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Interwar U.K. Unemployment: The Benjamin and Kochin Hypothesis or the Legacy of "Just" Taxes?

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Abstract: Benjamin and Kochin (1979, *Journal of Political Economy*) present regression estimates to support their hypothesis that larger unemployment benefits increased U.K. unemployment post–World War I (WWI). The Benjamin-Kochin (BK) regression is easy to replicate. When the replication is widened to include income tax rates and WWI observations using Bayesian Monte Carlo methods, the evidence moves against the BK hypothesis and in favor of regressions that include the capital income tax rate. We explain these results with Daunton (2002, *Just Taxes*). He argues that U.K. tax rates were set during WWI and the interwar period to achieve an equitable, or "just," mix of taxes and debt. Neoclassical theory suggests that capital income tax rates fluctuations created inefficient factor input allocations that drove up interwar U.K. unemployment.

JEL classification: E32, E62, N14, N34, N44

Key words: U.K. interwar unemployment, replacement ratio, capital income tax rate, Markov chain Monte Carlo

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1. INTRODUCTION

Benjamin and Kochin (1979) contend that more generous unemployment insurance, UI, benefits caused the rise in U.K. unemployment subsequent to World War I (WWI). The Benjamin and Kochin (BK) hypothesis is that the response of the U.K. unemployment rate, UR, to the replacement ratio, RR (equal to UI benefits divided by wages), measures the work disincentives larger UI benefits created by lowering the price of leisure during the 1920s. Key to the BK hypothesis is the ordinary least squares (OLS) regression of the UR on the RR, detrended log real net national product, $\widetilde{Y}$, and a constant. BK report the regression:

$$(1) \quad \underset{}{UR_t} = \underset{(2.64)}{5.19} + \underset{(4.46)}{18.30\, RR_t} - \underset{(-8.30)}{90.00\, \widetilde{Y}_t}, \quad \overline{R}^2 = 0.82, \quad \text{Sample: } 1920 - 1938, \quad \widehat{\sigma} = 1.90,$$

where $\widetilde{Y}$ is interpreted as a measure of real aggregate demand, parentheses contain $t-$ratios, and $\widehat{\sigma}$ is the standard deviation of the regression residuals. According to BK, the large $t-$ratio on the estimated RR coefficient is evidence in support of their hypothesis.

This paper presents a wide sense replication of the BK regression (1) and its associated hypothesis. We ask if the BK regression is robust to including income tax rates on capital, τ_K, or labour, τ_N, and to extending the sample back to 1914. The 1914 – 1938 sample helps to assess the impact of WWI on the BK regression and hypothesis.

Our motivation for adding an income tax rate to the BK regression is Daunton (2002). He argues that U.K. fiscal policymakers committed to a path of primary (non-defense) budget surpluses and bond repayment during and after WWI to support an equitable or 'just' mix of taxes and debt. Textbook neo-classical theory indicates income taxes distort factor input decisions.

We obtain regression estimates from Bayesian Markov chain Monte Carlo (MCMC) simulations. The simulations produce posterior odds ratios that yield evidence in favour of including τ_K

in the regression conditional on either the 1920 – 1938 or the 1914 – 1938 sample, but do not support the BK hypothesis on the 1914 – 1938 sample.

2. The Benjamin-Kochin Hypothesis Revisited

This paper has few problems with a narrow sense replication of estimates of regression (1) using data provided by Ormerod and Worswick (1982). Our OLS estimates of the BK-regression on the 1920 – 1938 sample are shown in the first row of the top panel in table 1. The estimated coefficients differ little from those reported by BK.[1] Although there is a small disparity across these regressions for $\widehat{\sigma}$, the impact on the t-ratios is negligible.[2]

The structural interpretation BK give to the RR coefficient of regression (1) remains controversial. Critics of BK have focused on: (i) measuring aggregate U.K. unemployment and the extent of UI coverage across industries and trades classification (Cross (1982), Metcalf, Nickell, and Floros (1982), Eichengreen (1987), Hatton and Bailey (2002), and Hatton (2004)); (ii) long-term change in U.K. industrial structure (Collins (1982), Garside (1990), Loungani (1991), and Cole and Ohanian (2002)); and (iii) small sample issues (Cross (1982) and Ormerod and Worswick (1982)).[3]

Mindful of these critiques, we do not debate the merits of structural interpretations of the BK regression and hypothesis. Instead special emphasis is placed on the 'just' taxes arguments of Daunton (2002) because the fiscal policy issues he raises are not addressed elsewhere, although the *Journal of Political Economy* (April 1982) devotes 67 pages to comments and responses to BK (1979) and, among others, Hatton (2004) and Cole and Ohanian (2002) review U.K. interwar economic history review in light of BK's empirical work. We examine a 'just' taxes alternative to the BK hypothesis in the next section.

[1]Our estimates also coincide with those of Ormerod and Worswick (1982), except for $\widetilde{Y}_t$ which they report as -91.2.

[2]MatLab version 7.0 (R14) is the platform for estimation, graphics, and Bayesian simulations.

[3]Benjamin and Kochin (1982) replies to these critiques.

3. EXTENDING THE REPLICATION OF THE BENJAMIN-KOCHIN REGRESSION AND HYPOTHESIS

This section compares and contrasts the BK regression (1) to models with income tax rates using posterior odds ratios. We use posterior odds ratios to uncover which candidate regression receives most support from the data, conditional on our priors. Posterior odds are calculated from regression model likelihoods (*i.e.*, marginal densities) that are generated by MCMC simulations given our priors and either the 1920 – 1938 or the 1914 – 1938 sample. We employ software described in McCausland and Stevens (2004) to compute MCMC simulations.[4] Geweke (1999a, 1999b) develops the exact Bayesian theory behind the MCMC simulations.

One view of 'just' taxes arguments suggests that the labour income tax rate, τ_N, *and* capital income tax rate, τ_K, should be included as regressors. Since posterior odds favour the exclusion of τ_N from all of the regressions, we relegate results with τ_N to the appendix.[5]

Table 1 reprises the BK regression and presents OLS estimates with the capital income tax rate, τ_K, included with the BK regressors, and with τ_K replacing detrended output, $\widetilde{Y}$.[6] The top and bottom panels of table 1 contain results based on the 1920 – 1938 and 1914 – 1938 samples, respectively. Our priors are also summarized by the OLS estimates that appear in table 1. For example, the 1920 – 1938 sample together with the priors shown in first row of the top panel of table 1 are the basis for the MCMC simulations of the BK regression.

We generate 5000 replications from MCMC simulation software for linear Gaussian models. The simulations yield posterior distributions of the regression coefficients and standard deviation of the regression residuals, σ, along with regression model likelihoods, given the priors, empirical

[4]The MCMC software is found at *http://www2.cirano.qc.ca/∼bacc/*. For more detail, see the notes to tables 1 and 2.

[5]Posterior distributions of the coefficients of the BK regressors and τ_K are qualitatively unchanged by including τ_N.

[6]The appendix contains details of data sources, definitions, and construction.

model, and data. Posterior means of the regression coefficients appear in table 2, together with 16th (left element) and 84th (right element) percentiles of the empirical distributions in brackets.

The top panel of table 2 reveals that placing τ_K in the unemployment regression has few effects on other coefficient estimates, other than to shrink the intercept (whose 68 percent interval covers zero), conditional on the 1920 – 1938 sample. In particular, BK report a RR coefficient estimate that lies within the one standard deviation interval obtained from the MCMC simulations. The posterior mean of the τ_K coefficients suggests that UR fluctuations respond to income tax rates. The posterior mean for σ is smallest for the τ_K regression.

The distributions of posterior coefficients summarized in the bottom panel of table 2 are based on the 1914 – 1938 sample. Compared to results in the top panel of table 1, the RR remains an important determinant of the UR when the sample is extended back to 1914. But the inclusion of τ_K reduces the posterior mean of the RR coefficient more than a third compared to the estimate reported by BK. The one-standard deviation interval of the $\widetilde{Y}$ coefficient has the wrong sign when τ_K is introduced to the regression. On the other hand, dropping $\widetilde{Y}$ produces a slight increase in σ and gives a posterior mean coefficient for RR that is approximately half BK's reported value.

Figure 1 helps explain the superior fit of regressions that include τ_K. A striking feature of figure 1 is that plots of UR and τ_K move together during the 1914 – 1938 sample. The relevant contemporaneous correlation equals 0.92. For the 1920 – 1938 sample, the equivalent correlation is 0.78. The same correlations for UR and RR (τ_N) are 0.78 and 0.39 (0.54 and 0.41) respectively. Thus, τ_K exhibits the strongest co-movement with UR during WWI, the 1920s, and into the 1930s.

Posterior odds ratios are used to compare competing regression models. We compare the BK regression that includes the capital income tax rate, the τ_K-regression, against the BK regression. The posterior odds ratios are 1:193 in favour of the τ_K-regression conditional on the 1920 – 1938 sample. Including the pre-1920 observations, the equivalent posterior odds are 1:1319. Thus, the 1920 – 1938 and 1914 – 1938 samples reject excluding τ_K from the BK regression.

We also explore whether $\widetilde{Y}$ should appear in the τ_K-regression. The posterior odds ratio is 1:472730 against excluding $\widetilde{Y}$, conditional on the 1920 – 1938 sample. The longer sample yields the corresponding odds 1:7.69 in favour of dropping $\widetilde{Y}$. Given the WWI observations, it is unnecessary to include a real aggregate demand measure, $\widetilde{Y}$, when τ_K is included in the regression.

This section presents results that suggest another reassessment of the BK regression and hypothesis, especially for the 1914 – 1938 sample. First, the results indicate regressions that include τ_K are supported by the 1920 – 1938 and 1914 – 1938 samples. Next, including τ_K in the regression and the 1914 – 1919 observations in the sample point reduce support for the BK hypothesis. For example, BK claim that high RRs raised the average UR by "about five to eight percentage points" (BK 1982, p 468) relative to pre-WWI. The MCMC simulations for our preferred regression on the 1914 – 1938 sample (last row, table 2) imply simulated time paths for the UR. Conditional on the RR held constant at its 1914 value, this ensemble of regression coefficients predict the UR averages just over nine percent on the 1914 – 1938 sample. This sample and these regression coefficients also yield a probability of less than one percent that the UR would rise about five percentage points in response to a one percent increase in the RR.

4. Conclusions

This paper replicates the Benjamin and Kochin (1979) regression on a 1920 – 1938 sample. The Benjamin and Kochin hypothesis is that increased generosity of U.K. unemployment insurance benefits beginning in the early 1920s, made leisure more attractive relative to work, which lowered labor supply and raised the unemployment rate. We experience few problems replicating the Benjamin and Kochin regression and hypothesis.

We widen the replication to study the impact on the Benjamin and Kochin regression and hypothesis of income tax rates and World War I observations of 1914 to 1919. Income tax rates are included in the Benjamin and Kochin regression because of Daunton (2002). He argues that U.K. fiscal policymakers aimed to finance WWI and its aftermath with an equitable or 'just' mix of taxes and debt through WWI and the interwar period. We carry out the wider replication with Bayesian Monte Carlo simulations, which provide posterior odds ratios to conduct hypothesis tests.

Posterior odds ratios provide evidence that regressions with the capital income tax rate dominate the Benjamin and Kochin regression in the view of the data. The evidence suggests that capital income tax rate movements created distortions that negated efficient use of factor inputs in the interwar U.K. economy, lowering labor demand, and producing greater unemployment. However, our results should not be given a structural macroeconomic interpretation. Since the Benjamin and Kochin regression lacks the underlying framework of a dynamic stochastic general equilibrium model, it is not possible to disentangle structural causation from the reduced-form predictive power, say, of unemployment benefits or the capital income tax rate for the unemployment rate. Nonetheless, our re-examination of the Benjamin and Kochin hypothesis points to the need for further research on the impact of fiscal policy on the interwar U.K. economy. Nason and Vahey (2006) is a step in this research agenda.

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Table 1: OLS Regression Estimates as Priors

Dependent Variable: U.K. Unemployment Rate, UR_t

SAMPLE: 1920 – 1938

Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	$\widehat{\sigma}$	$\overline{R}^2$
5.12	18.37	−91.35	–	1.79	0.84
(1.82)	(3.81)	(10.25)			
−1.39	16.97	−65.15	37.92	1.40	0.90
(2.41)	(3.01)	(11.20)	(11.34)		
−8.85	14.28	–	84.03	2.44	0.70
(3.57)	(5.19)		(14.16)		

SAMPLE: 1914 – 1938

Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	$\widehat{\sigma}$	$\overline{R}^2$
−0.08	27.97	−25.21	–	3.21	0.76
(1.66)	(3.93)	(6.30)			
−3.58	5.07	8.04	81.03	2.39	0.86
(1.48)	(6.08)	(9.05)	(18.84)		
−2.88	8.91		66.71	2.38	0.87
(1.26)	(4.25)	–	(9.74)		

The mnemonics RR_t, $\widetilde{Y}_t$, $\tau_{K,t}$, and $\widehat{\sigma}$ denote the replacement ratio, linearly detrended log output, average capital income tax rate, and the standard deviation of the regression residuals, respectively. Parentheses contain OLS standard errors. Priors for MCMC simulations are the OLS point estimates and estimated standard errors. The latter estimates are the inverse of the square roots of the diagonal of the precision matrix of the regression coefficients. The scale parameter of the precision matrix of the regression coefficients is $\widehat{\sigma}$.

Table 2: MCMC Regression Results

Dependent Variable: U.K. Unemployment Rate, UR_t

SAMPLE: 1920 – 1938

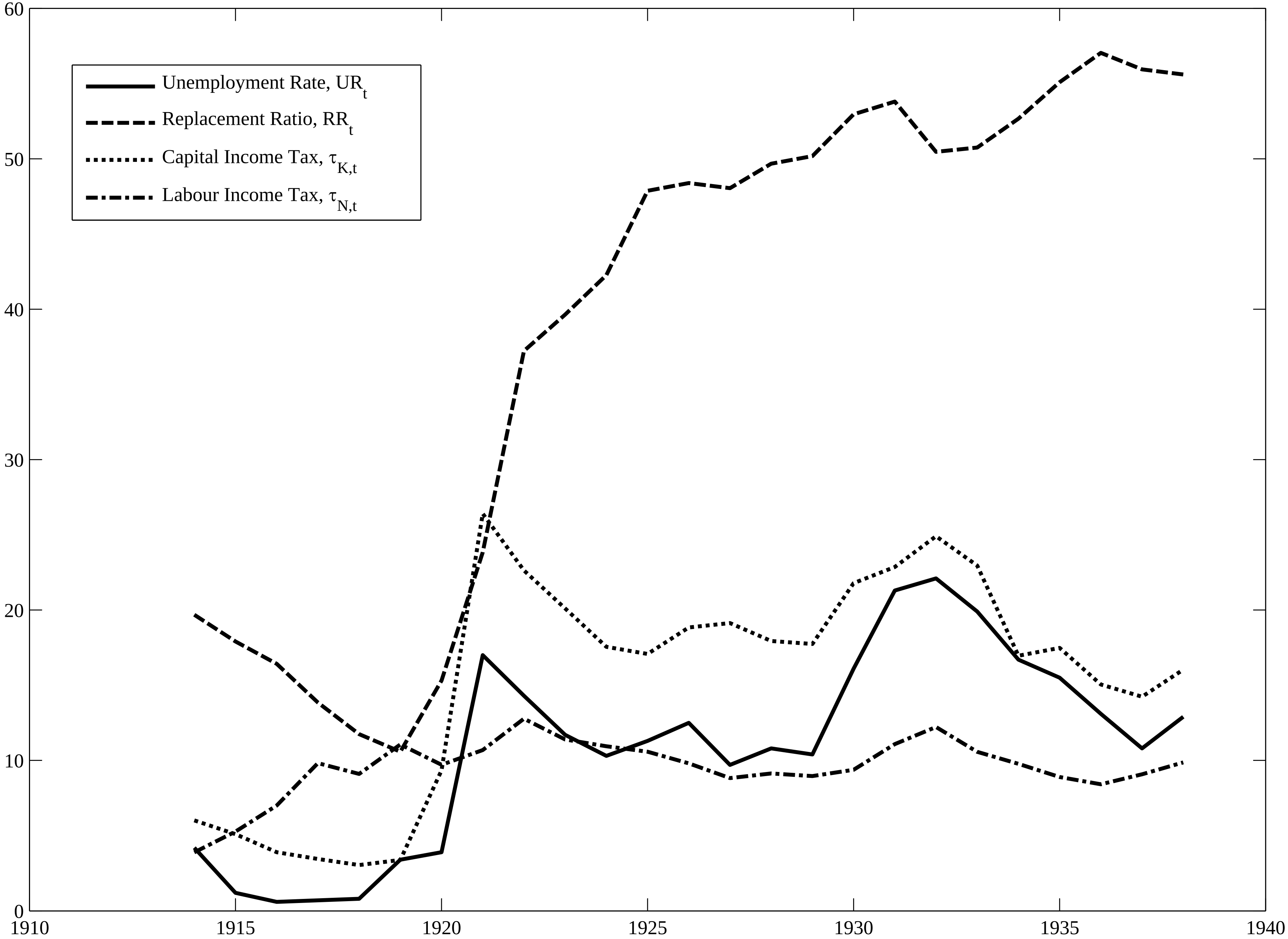
Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	σ
5.14	18.35	−91.34	–	1.59
[3.91, 6.34]	[15.8, 20.9]	[-98.0, -84.4]		[1.40, 1.90]
−1.37	16.93	−65.18	37.94	1.20
[-2.96, 0.20]	[15.01 , 18.89]	[-72.32, -57.90]	[30.71, 45.25]	[1.05, 1.44]
−8.87	14.29	–	84.153	2.17
[-11.23, -6.48]	[10.81, 17.74]		[74.62, 93.55]	[1.90, 2.60]

SAMPLE: 1914 – 1938

Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	σ
−0.07	27.95	−25.19	–	2.94
[-1.20 ,1.04]	[25.32, 30.67]	[-29.33, -20.96]		[2.61, 3.42]
−3.57	5.02	8.03	81.13	2.12
[-4.56, -2.58]	[1.02, 8.92]	[2.07, 13.97]	[68.74, 93.48]	[1.88, 2.48]
−2.89	8.91	–	66.79	2.18
[-3.72, -2.04]	[6.08, 11.78]		[60.14, 73.40]	[1.94 , 2.55]

The mnemonic σ denotes the standard deviation of the regression error. Regression estimates are means of posterior distributions generated by MCMC simulations. The brackets enclose the 16th and 84th percentiles of the posterior distributions. Priors of the MCMC simulations are OLS point estimates and covariance matrices. The software is found at *http://www2.cirano.qc.ca/∼bacc/* and is discussed by Geweke (1999a, 1999b) and McCausland and Stevens (2004). See the notes to table 1 for more information.

FIGURE 1: UNEMPLOYMENT, REPLACEMENT RATIO AND INCOME TAX RATES



Appendix to:

Interwar U.K. Unemployment:
The Benjamin and Kochin Hypothesis or the Legacy of 'Just' Taxes?

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Appendix

The appendix provides details about data construction and includes tables of ordinary least squares and Bayesian Monte Carlo simulation regressions estimates.

Data are annual and post−1919 data excludes Ireland. Some series are converted from a fiscal year (FY) basis to the calendar year (CY). The formula $CY_t = 0.25FY_t + 0.75FY_{t+1}$ is the transformation from FY to CY.

Figure 1 uses the series U_t, RR_t, $\tau_{K,t}$ and $\tau_{N,t}$. All series are as described below except that the last three variables have been scaled up by 100 for the figure but not the regressions.

The average capital income tax rate, $\tau_{K,t}$, equals the ratio of capital tax revenue to capital income. For 1920 – 1937, capital tax revenue is the sum of taxes on corporate income found in Feinstein (1972, T77) plus taxes on capital from Feinstein (1972, T79). Capital income is total corporate income taken from Feinstein (1972, T77).

There are no data for either capital tax revenue or capital income in Feinstein (1972) prior to 1920. Mitchell (1988) is the source of this pre-1920 data. Capital tax revenue was imputed using death duties revenue from Mitchell (1988, p583-584). These averaged around 50 percent of capital tax revenue post-1919. Prior to 1920, capital income was imputed using gross trading profits from Mitchell (1988, p829-830). These averaged about 60 percent of total corporate income post-1919. The resulting pre-1920 series was spliced to the 1920 – 1937 ratio of capital tax revenue to capital income to create the average capital income tax rate, $\tau_{K,t}$. Note that these calculations exclude Excess Profit Duty revenue, which was in effect from the end of 1915 to the end of FY1922.

The average labour income tax rate, $\tau_{K,t}$, equals the ratio of labour tax revenue to labour income. Labor tax revenue is income tax revenue found in Feinstein (1972, T31-32) minus Excess Profit Duty and corporation tax revenue from Mitchell (1988, p583-4). Labour income is employment income taken from Feinstein (1972, T5-6).

The replacement (or benefit to wage) ratio is the measure Benjamin and Kochin (1979) favour. Ormerod and Worswick (1982) provide this series. It is based on Benjamin and Kochin's calculations using data for average weekly wages of full-time employees, Chapman (1953), and the benefit entitlements of an adult male with a spouse and two children from Burns (1941, table XI p368). Data prior to 1920 are from the same source as benefits, but weekly wages are not available on the same basis. Feinstein (1972, T140) reports an average weekly wage earnings series. The pre-1920 data and Benjamin and Kochin's preferred series are spliced together to form the replacement ratio, RR_t, the paper employs.

BK's output series is also reported by Ormerod and Worswick (1982). They use net national product data at 1938 factor costs available from Feinstein (1972, T15). The paper works with output observations from 1913 to 1919 also found in Feinstein (1972, T15). The longer series is logged and linearly detrended to yield $\widetilde{Y}_t$. The series for the shorter sample is detrended using 1920 – 1938 data. Note that the output measure is not per capita.

Benjamin and Kochin's unemployment rate data are also found in Ormerod and Worswick (1982, table 1) for the 1920 – 1938 sample. The original source of the post-1920 data is Feinstein (1972, T128). He presents an unemployment rate series that is based on those workers covered by unemployment insurance. Mitchell (1988, p124) reports additional observations for the 1913 – 1918 period using similar sources and definitions. The 1919 observation is based on Feinstein (1972, T126), whose data sources are trade union records. The 1913 – 1918, 1919, and 1920 – 1938 data are combined to obtain the unemployment rate, UR_t.

Among others, Cross (1982) Metcalf, Nickell, and Floros (1982), Ormerod and Worswick

(1982), and Hatton (2004) have concerns about the quality of U.K. interwar data. We use BK's preferred series whenever possible. For this paper, there is empirical work that employs alternative definitions of unemployment rates, output gaps, and replacement ratios that have been discussed in the literature. According to our empirical work, BK's results appear to be robust to the various measurement concerns raised by Cross (1982) Metcalf, Nickell, and Floros (1982), Ormerod and Worswick (1982), and Hatton (2004). These results are available on request. Collins (1982), Garside (1990) and Loungani (1991) also discuss sectoral and regional displacement in the interwar U.K. economy. Since there are no equivalent observations from 1914 to 1919, we omit analysis of the associated alternative hypotheses.

APPENDIX TABLES with τ_N included

Table A.1: OLS Regression Estimates as Priors

Dependent Variable: U.K. Unemployment Rate, UR_t

SAMPLE: 1920 – 1938

Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	$\tau_{N,t}$	$\widehat{\sigma}$	$\overline{R}^2$
0.62	19.54	−84.79	–	39.16	1.81	0.84
(5.73)	(4.10)	(13.02)		(47.17)		
−1.05	16.85	−65.85	38.30	-3.54	1.45	0.90
(4.62)	(3.40)	(12.18)	(12.51)	(40.27)		
−14.28	16.67	–	73.04	63.28	2.44	0.70
(6.61)	(5.74)		(18.10)	(64.76)		

SAMPLE: 1914 – 1938

Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	$\tau_{N,t}$	$\widehat{\sigma}$	$\overline{R}^2$
−4.54	26.77	−19.65	–	51.72	3.18	0.76
(4.08)	(4.02)	(7.77)		(43.26)		
−6.43	4.99	10.69	78.49	34.33	2.39	0.87
(3.10)	(6.07)	(9.38)	(18.96)	(32.80)		
−4.73	9.75		61.60	24.26	2.41	0.86
(2.74)	(4.43)	–	(11.91)	(31.81)		

The mnemonics RR_t, $\widetilde{Y}_t$, $\tau_{K,t}$, and $\widehat{\sigma}$ denote the replacement ratio, linearly detrended log output, average capital income tax rate, and the standard deviation of the regression residuals, respectively. Parentheses contain OLS standard errors. Priors for the MCMC simulations are OLS point estimates and estimated standard errors. The latter estimates are the inverse of square roots of the diagonal of the precision matrix of the regression coefficients. The scale parameter of the precision matrix of the regression coefficients is $\widehat{\sigma}$.

APPENDIX TABLES with τ_N included

Table A.2: MCMC Regression Results

Dependent Variable: U.K. Unemployment Rate, UR_t

SAMPLE: 1920 – 1938

Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	$\tau_{N,t}$	σ
0.57	19.52	−84.75	–	39.79	1.54
[-3.17, 4.24]	[16.88, 22.15]	[-93.15, -76.21]		[9.63, 70.29]	[1.35, 1.84]
−1.02	16.84	−65.44	38.34	-3.86	1.20
[-3.96, 1.91]	[14.71, 19.00]	[-73.24, -57.86]	[30.38, 46.29]	[-30.27, 22.58]	[1.05, 1.44]
−14.32	16.66	–	72.89	64.03	2.08
[-18.65, -10.08]	[12.94, 20.37]		[60.88, 84.86]	[21.26, 106.93]	[1.83, 2.47]

SAMPLE: 1914 – 1938

Intercept	RR_t	$\widetilde{Y}_t$	$\tau_{K,t}$	$\tau_{N,t}$	σ
−4.57	26.76	−19.67	–	52.14	2.81
[-7.29, -1.88]	[24.11, 29.38]	[-24.80, -14.46]		[23.53, 80.46]	[2.50, 3.29]
−6.39	5.03	10.66	78.41	33.91	2.06
[-8.39, -4.39]	[1.06 , 8.95]	[4.50, 16.73]	[66.13, 90.98]	[12.11, 55.55]	[1.84, 2.41]
−4.75	9.74	–	61.50	24.65	2.13
[-6.59, -2.94]	[6.81, 12.62]		[53.52, 69.55]	[3.20, 46.13]	[1.90, 2.48]

The mnemonic σ denotes the standard deviation of the regression error. Regression estimates are means of posterior distributions generated by MCMC simulations. The brackets enclose the 16th and 84th percentiles of the posterior distributions. Priors of the MCMC simulations are OLS point estimates and covariance matrices. The software is found at *http://www2.cirano.qc.ca/∼bacc/* and is discussed by Geweke (1999a, 1999b) and McCausland and Stevens (2004). See the notes to table A.1 for more information.