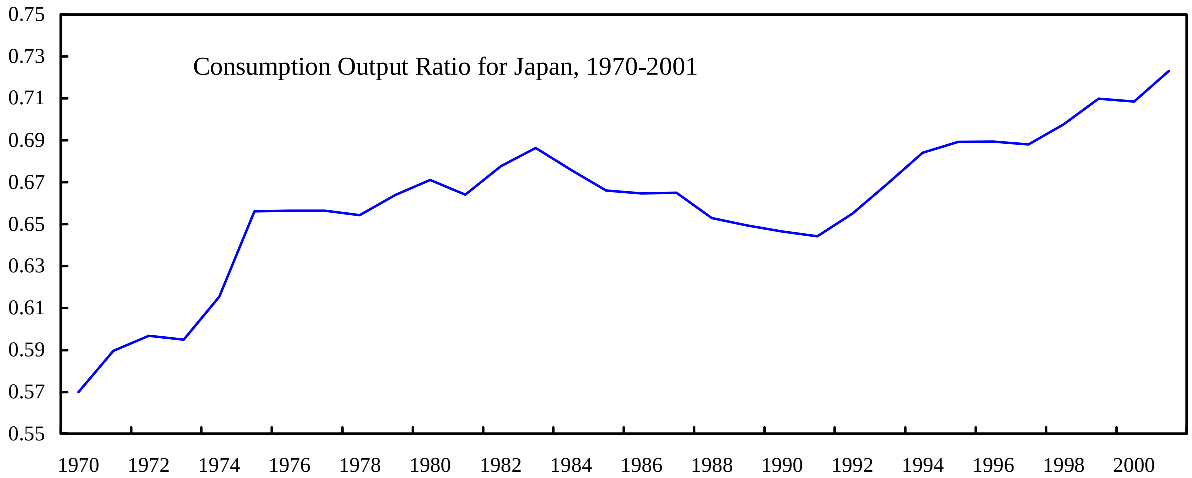
Figure 1i. Japan

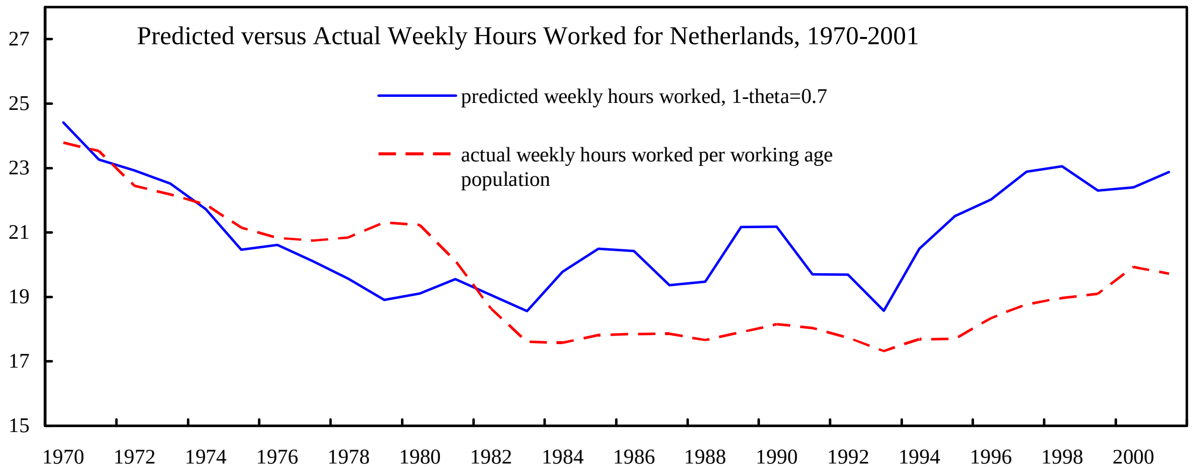


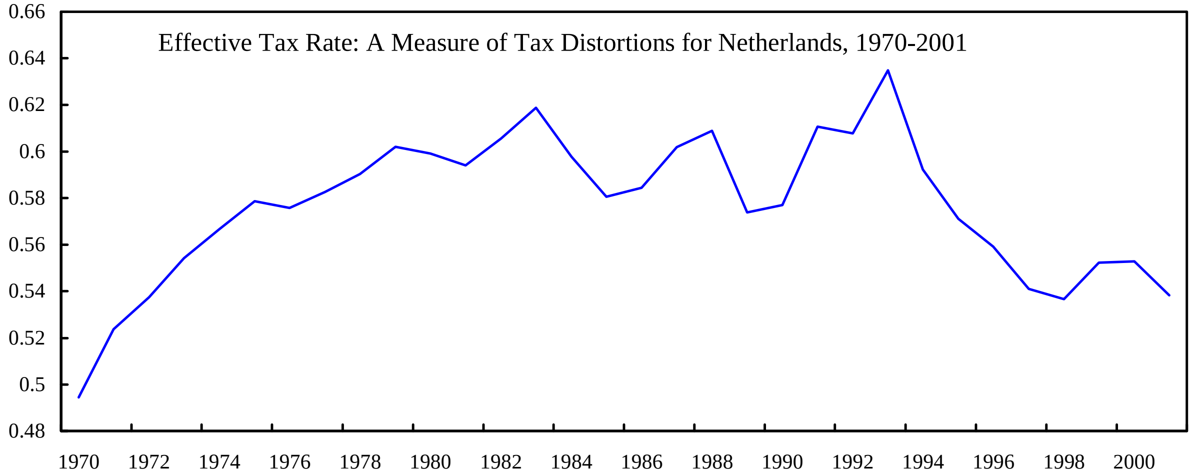


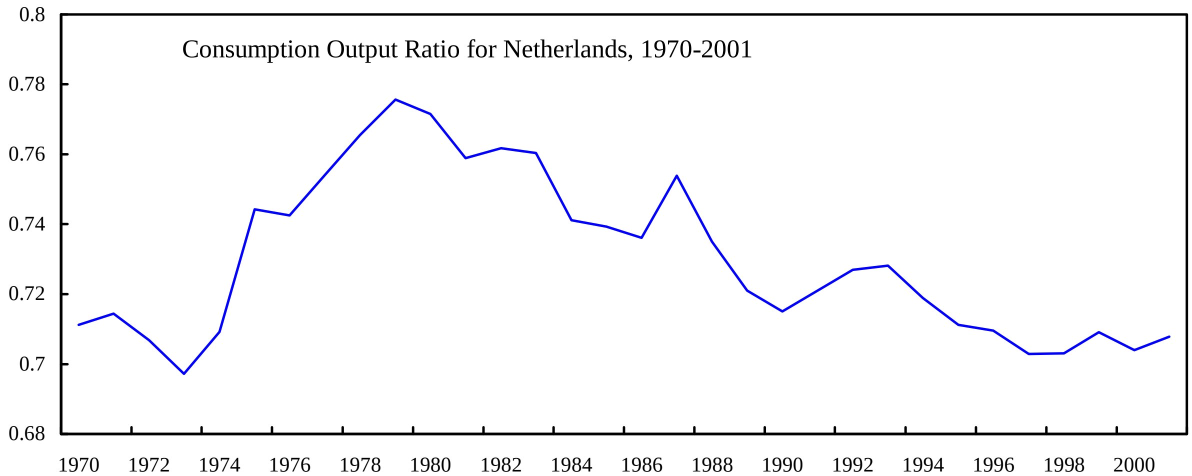


Source: Authors' calculations.

Figure1j. Netherlands

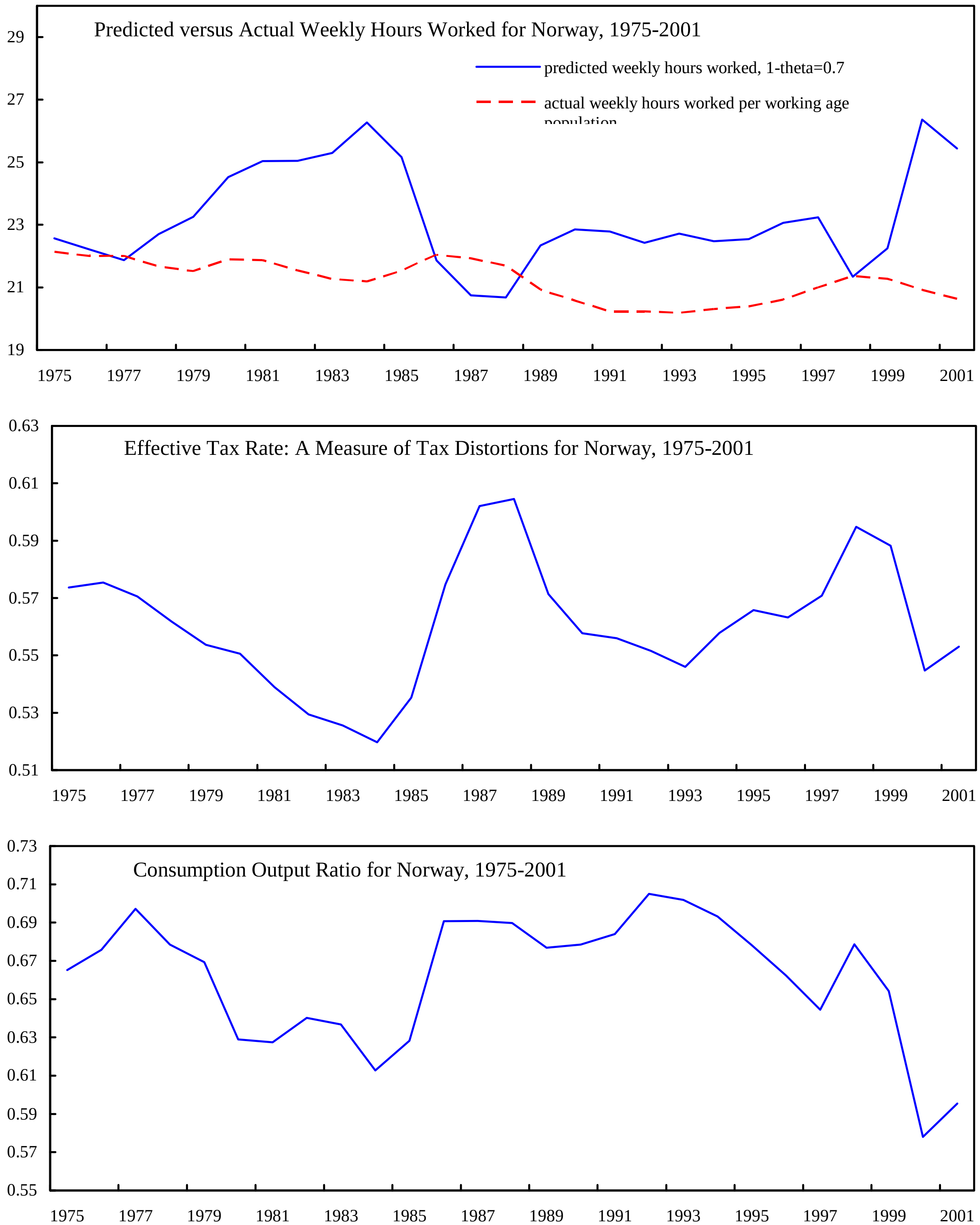






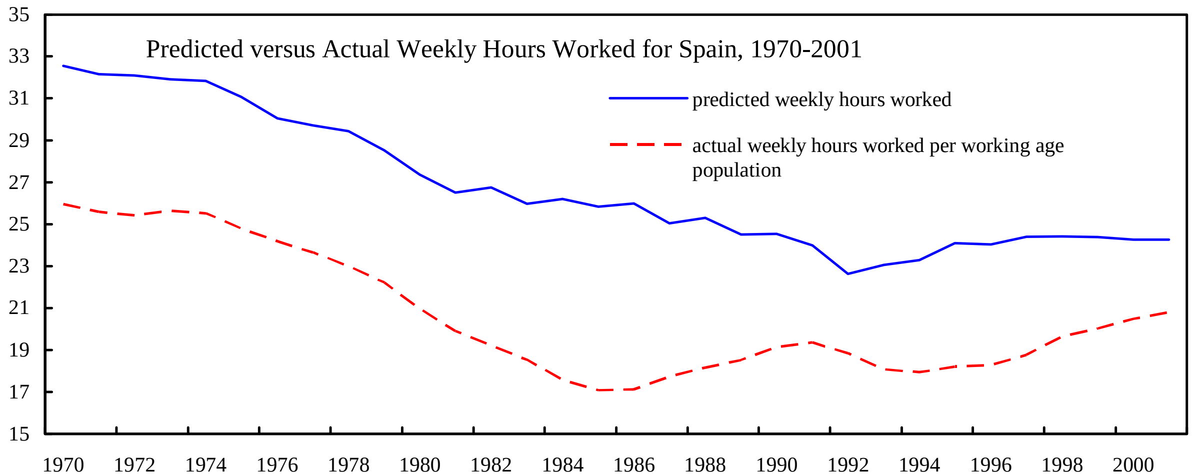
Source: Authors' calculations.

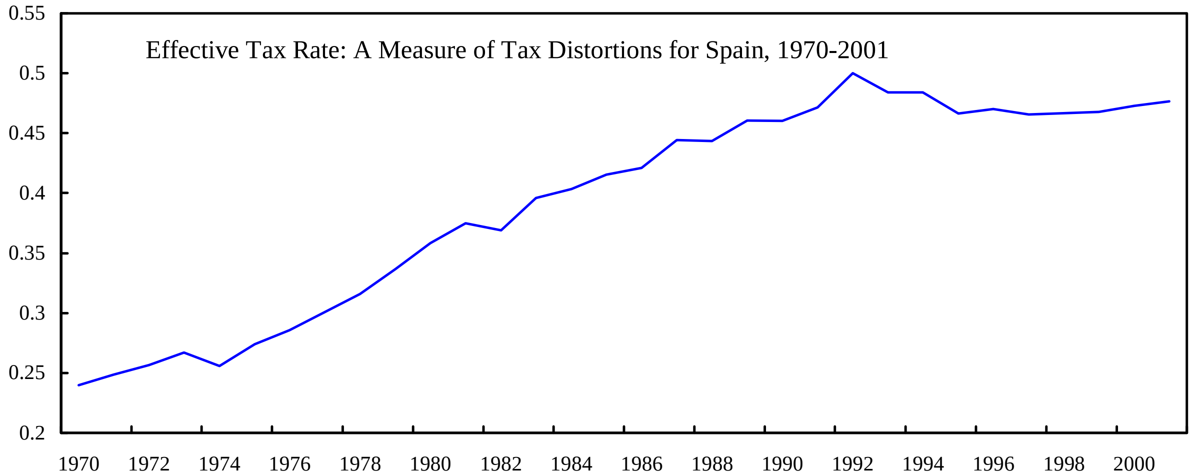
Figure 1k. Norway

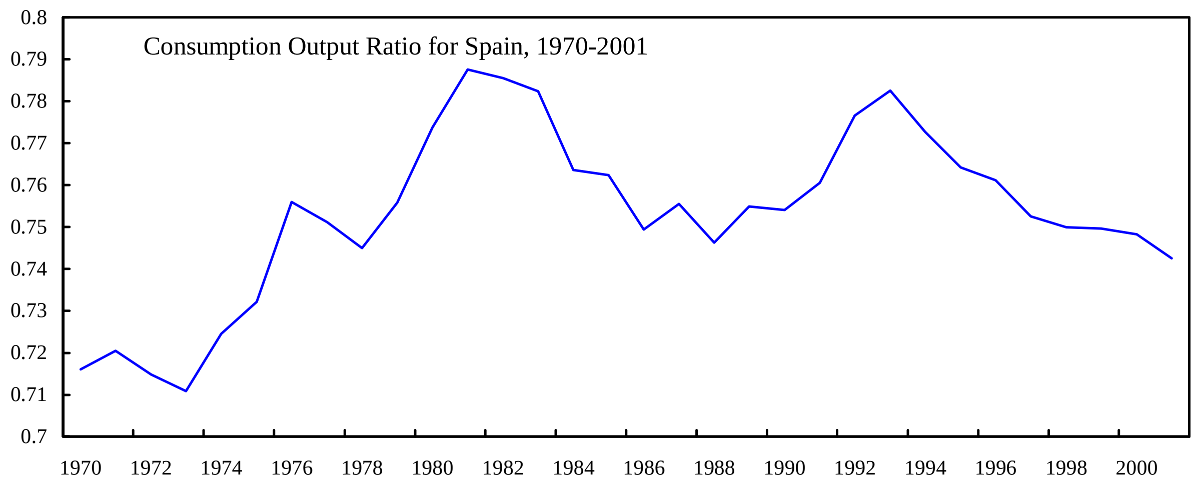


Source: Authors' calculations.

Figure 1l. Spain

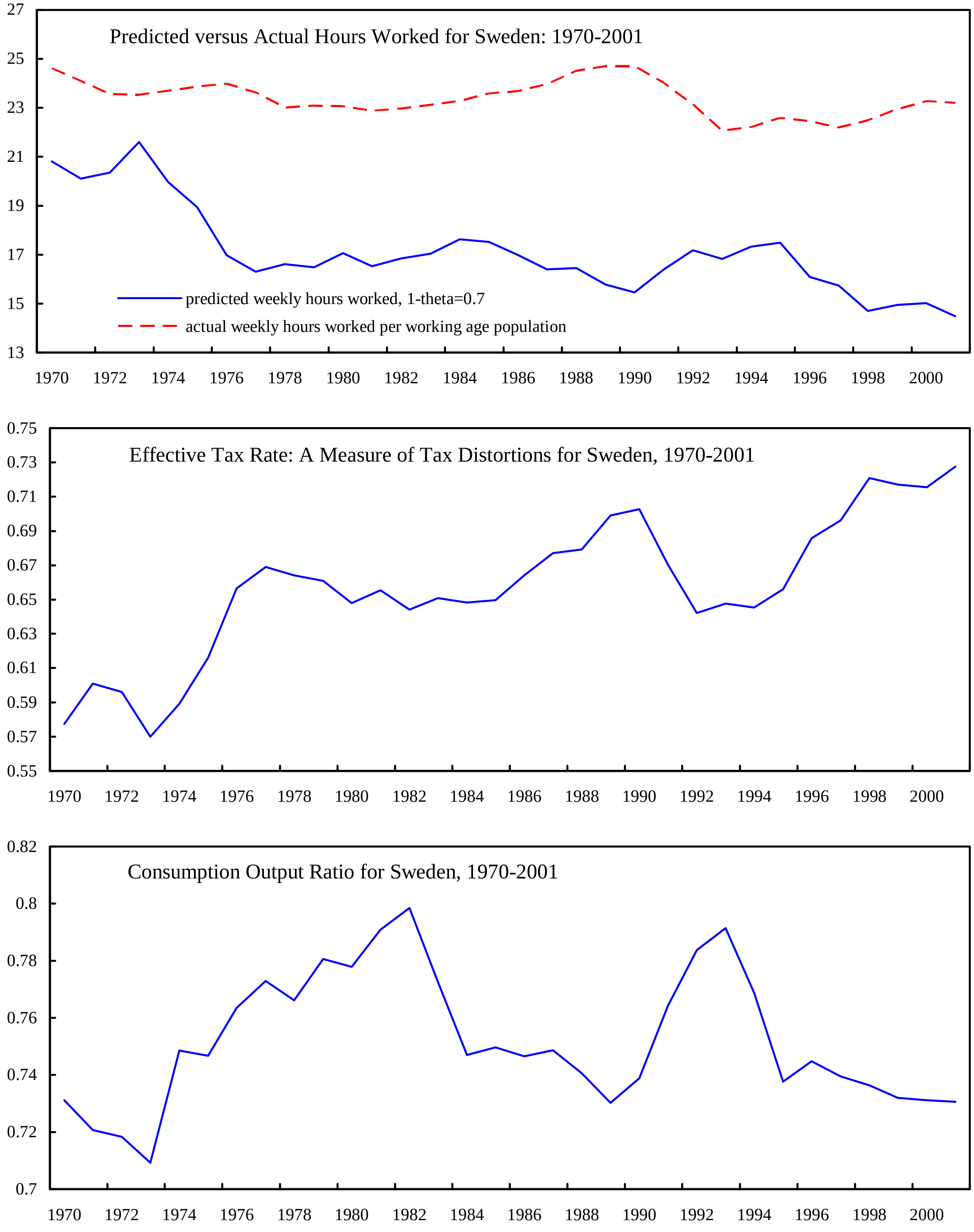






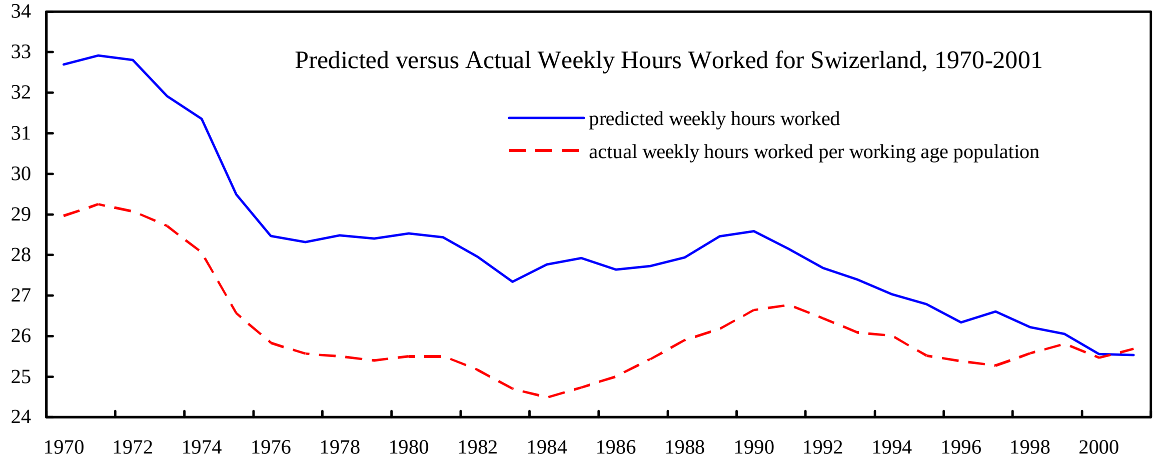
Source: Authors' calculations.

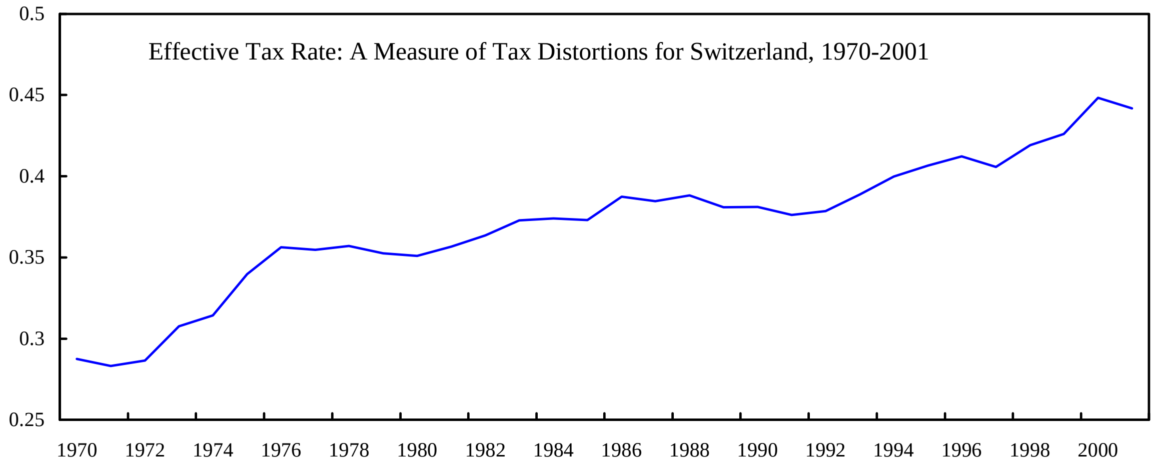
Figure 1m. Sweden

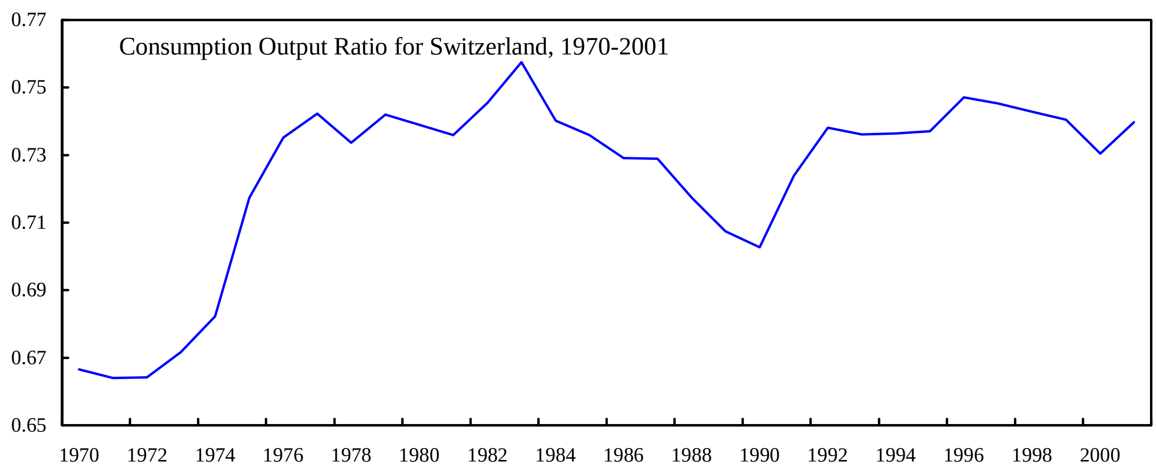


Source: Authors' calculations.

Figure 1n. Switzerland

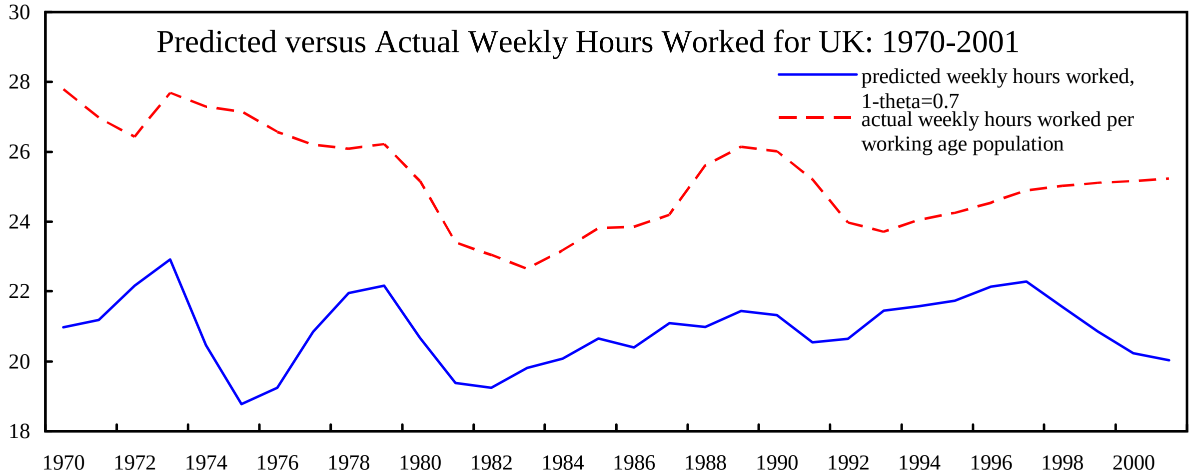


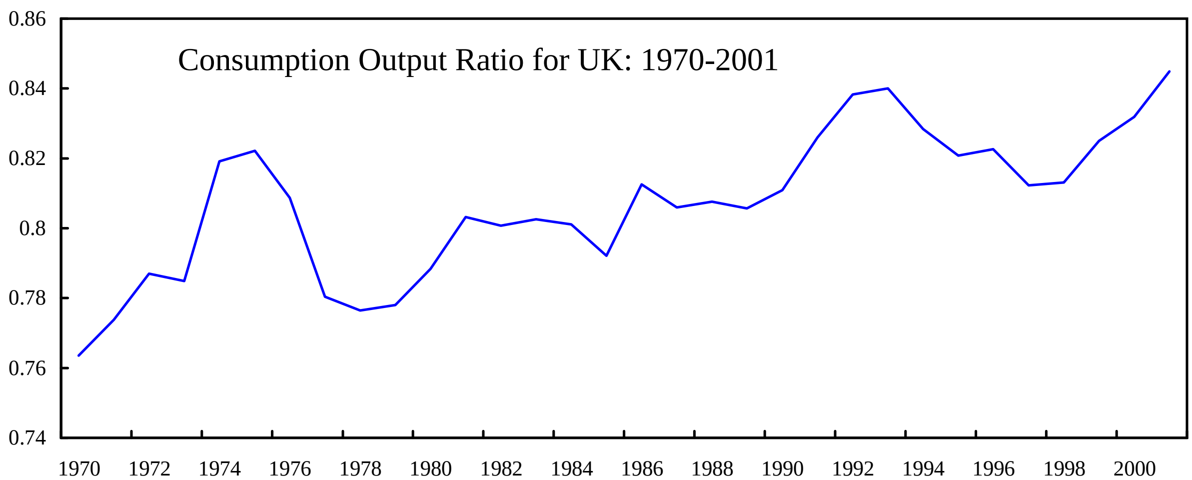




Source: Authors' calculations.

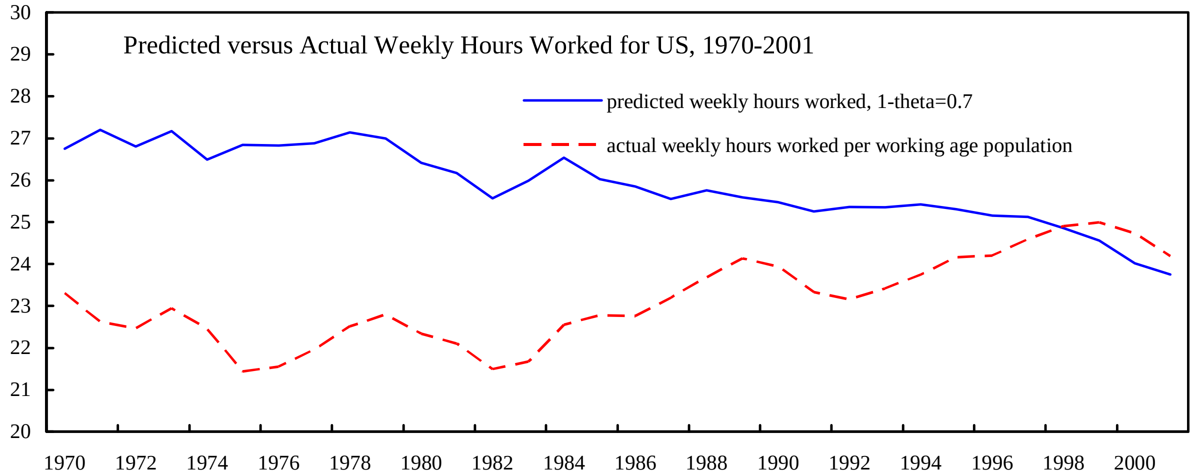
Figure 1m. UK

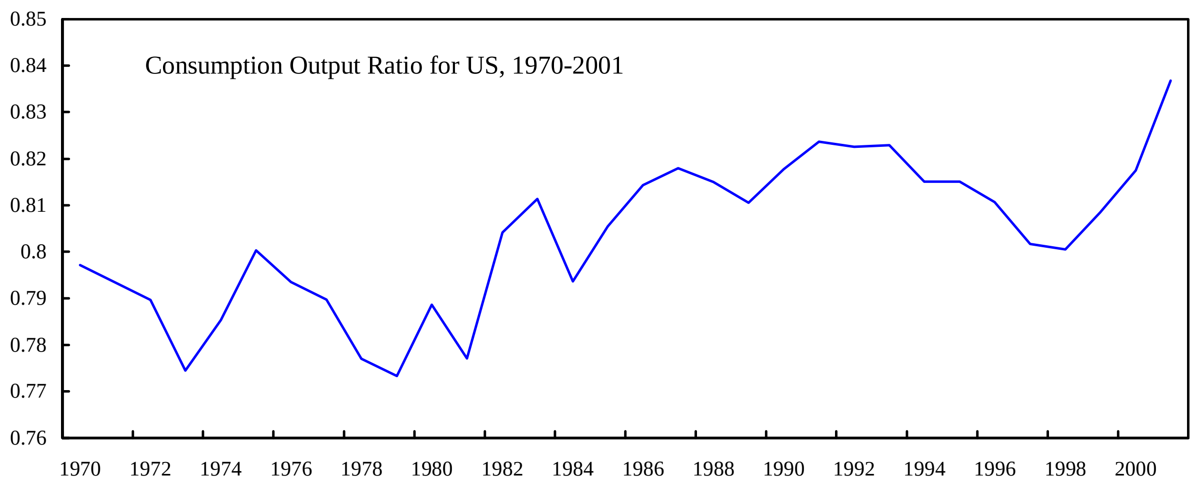




Source: Authors' calculations.

Figure 1n. United States





Source: Authors' calculations.

Next, based on these calibrations, and using the welfare measure described in Appendix II, the steady-state welfare effects of varying the size of government can be analyzed. Table 2 provides the results of two such thought experiments: (i) to cut the marginal tax rate by five percentage points and (ii) to adopt U.S. taxation levels (in both accompanied by offsetting changes in spending), with the welfare change measured in the incremental consumption equivalent of the tax cuts. For example, had Belgium between 1990–99 cut marginal income tax rates by five percentage points, it would have reaped a welfare gain equivalent to 7⅓ percent of aggregate consumption (or of 21 percent if it had adopted US tax levels).

Table 2. Incremental Welfare Improvement from Different Tax Policies 1/
(in percent of consumption, average 1992–2001)

	I Cut in marginal taxes by 5 percent points	II Adoption of the US taxation levels
Belgium	7	21
Canada	4	7
Denmark	12	39
Finland	8	24
France	6	17
Germany	5	14
Greece	3	2
Italy	5	13
Japan	2	-2
Netherlands	5	13
Norway	4	11
Spain	3	5
Sweden	8	25
Switzerland	2	0
UK	4	8
US	3	0

Source: Authors' calculations.

1/ Assuming tax cuts are fully matched by expenditure cuts.

These are large potential welfare gains from cutting back government. Are they real, or, alternatively, why don't electorates adopt policies that would generate such a drastic improvement in their welfare? One way to check is to look into how well the model tracks actual data.

C. Assessing the Fit of the Model

Even at a casual inspection, the model does not fit the data well in a number of countries depicted in Figure 1. Indeed, the "eyeballing" assessment of a calibrated model's fit is a common practice in the relevant literature, in many case even only to singular average observations (e.g., Rogerson, 2005).

In contrast, the econometric literature has developed a host of tests to assess model fit. However, these measures are usually difficult to import into real business cycle-type models as these models tend to describe steady state equilibria, while actual data are probably best be viewed as reflecting an adjustment process to (constantly) changing steady states. For the current purpose, though, this caveat is less important since Prescott (2002) endorses the use of steady state models in matching observed annual data. However, the limitations of using a parsimonious steady state specification in describing annual observations (in our case of hours worked) must be kept in mind, suggesting very limited explanatory power.[11]

Against this background, the fit of the basic model is remarkable. Table 3 assesses the goodness of fit between actual labor supplies and predicted ones over the sample period by depicting implied general coefficient of determination, R^2s, i.e. the contributions of the model predictions in explaining the inherent variance in the observed hours of work over time.[12] While in the majority of countries the model does not seem to fit—and actually adds variation to the underlying data, indicated by a negative R^2—it provides an excellent explanation of the evolution of labor supply in France and Germany, and an important one for Belgium and Japan.

[11] In addition to the model's steady state nature, it abstracts from other dynamic aspects, such as the impact of capital taxes and also assumes fairly quick transmission and adoption of the world-production possibility frontier. By the same token, it does not allow for country specific tax-raising technologies (which, would manifest themselves in differential marginal tax multipliers).

[12] The general coefficient of determination R^2 is defined as: $R^2 \equiv \frac{RSS}{TSS}$, where RSS = residual sum of squares, and TSS = total sum of squares. For a linear estimator, such as an OLS regression, TSS = RSS + ESS, where ESS is the explained sum of squares, such that $R^2 = \frac{RSS}{TSS}$. For assessing the fit of a non-estimated, calibrated model, the general definition is required.

Table 3. Goodness of Fit over the Period 1970–99
(Coefficient of determination, “R-squared”)

	Prescott	only c/y varies	"marginal R2 from marginal tax rate"
Belgium	0.20	0.40	< 0
Canada	< 0	< 0	< 0
Denmark	< 0	< 0	0.42
Finland	< 0	< 0	< 0
France	0.87	0.43	0.44
Germany	0.71	0.43	0.28
Greece	< 0	< 0	< 0
Italy	< 0	< 0	< 0
Japan	0.24	0.30	< 0
Netherlands	< 0	< 0	0.17
Norway	< 0	< 0	< 0
Spain	< 0	< 0	0.72
Sweden	< 0	< 0	< 0
Switzerland	< 0	< 0	< 0
U.K.	< 0	< 0	< 0
U.S.	< 0	< 0	< 0

Source: Authors’ calculations.

Moreover, a straightforward extension of the model allowing country variation in consumption output ratios lends further support to the effect of taxes on labor supply (columns 2 and 3 of Table 3). Varying consumption-output ratios is one way of accounting for the fact that countries with the same tax rates show differences in labor supply (see also Ljunqvist, 2005). Column 2 of Table 3 shows the fit of the model if we abstract from variation of (marginal) taxes and allow only the consumption-output ratio to vary. Column 3 depicts the difference between the first and second columns, thus indicating the improvement in the model’s fit from including taxes as a variable. The marginal tax rate in this sense provides relevant explanations of labor supply of core euro zone economies like France, Germany and the Netherlands, as well as Spain and Denmark, in Germany’s case notwithstanding the unification shock. What is surprising though, is the very poor fit for the U.S. in either variant of the model.[13]

D. Different Preference Structures

What could account for such differences in consumption-labor ratios? Preferences and tastes are arguably the chief factor. As was shown in Appendix I, however, empirically valid models have found it essential to impose tight restrictions on preferences, as embodied in the balanced

[13] This suggests caution in using this class of model as a benchmark in U.S. economic policy evaluations, e.g., Presscott’s (2004) favorable analysis of privatizing social security.

growth model. However, even within the confines of that model, there is a possibility to incorporate systematically different utility functions over countries into the analysis, for example by allowing for different curvatures.[14]

Accordingly, Appendix III extends model with the following utility function:

$$(16) \qquad \int e^{-\rho t} \frac{[C_t (N_t - H_t)^{\alpha}]^{1-\gamma}}{1-\gamma} dt$$

Where the previous benchmark model marks a limiting case where γ goes to 1.

The curvature assigns a role to the capital stock. Similarly to equation (9) in the benchmark model, it is possible to derive an equilibrium relation for hours worked (where δ stands for the depreciation rate of the capital stock, for the details see Appendix III):

$$(17) \qquad \frac{1}{h_t} - 1 = \frac{1+\tau_c}{1-\tau_h} \frac{\alpha}{1-\theta} [1-(g+\delta)(\frac{K}{AH})^{1-\theta}]$$

Again, this relation can be calibrated and the resulting predictions compared with the actuals, though missing capital stock data result in a generally shorter and smaller sample.[15] [16] In the event, the above model does not significantly improve the model's performance, but does result in better fits (in the sense of positive R^2s) for the Netherlands and Japan, and finds simulated gains from tax reform that are in general again in line with those in Table 2.

IV. A Role for Efficiency-Enhancing Government

The basic model has considerable difficulties in accounting for labor supply in very high-tax countries, which it frequently underpredicted (e.g., the Nordic countries, excluding Norway, Switzerland, and the U.K.).[17] In other words, for these countries, the implied tax rate, as reflected in the household's labor supply decision, is—often much—smaller than the measures

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[14] Another option would be to introduce country-specific α parameters, but this would subsume most of the relevant observations in hours worked and not yield interesting policy advise.

[15] There are no observations for Canada, Denmark, Greece, Italy and Norway.

[16] Similar to the selection of the α parameter in the baseline model, the depreciation rate δ (9.5 percent) was selected so as arrive at the observed sample averages for hours worked and the capital stock.

[17] In the context of the debate over the respective merits of different European social policy "models" (e.g., Sapir, 2006), it is interesting that the model underpredicts more often for European countries outside the euro zone (U.K., Sweden, Denmark, and Switzerland), and only two for euro zone countries in the group (Belgium and Finland).

of the marginal tax rate used in our analysis.[18] The explanation pursued in the following centers on efficiency-enhancing government activity that is financed by these tax revenues.[19]

What might such efficiency enhancing government activities encompass? Recall that the Prescott model treats government consumption as a full substitute for private consumption, such that they already imply the same level of utility for the consumer. As the taxes that finance such spending introduce distortions, this implies that the optimum size of government is zero, which is clearly at odds with the revealed preferences of just about any electorate in the real world. Thus a model specification that allows for government activity to shift out the economy's production possibility frontier looks promising. Redressing market failures is a classic case justifying government intervention.[20]

With respect to labor supply, market failures may arise from imperfect information, e.g., in the search time spent by employers and employees until they enter into an employment match. If government were able to provide labor market participants with the necessary information to shorten the search process, and/or to improve the quality of worker-firm matches, overall economic welfare would improve.

A. Frictions in the Labor Market

With frictional labor markets, the assumption that each household allocates its time endowment to only leisure or labor supply cannot be maintained. Instead, a household must spend time seeking jobs. Search time is not leisure and also depends on the unemployment rate. Search implies that in order to increase work time by one unit, the household must forego more than one unit of leisure time. In contrast, the utility function given by Equation (1) assumes a unitary transformation rate between leisure and work time. Moreover, the higher the unemployment rate, i.e., the harder jobs are to find, the more leisure time must be sacrificed to increase work by one unit of time. The utility function becomes:[21]

(18) $$u(c,h) = \log(c) + \alpha \log(T - \frac{h}{1-u})$$

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[18] If the model were correct, then this implied tax rate would correspond to the actually observed one.

[19] This does not mean that the analysis only applies to countries where the basic model under-predicts labor supply. Much rather, there may well be general efficiency-enhancing government activities, but not all countries may be pursuing them. Alternatively, some countries are better at implementing such activities than others, with the latter then exhibiting less labor supply than predicted by the basic model.

[20] A different channel could model the government's role in income redistribution, as was discussed in Knappe (1980). In the current framework, this could be modeled as a (minimum) level of other economic agents' utility, that enters the aggregate utility function. This would be a public good whose provision will have to rely on mandatory taxes, and that, if achieved, lifts everybody's utility.

[21] Mulligan (2002) introduces the same idea to the analysis of the U.S. labor supply over the 20th century.

where u is the unemployment rate. An increase of work time by one unit requires a cut in leisure by 1/(1-u). The marginal static labor supply condition turns into:

$$h = \frac{T(1-u)(1-\theta)}{1-\theta+\frac{c}{y}\frac{\alpha}{1-\tau}} \quad (19)$$

To implement this model empirically, we focus on the impact of long-term unemployment, as this arguably best captures the costs of labor market frictions. Table 4 shows the implied goodness of fit over the period 1990-99 (the only period for which data on long-term unemployment are available). The first column shows the fit of the basic specification (Equation 9) and the second column corresponds to predictions derived from Equation 19.

Table 4. Goodness of Fit of the friction model, Period 1990-99 ("R-squared")

	Prescott	Model with U	"marginal R2 from adding U"
Belgium	0.66	0.48	<0
Canada	<0	0.53	>0
Denmark	<0	<0	>0
Finland	<0	<0	>0
France	0.87	0.87	0 (benchmark)
Germany	0.83	0.55	<0
Greece	<0	<0	<0
Italy	<0	<0	>0
Japan	0.88	0.34	<0
Netherlands	<0	<0	<0
Norway	<0	<0	<0
Spain	<0	<0	>0
Sweden	<0	<0	>0
Switzerland	<0	<0	<0
U.K.	<0	<0	>0
U.S.	0.46	<0	<0

Source: Authors' calculations.

The results are encouraging as the improvement is concentrated in countries that were previously underpredicted, like the Nordic countries and the U.K. However, it is not clear which policies may contribute to a lowering of frictions, and whether there are any trade offs to be considered. The next section takes up these issues more formally by developing a search and matching model that explicitly captures information externalities in the labor market.

B. Labor Market Frictions, Productivity, and Policy

Assume that job seekers do not have information about all possible matches and have to engage in costly search. Firms, looking for workers, also undertake costly recruiting and selection activities. Several policy options are possible to redress these frictions, and two will be considered in the following. In the first place, policies could try to overcome informational difficulties, e.g. by subsidizing search. Another approach might be to attempt to mitigate the need for job search by granting employment protection on jobs. These approaches yield rather different results.

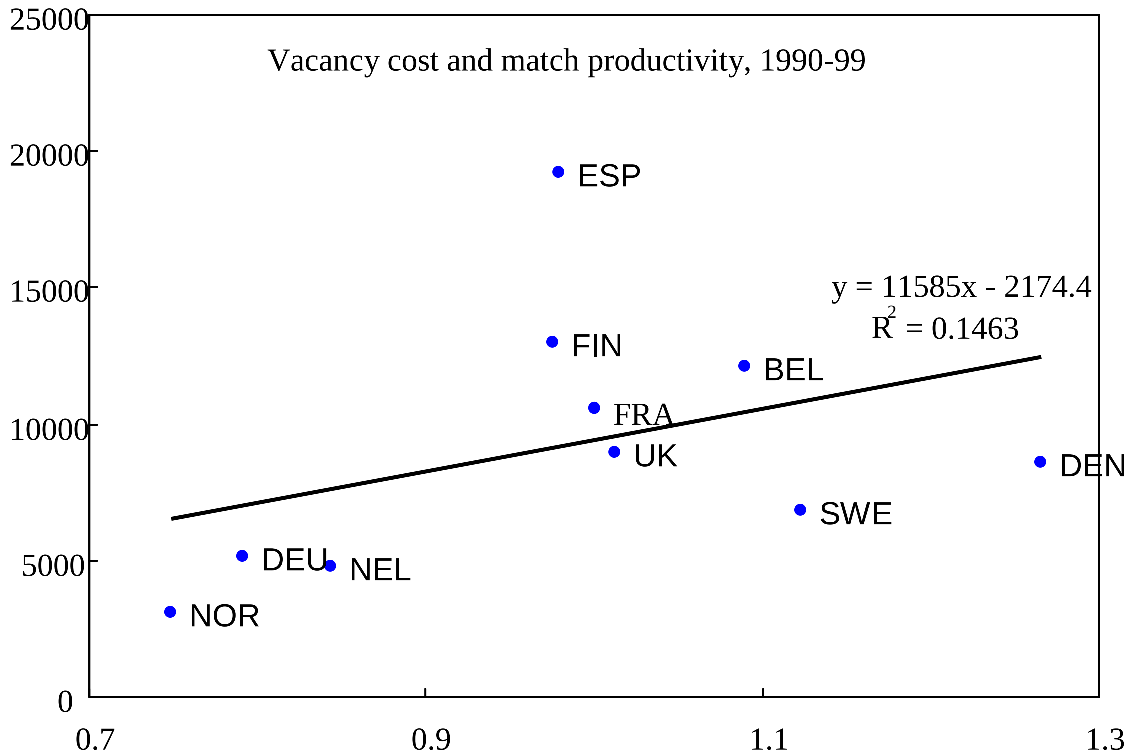
In principle, a government program that subsidizes search activities may be able to trigger longer searching, until the worker finds a better match, with attendant positive effects on macroeconomic performance. Of course, such a scheme will also provide two disincentives: (i) the standard moral hazard and (ii) the adverse incentive effects from higher marginal taxes (needed to finance the subsidy for job search) that were indeed the driving force of the basic model. As in Prescott (2002), government taxation drives a wedge between the MRS and MPL, but here, it may also redress an underlying market failure associated with imperfect information. On the other hand, employment protection appears to offer the advantage of not explicitly calling for such tax support; however, it greatly reduces flexibility, importantly, the flexibility to terminate a suboptimal match.

The model is fully specified in Appendix IV. It allows for country differences in labor market friction (modeled as the cost of a vacancy, k) and in match quality (modeled as an employed worker's productivity j). The idea is that it may be possible for governments to reduce friction, (thus shortening unemployment spells and increasing observed labor supply) and/or to improve the information available to workers and firms, thereby raising aggregate productivity. The extent to which different countries pursue different policies along these dimensions can then be picked up in the calibration exercise. In the model's terms, it would be desirable to have high match productivities and low vacancy costs.

European countries fall into distinct clusters (Figure 2 plots the calibrated vacancy costs on the vertical axis and the level of productivity on the horizontal). One group comprising Sweden and Denmark combines lower levels of vacancy costs with high levels of productivity, i.e. providing incentives for higher labor supply on both dimensions. Both countries are often singled out as countries with large government, but, as seen in the previous, both also have higher than predicted labor supply in the baseline model. In contrast, low levels of vacancy costs in Germany, the Netherlands, and Norway coincide with relatively low levels of match productivity, with the latter offering an alternative explanation for low labor supply, augmenting the high tax wedge.[22] Finally, relatively high vacancy costs with simultaneously middle-of-the-range levels of productivity in the remainder of the sample encompass countries with depressed labor supply, as well as others without.

[22] Of course, Germany, but also likely the Netherlands, have been adversely affected by the German unification shock over much of the sample, which in the current calibration may be picked up in the "productivity" estimate.

Figure 2: Calibrated Vacancy Cost and Match Productivity (1990-99)

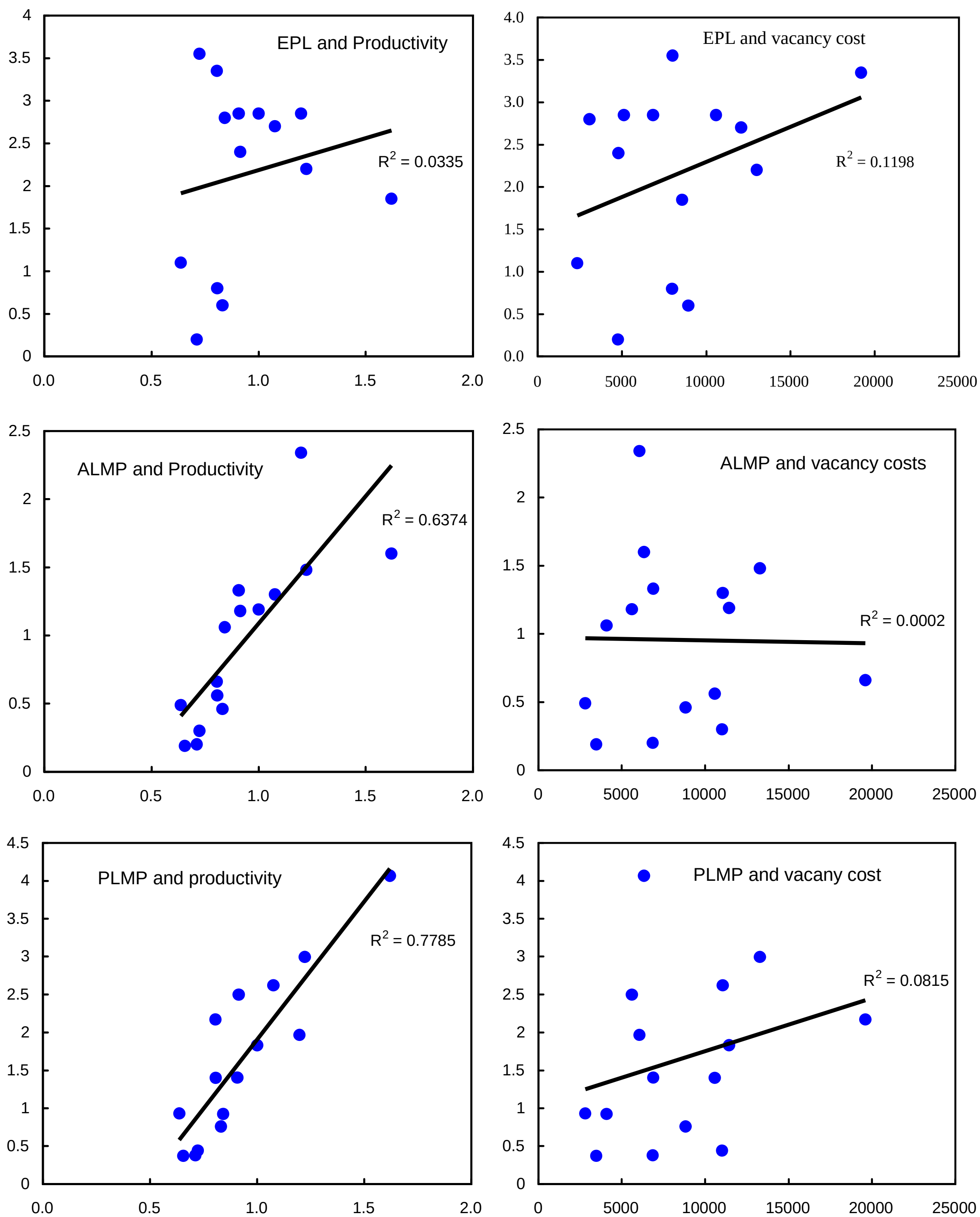


Source: Fund staff calculations.

How are actual policies related to this outcome? In particular, is there any evidence that active labor market policies (ALMP) are associated with lower vacancy cost and higher productivity? Are employment protection measures detrimental, what about policies trying to distribute income toward the unemployed via unemployment insurance (so called passive labor market policies, PLMP)?

To assess these questions empirically, we use data and definitions provided by the OECD on ALMP and PLMP (measures in respective expenditures as a share in GDP) and employment protection legislation (EPL) and assess their ability to explain the calibrated values for vacancy cost (k) and match productivity/wages (w) from the model. Figure 3 shows simple bivariate scatter plots between these policies and v and w. These reveal that ALMP and PLMP have some relation with higher match productivity, but the relation with vacancy costs is quite weak while EPL and both productivity and vacancy cost are more weakly correlated.

Figure 3. Bivariate Relations Between Labor Market Policies and Efficiency



Source: Authors' calculations.

However, there is considerable variation across the sample and low ALMP spending by no means imperils reasonable productivity (U.K.) while higher levels may even be quite unproductive (e.g., Germany). Some of these variations may simply reflect the multivariate nature of the relationship between policies and labor market efficiency parameters. Table 5 shows the results of a multivariate regression exercise.

Table 5: Ordinary Least Squares Regression of Labor Market Efficiency Indicators and Policies

	(1)	(2)	(3)	(4)
Dependent variable	w	k	k/w	Excess H
Constant	0.58***	3,656	8,979***	-0.78
	(7.084)	(1.339)	(2.891)	(-0.445)
ALMP	0.19**	-4,495*	-8,167**	4.06**
	(2.391)	(-1.731)	(-2.765)	(2.418)
EPL	-0.04	1,758*	2,817**	-2.21**
	(-1.125)	(1.576)	(2.220)	(-3.065)
PLMP	0.15***	3,067**	1,745	0.65
	(3.758)	(2.243)	(1.122)	(0.731)
R squared	0.80	0.25	0.34	0.53
observations	14	14	14	14

Explanation: t-statistics in parentheses. Significance at the 10, 5 and 1 percent level are indicated by *, **, and ***, respectively.

Source: Authors' calculations.

There is a considerable equity-efficiency trade-off in labor market policies, while employment protection just appears to impart a deadweight loss:

- Column (1) in particular shows that match productivity is significantly boosted by active and passive labor market policies in about equal measure (i.e., their respective regression coefficients size are quite similar).

- Conversely column (2) indicates that ALMP also lower vacancy cost, but that their effect can be offset by PLMP (at 95 percent confidence intervals). Moreover, employment protection imparts significant labor market inefficiencies.

- Assessing overall labor market inefficiency, as measured by the ratio of k over w, in column (3) thus confirms the positive role of ALMP and the adverse effect of EPL, while PLMP fail to have any effect (consistent with their positive impact on match productivity and adverse on vacancy costs).

- In general, in all regressions, the policy variables have considerable explanatory power for countries' calibrated labor market efficiency parameters, as evidenced by overall fit and individual significance levels; of course, the overall sample of 14 is not large.

This suggests that some tax revenues are put to efficiency enhancing uses, while policies without direct fiscal costs, such as EPL can have adverse effects as well. In this context, lacking data precludes an analysis of product market regulation, which, as pointed out by Bartelsman (2004) is closely related to innovation and thus productivity.[23]

Of course, the partial equilibrium labor market search model used here may not be correctly specified, and thus the effects of policies mismeasured. In order to check for this possibility, we go back to the initial general equilibrium model and use the information on its prediction errors, i.e., the difference between predicted and actual labor supply. Column (4) indicates that this excess labor supply (measured in hours per week) is significantly boosted by ALMP and reduced by EPL, while PLMP do not have an effect. Thus, to the extent that PLMP require revenue raising, government policies do not fully offset the underlying distortion from taxation (in contrast to ALMP). On the other hand, polices without a revenue burden like EPL can significantly lower economic welfare.

V. Concluding Remarks

The blanket claim that differences in the size of government account for the differences between some European countries' and the U.S.' labor supply over the last three decades does not stand up to a broader sample of countries than has so far been used in the literature. However, the size of government does play a significant role in explaining lower European labor supply, while the size of European governments appears to imply large welfare costs.

In an effort to understand why such large costs could prevail in democratic societies, the paper turned to allowing for an efficiency-enhancing role of government. It did find support for such government activities in the data, but also found that actual governments' spending is often not in line with what would be needed to enhance efficiency.

In particular, direct income support does not appear to be a superior policy choice to redress efficiency issues. Nevertheless, this policy tool is quite prevalent as PLMP, when other policies such as ALMP would appear to be preferable on efficiency grounds. Moreover, government

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[23] On the other hand, Fang and Rogerson (2007) pointed out that product market regulation affects labor supply in the same way as taxes, and that a variation of regulation has negligible effects on labor supply to the market. They show that only income transfers to households matter, which usually do not keep pace with regulatory costs, and are in any event, part of the basic model's government (and thus household) consumption. Our analysis is not subject to these caveats as labor market regulation is shown to have important effects that go beyond transfer payments to households.

policies that do not directly increase the size of government, e.g., regulation, are observed to also impart significant costs.

These observations point to the importance of distributional dimensions of government policies, in the case of PLMP through the form of direct income support to the unemployed and indirectly, the protection of insider rents, whereas in the case of EPL, the protection of insider rents appears to be paramount. An extension of our work would need to more directly deal with income redistribution to give more justice to this discussion.

A final recurrent theme of the preceding analysis is that the tax-distortion argument appears to particularly apply to core euro zone countries. Tax distortions clearly mattered for these countries' labor supply, and their labor market policies were not in line with those of other countries, e.g., the Nordic countries, that appear to have found ways to make labor markets function with fewer frictions. The debate on the uncertain future of the "Rhineland" social model, the success of "flexicurity" arrangements elsewhere in Europe, and more recent—post-sample—labor market policy reforms in core euro-zone economies are thus all consistent with our work.

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APPENDIX I. LABOR SUPPLY IN BALANCED GROWTH MODELS

This appendix shows that under the log utility function, labor supply must be constant over time along the balanced growth path.

Consider a continuous time growth model. Let a utility function be:

(A1.1) $$\log(C) + \alpha \log(1 - L)$$

where C is consumption and L is labor supply and 1 is a normalized time endowment.
Let a production function be:

(A1.2) $$Y = AK^{\theta}(L)^{1-\theta}$$

The intramarginal condition (the first order condition for labor supply) is:

(A1.3) $$\frac{c\alpha}{1-L} = A(1-\theta)(\frac{K}{L})^{\theta}$$

The resource constraint is:

(A1.4) $$C + \dot{K} = AK^{\theta}L^{1-\theta}$$

By dividing this resource constraint by K, we obtain:

(A1.5) $$\frac{C}{K} + \frac{\dot{K}}{K} = A(\frac{L}{K})^{1-\theta}$$

Along the balanced growth path, $\dot{K}/K$ is constant over time at g. Equation (A1.5) implies that

(A1.6) $$\frac{\dot{C}}{C} = \frac{\dot{K}}{K} = g$$

Let X=1-L. From (A1.3), we obtain:

(A1.7) $$\frac{\dot{C}}{C} - \frac{\dot{X}}{X} = \frac{\dot{A}}{A} + \theta(\frac{\dot{K}}{K} - \frac{\dot{L}}{L})$$

which is rewritten as:

(A1.8) $$\frac{\dot{K}}{K} - \frac{\dot{X}}{X} = \frac{\dot{A}}{A} + \theta(\frac{\dot{K}}{K} - \frac{\dot{L}}{L})$$

since both C and L grow at the same rate.

From (A1.5), we have:

(A1.9) $$\frac{\dot{A}}{A} + (1-\theta)(\frac{\dot{L}}{L} - \frac{\dot{K}}{K}) = 0$$

(A1.8) and (A1.9) imply that:

(A1.10) $$\frac{\dot{X}}{X} = \frac{\dot{L}}{L}$$

Since X+L=1, this implies that:

(A1.11) $$\frac{\dot{X}}{X} = \frac{\dot{L}}{L} = 0$$

(A.11) says that labor supply is constant over time along the balanced growth path.

APPENDIX II. ANALYSIS OF WELFAFRE EFFECTS OF DIFFERENT GOVERNMENT SIZE

This appendix describes the construction of the measure used in a counter-factual thought experiment to analyze an economy's welfare in response to different sizes of government.

We measure the welfare effect of the change in tax rate from t0 to t1 in the following way. Let c(t) and h(t) be consumption and hours worked associated with tax rate t. Suppose that tax rate is reduced from t0 to t1, where t0 > t1 > 0. The welfare improvement in consumption equivalent from this change in tax rate, which is denoted by x, is given by:

$$\text{(A2.1)} \qquad \log[c(t1)(1-x)] + \alpha \log[100 - h(t1)] = \log[c(t0)] + \alpha \log[100 - h(t0)]$$

Note that while we can measure the welfare effect in terms of consumption, this measure explicitly accounts for the positive partial welfare effect from variations in leisure.

APPENDIX III. INTRODUCING RISK AVERSION AND CAPITAL

This appendix relates the consumption output ratio in the formula for predicted hours worked relates to deeper parameters in an intertemporal framework.

Consider a continuous time growth model. Let a production function be:

$$Y = K^{\theta}(AH)^{1-\theta} \tag{A3.1}$$

where Y is output, K is capital stock, A is technology and H is total hours worked. Since we consider a balanced growth path, the technology improvement A needs to be labor-augmenting, as above.

The resource constraint is:

$$C + \dot{K} + \delta K = K^{\theta}(AH)^{1-\theta} \tag{A3.2}$$

This resource constraint implies that along the balanced growth path,

$$g = \frac{\dot{A}}{A} = \frac{\dot{C}}{C} = \frac{\dot{K}}{K} \tag{A3.3}$$

where g>0 is the exogenous technological growth rate, and H is constant.

The household's utility is:

$$U(C,H) = \int e^{-\rho t}\frac{[C_t(N_t - H_t)^{\alpha}]^{1-\gamma}}{1-\gamma}dt \tag{A3.4}$$

where C is consumption and N is working age population, which is equal to the total time endowment, assuming that each person is endowed with one unit of time. Observe that Prescott's (2002) specification occurs when γ goes to 1.

The household's budget constraint is:

$$(1+\tau_c)C_t + \dot{K}_t + \delta K_t = (1-\tau_h)w_t H_t + (1-\tau_k)(r_t - \delta)K_t + T_t \tag{A3.5}$$

The inter-temporal condition (the Euler equation) is:

$$g = \frac{\dot{C}}{C} = \frac{(1-\tau_K)(r_t - \delta) - \rho}{\gamma} \tag{A3.6}$$

Since the factor market equilibrium implies that

(A3.7) $$r = \frac{\partial}{\partial K}[K^{\theta}(AH)^{1-\theta}] = \theta(\frac{AH}{K})^{1-\theta}$$

the Euler equation above is rewritten as:

(A3.8) $$\frac{\dot{C}}{C} = g = \frac{(1-\tau_K)[\theta(\frac{AH}{K})^{1-\theta} - \delta] - \rho}{\gamma}$$

Observe that the rise in γ (the more risk averse) decreases (K/AH), which is intuitive.

Observe also that the preference parameter γ does not affect directly the leisure consumption static condition. But it affects indirectly through its effect on K/AH or K/Y. This is seen as follows.

The intra-temporal condition (the first order condition for labor supply) is:

(A3.9) $$\frac{\alpha C_t}{N_t - H_t} = \frac{(1-\tau_h)w_t}{1+\tau_c}$$

Let h=H/N be hours worked per working age population. Then, the intra-temporal condition above is rewritten as:

(A3.10) $$1 - h_t = \frac{(1+\tau_c)\alpha C_t / N_t}{(1-\tau_h)w_t}$$

The factor market equilibrium implies:

(A3.11) $$w = \frac{\partial}{\partial H}[K^{\theta}(AH)^{1-\theta}] = A(1-\theta)(\frac{K}{AH})^{\theta}$$

From the resource constraint,

(A3.12) $$\frac{C}{AH} = (\frac{K}{AH})^{\theta} - (g+\delta)(\frac{K}{AH})$$

Hence, we obtain:

(A3.13) $$\frac{C}{w} = \frac{H[(K/AH)^{\theta} - (g+\delta)(K/AH)]}{(1-\theta)(K/AH)^{\theta}}$$

which is decreasing in (K/AH).

By plugging this expression for C/w into the equation for 1-h, we obtain:

(A3.14) $$\frac{1}{h_t} - 1 = \frac{1+\tau_c}{1-\tau_h} \frac{\alpha}{1-\theta} [1 - (g+\delta)(\frac{K}{AH})^{1-\theta}]$$

It is seen from this equation that h is decreasing in capital tax τ_K.

Also recall that (K/AH) is decreasing in the preference parameter γ. Hence, the rise in γ (the more risk averse) decreases hours worked h through its negative effect on (K/AH).

APPENDIX IV. CALIBRATING LABOR MARKET SEARCH FRICTIONS FOR EUROPEAN COUNTRIES USING A SEARCH MODEL

This appendix describes a model used in the section III.B., which examines the extent to which cross-country variation in labor market frictions may be relevant in explaining hours worked across countries.

A. Model

We consider a variant of the textbook search and matching model of Diamond (1982), Mortensen (1982) and Pissarides (1985, 2000). Time is continuous.

Production
A match of an employed worker and a firm produce 2wh per period, where h is hours worked per period, and w is a parameter of labor productivity.

Wage Determination
Assume that a (flow) wage is determined by splitting equally a (flow) output 2wh between a worker and a firm. While this differs from the standard wage determination rule of Nash bargaining, it greatly simplifies an exposition and can also be justified by an alternating-offer bargaining setup.

Choice of Hours Worked during Employment
Each employed worker chooses how many hours to work (h) by maximizing:

(A4.1) $$(1-\tau)wh + \alpha \log(T-h)$$

where τ is a wage income tax rate, T is a time endowment. T-h is leisure. The first order condition for optimal hours worked is given by:

(A4.2) $$h = T - \frac{\alpha}{(1-\tau)w}$$

Matching Technology
The labor market is characterized by search frictions. Each unemployed worker contacts a vacant job at a rate $\mu\theta^{0.5}$, where $\theta \equiv v/u$ is the vacancy unemployment ratio, with v the number of vacant jobs and u the number of job-seekers. Each vacant job contacts a job-seeker at a rate $\mu\theta^{-0.5}$.

Value of Unemployment and Employment
The value of job-seeking for each unemployed worker, U, satisfies:

(A4.3) $$rU = z + \mu\theta^{0.5}[W-U]$$

The value of unemployment comes from (i) the utility during unemployment z, and (ii) an expected "capital" gain from changing a status from unemployment to employment.

The value of employment for the employed, W, satisfies:

(A4.4) $$rW = (1-\tau)wh + \alpha\log(T-h) + s(U-W)$$

It comprises (i) utility during employment, and (ii) an expected capital gain from changing a state from employment to unemployment, which happens with an exogenous rate s>0.

Free Entry of Vacancies
The free entry of vacant firms implies that:

(A4.5) $$\frac{k}{\mu\theta^{-0.5}} = \frac{wh}{r+s}$$

which equates a vacancy cost (job opening, recruiting, etc) k with an expected value of a filled job. Recall that each filled job, employing a worker, receives a profit wh per period.

Steady State Accounting
The steady state accounting implies that a flow into unemployment (1-u)s must be equal to a flow out of unemployment pool $u\mu\theta^{0.5}$, implying that:

(A4.6) $$u = \frac{s}{s+\mu\theta^{0.5}}$$

Definition of an Equilibrium:

A steady state equilibrium for the economy described above is a set $\{U, W, h, \theta, u\}$ such that (A4.2), (A4.3), (A4.4), (A4.5) and (A4.6) are satisfied.

B. Calibration Procedure:

Assumptions

(1) α , s and μ is constant across countries.
(2) k and w differ across countries.

Parameter Choice

We choose one period to be one year.

$$s = 0.3$$
$$r = 0.048$$

Step 1:

We choose France as a benchmark country.

Using (A4.6) and the observed unemployment rate u, we obtain μ. Normalize θ for France to be unity, without loss of generality.

Then, using (A4.5) and observed hours worked (h), we obtain k. Here, we normalize w for France to equal 1.

Finally, using (A4.2), we pick α.

Step 2:

We compute w(j), k(j) for each country j other than France.

First, using the steady state accounting equation (A4.6), we compute θ(j) for each country j. Recall the assumption that μ and s are constant across countries.

Next, using (A4.2), we compute w(j) for each country j. Note that we are assuming that T and α are constant across countries.

Then, using the free entry equation (A4.5), we compute k(j) for each country j.

C. Calibration Results

Now, we have a set of

$$\{k(j), w(j)\}$$

for each country j.

For France (the benchmark country):

For a benchmark country, France, we have:

$$\mu = \frac{s(1-u)}{u\theta^{0.5}} = \frac{0.3(1-0.11)}{0.11\times 1} = 2.43$$

Observe that we normalize theta for France to be unity.

$$\alpha = (1-\tau)w(T-h) = (1-0.642)\times 1\times (100\times 52 - 29.17\times 52) = 1319$$

where we assumed that an hourly wage for France is normalized to unity and yearly time endowment is 100*52 hours.

Using (A4.5), we have:

$$k(FRA) = \mu\theta^{-0.5} \times \frac{wh}{r+s} = 2.427 \times 1 \times \frac{1 \times 29.17 \times 52}{0.048 + 0.3} = 10578.65$$

For France, the set is:

$$k(FRA) = 10579, w(FRA) = 1, \theta(FRA) = 1$$

For the other countries:
Using parameters α and μ common across countries calibrated for a benchmark France above, we calibrate k(j) and w(j) for other countries j other than France.

First, using a steady state accounting equation (A4.6), we compute θ(j) for each country j:

$$\theta(j) = [\frac{s[1-u(j)]}{u(j)\mu}]^2$$

Next, using an equation (A4.2), we compute an hourly wage w(j) for each country j as follows:

$$w(j) = \frac{\alpha}{[1-\tau(j)][T-h(j)]}$$

Recall that we are assuming that T and α are constant across countries.

Finally, using a free entry equation (A4.5), we compute a flow vacancy cost k(j) for each country j as follows:

$$k(j) = \mu[\theta(j)]^{-0.5} \times \frac{w(j)h(j)}{r+s}$$

Recall that we are assuming that r, s, and μ are constant across countries. Table A4.1. summarizes the calibrated values for each country:

Table A4.1. Summary of Calibrated Parameter Values

	Calibrated parameters		
	Vacancy to unemployment ratio	Productivity/ hourly wage	Vacancy cost
	Theta(j)	w(j)	k(j)
Belgium	1.00	1.08	11,922
Denmark	2.79	1.62	10,259
Finland	0.84	1.22	16,246
France	1.00	1.00	11,438
Germany	2.43	0.91	6,256
Italy	1.07	0.95	11,334
Japan	15.54	0.66	2,283
Netherlands	4.09	0.91	5,139
Norway	5.98	0.84	3,449
Spain	0.48	0.81	15,799
Sweden	3.51	1.20	7,274
UK	2.12	0.83	7,351
Canada	1.37	0.81	8,542
Switzerland	15.76	0.64	1,793
USA	4.09	0.71	4,885
Greece	1.41	0.72	7,973

Source: Authors' calculations.