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Endogenous Stabilization in Open Democracies

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Abstract

In the new Keynesian theory of endogenous stabilization governments react quickly to lean against the macroeconomic wind. In open economies policymaking is complicated by concern about the trade balance. We extend the political business cycle model by assuming that governments have objectives with respect to macroeconomic performance relating to three indicators (growth, inflation and net exports), but are constrained by an augmented Phillips curve and the inverse relation between net exports and domestic output. As long as adaptive expectations replace rational ones, econometric tests support this characterization of the political-economic equilibrium, and suggest how it is conditioned by political ideology and central bank independence.

JEL codes: E52, E63, F41

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1. Introduction

Macroeconomic stabilization is fundamentally political: Kalecki (1943) warned that Keynesian governments would be tempted to manipulate economic policies to gain political support and to suppress the working class. Recent modeling has focused on the different inflation targets of different political parties and governments, and the relative independence of central bankers. This paper investigates these theories using recent measurements of political ideology and central bank independence in an econometric model of endogenous stabilization.

Empirical application of these ideas confronts the fact that the theoretical literature has invariably modeled closed economies, while all available observations of macroeconomic outcomes come from open economies. International trade can complicate the problem by adding a new variable, the trade balance, to the policymaker's list. In a circumstance in which stabilization logic favors a particular policy toward inflation and growth (say, activist intervention to increase growth), the government's decision may be altered by trade considerations (say, choosing lower growth to prevent a decline in net exports). We model short-run stabilization as the constrained optimization of a quadratic objective function in inflation, growth and net exports, subject to an augmented Phillips curve and a net export function. The solution to this policy problem defines a reduced form econometric model. An examination of the post-war economic record of 18 democracies validates this approach, and ideological and institutional indicators enhance this understanding in plausible ways.

A prominent feature of the recent literature is the rational expectation assumption: economic agents use all available information to update their forecasts. This approach coheres with the notion of well-informed maximizing agents. We accommodate this convention by estimating alternative regressions under the assumption of strongly rational inflation forecasts. However, on empirical grounds we favor a weaker version of rationality in which agents' forecasts are simply last year's inflation rate. Although such adaptive behavior may seem naïve, it may nonetheless be widespread in an uncertain world.

2. Structure and objectives in a closed economy

The literature on political macroeconomics invariably invokes a Phillips curve as a structural constraint on policymakers.[1] Conventionally this is an inverse relation between the unexpected inflation and the gap between actual unemployment and its "natural" level. Here we substitute the output gap for the unemployment gap in our Phillips curve,

$$\pi_t = \pi_t^e + \psi y_t + \varepsilon_t \tag{1}$$

where the output gap y_t is the log deviation of real output Y_t from its "natural" level Y_t^*, and ε_t defines a random inflation shock. Expected inflation π_t^e is the forecast of a typical agent based on information available in the previous period. Since expectations should be fulfilled in the long run, this model rules out any long-run deviation from y=0. However, as long as economic agents do not fully anticipate fiscal, monetary and other policies, governments are able to temporarily increase output at the cost of more rapid inflation.

Another essential element is an assumption about political objectives. One possibility is to suppose that the government's goals are given by a quadratic function of growth and inflation,

$$U_t = -\frac{1}{2}\left(\left(g_t - g_t^*\right)^2 + \left(\pi_t - \hat{\pi}\right)^2 \right), \tag{2}$$

where the growth rate of real output is $g_t = \ln(Y_t) - \ln(Y_{t-1})$, and $g_t^* = \ln(Y_t^*) - \ln(Y_{t-1}^*)$ is natural growth. We postpone consideration of the trade balance until Section 7. Perhaps the inflation target $\hat{\pi}$ reflects a desire for seigniorage. Differing targets for inflation could account for ideological differences. Since Right governments traditionally prefer lower inflation than the Left, we thus expect a lower target under Right governments. Of course, not all Right governments have the same target, nor do all Left ones; these differ over time and among countries.

The modeling of collective objectives is controversial. Textbooks define social welfare as some aggregation of individual preferences. Functions such as (2) have been called "abbreviated social welfare functions" because they are written in terms of economic indicators such as inflation or unemployment, rather than citizen preferences.[2] Within the family of quadratic forms a variety of alternatives are plausible;

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[1] See, for example, Nordhaus (1975) or Chappell (1982).
[2] See Lambert (1993).

quadratic objectives are tractable because they always result in linear reaction curves.[3] This is a "what if" investigation of whether observed outcomes are consistent with this particular assumption about governmental preferences.

3. Endogenous stabilization equilibrium

The government has limited options for activist stabilization. We assume that the government can exploit information and implementation advantages to lean against the macroeconomic wind, although its goals ($g_t = g_t^*$ and $\pi_t = \hat{\pi}$) are often unattainable.[4] The government uses up-to-date information to guide policy, observing contemporaneous shocks and setting inflation accordingly. It has an advantage over economic agents, whose forecasts date from the previous period. A prominent feature of this theory is that rational agents come to understand that a policy of $\hat{\pi} > 0$ implies perpetual inflation.[5] The stylized fact of inflation is consistent with the hypothesis that governments do prefer inflation.

The long-run equilibrium is disturbed by exogenous shocks, and perhaps by uncertainty about which party will rule in the next period.[6] To derive the government's policy in any particular year, we substitute the definition of the growth rate $g_t \equiv y_t - y_{t-1} + g_t^*$ into the Phillips curve,

$$\pi_t = \pi_t^e + \psi\left(g_t + y_{t-1} - g_t^*\right) + \varepsilon_t$$

and use this to substitute for g_t in the objective function (2),

$$U_t = -\frac{1}{2}\left(\left(\frac{\pi_t - \pi_t^e - \varepsilon_t}{\psi} - y_{t-1}\right)^2 + \left(\pi_t - \hat{\pi}\right)^2\right)$$

Maximizing with respect to π_t, the government's preferred outcome is

$$\pi_t = \frac{\pi_t^e + \varepsilon_t + \psi y_{t-1} + \psi^2 \hat{\pi}}{1 + \psi^2} \tag{3}$$

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[3] Sometimes circular indifference curves are made elliptical by adding a parameter to reflect the relative weight of growth versus inflation goals. Sometimes its growth target differs from the natural rate. Sometimes its indifference curves are parabolic. Another alternative asserts that goals are specified in terms of output levels, rather than growth rates. Equation (2) also assumes that only current conditions matter, but it might also include a discounted sum of future outcomes. The government might plan for its current term of office only, or it might plan to be in office for several terms, discounting the future according to the probability of holding office. Alternatively, it might weigh pre-election years more heavily. Kiefer (2000) reports evidence that only current conditions matter in political business cycle econometrics. Kiefer (2005b) explores of other quadratic objective functions, concluding that it is difficult to distinguish between circular and elliptical indifference curves, that the quadratic form is more likely than the parabolic one, and that growth goals are more likely than level goals.

[4] Fischer (1977) is an early example in this literature.

[5] This inflation bias result originated with Barro and Gordon (1983).

[6] Election uncertainty is the hallmark of the rational political business cycle of Alesina (1987) and Alesina and Roubini (1992).

$$g_t = g_t^* - y_{t-1} - \frac{y_{t-1} - \psi\left(\pi_t^e + \varepsilon_t - \hat{\pi}\right)}{1+\psi^2}$$

This implies that inflation and growth may either rise or fall over a government's term, depending on expectations, shocks, conditions inherited from the past, and policy targets. We assume that the government can implement its preferred policy, but we do not explicitly consider the instruments.

In the absence of shocks, the time-consistent equilibrium inflation rate should occur where inflation is just high enough so that the government is not tempted to spring a policy surprise. This equilibrium is the natural output, natural growth and an ideologically determined rate of inflation, $y = 0, g = g^*, \pi = \hat{\pi}$.

Ideally an agent should use available information to forecast inflation. The typical agent should be sophisticated enough to know the government's inflation target. She should also know the long-run trend in growth, the slope of the Phillips curve, and pre-existing economic conditions. However, she may not know the current inflation shock ε_t. Formally, her information set is $I = \left\{\hat{\pi}, g_t^*, \psi, y_{t-1}\right\}$. These are strong assumptions. Before elections the situation is less certain. Then, a sophisticated agent should make a forecast of the election outcome. The rational expectation under these conditions should be a weighted average of partisan targets; where the appropriate weights should be her predicted probabilities of electoral victory for each party. Furthermore, in many countries governments can call early elections at any time. In these cases every year is potentially an election year, so that there should always be a positive probability of government change.

To obtain the rational expectation of π given *I*, we take the conditional expectation of the inflation equation (3) and solve:

$$\pi_t^e = E\left(\pi_t\right) = \hat{\pi} + \frac{y_{t-1}}{\psi}, \tag{4}$$

so that expectations equal the government's inflation target with a correction for pre-existing conditions. Substituting (4) into (3) gives the rational solution

$$\pi_t = \hat{\pi} + \frac{\varepsilon_t}{1+\psi^2} + \frac{y_{t-1}}{\psi} \tag{5}$$

$$g_t = g_t^* - y_{t-1} - \frac{\psi\varepsilon_t}{1+\psi^2}$$

Because it assumes that agents are sophisticated forecasters of government behavior, we describe it as "strongly rational."

A weaker alternative holds that the expectation is simply the inflation rate observed in the previous period, $\pi_t^e = \pi_{t-1}$. This is commonly known as the adaptive model. It assumes that agents are quick learners (one period), but forgetful (disregarding observations with longer lags). Although many economists view the adaptive model with suspicion because such forecasts can be irrational, adaptive behavior is often observed. For this reason we characterize adaptive expectations as "weakly rational."

In the absence of shocks, the time-consistent equilibrium inflation rate should occur where inflation is just high enough so that the government is not tempted to spring a policy surprise. For both strongly and weakly rational expectations, this equilibrium is the natural output, natural growth and an ideologically determined rate of inflation, $y = 0, g = g^*, \pi = \hat{\pi}$.

4. Modeling the target

Whatever expectations model is most valid, politics and institutions can influence outcomes through the inflation target parameter. A famous result by Rogoff (1985) concludes that appointing central bank governors with conservative inflation targets can mitigate the inflation bias. This prescription can be modeled as governors with $\hat{\pi}^b < \hat{\pi}^g$, where superscripts denote the central bank and the government. However, a conservative banker will be ineffective in this regard if she is not also given independence to pursue her goals. Following Eijffinger and Hoeberichts (1998), we model central bank independence with the objective function

$$U_t = \theta_t\left(-\frac{1}{2}\left(\left(g_t - g_t^*\right)^2 + \left(\pi_t - \hat{\pi}^b\right)^2\right)\right) + (1-\theta_t)\left(\frac{1}{2}\left(\left(g_t - g_t^*\right)^2 + \left(\pi_t - \hat{\pi}^g\right)^2\right)\right), \qquad (6)$$

where θ_t measures the degree of independence on the interval (0,1). With this extension we find that the policy rules are unchanged, except that $\hat{\pi} = \theta_t\hat{\pi}^b + (1-\theta_t)\hat{\pi}^g$. This result indicates that conservativeness without independence $(\theta_t = 0)$ has no impact, nor does independence without conservativeness $\left(\hat{\pi}^b = \hat{\pi}^g\right)$.

We further model the government's target by allowing that rightwing governments aim for a lower inflation target, $\hat{\pi}^g = \hat{\pi}^{g0} + \hat{\pi}^\rho\rho_t$ where ρ_t is a Left-Right index of the government ideology defined on the interval (-1,1). Putting the effects of central bank independence and conservatism together with government ideology gives a model of the target,

$$\hat{\pi} = \theta_t \hat{\pi}^b + (1-\theta_t)(\hat{\pi}^{g0} + \hat{\pi}^{\rho}\rho_t), \tag{7}$$

which can be substituted as an extension to (3). For the rational expectations version (5) this substitution is appropriate only when the typical agent accurately forecasts changes in central bank independence and government ideology, so that post-election and post-bank reform adjustment dynamics disappear quickly. Empirical considerations lead to further consideration of adjustment dynamics below.

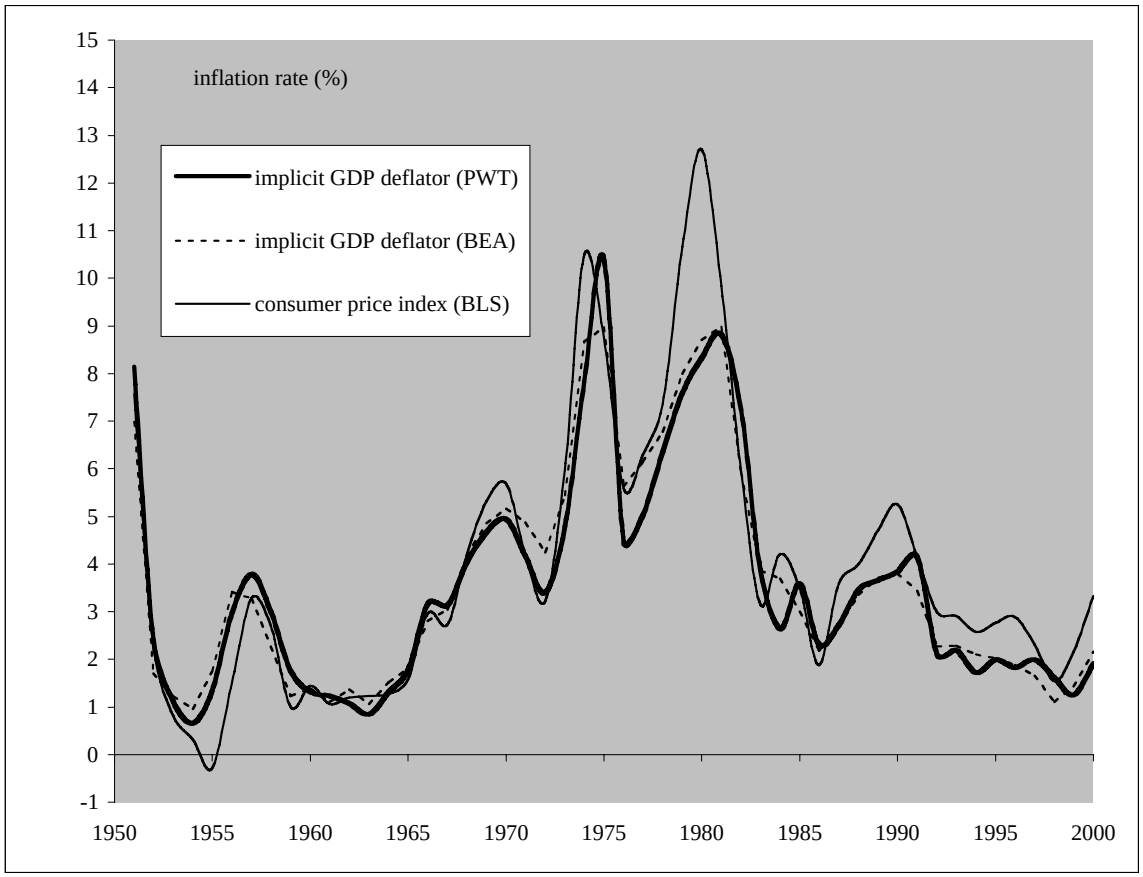
5. Data definitions

Most of our data derive from the Penn World Tables (PWT6.1), which includes internationally comparable time series on national accounts for almost all the countries in the world for 1950-2000. Percentage growth is measured as the log difference in real GDP per capita; for the details on variable construction see Table 1. Although it is customary to study stabilization outcomes with aggregate statistics, such analysis is equally appropriate for the per capita data used here. The difference is that aggregate growth rates include population growth. Since population growth changes slowly, it has little effect on short-run stabilization.

Table 1. Variable definitions

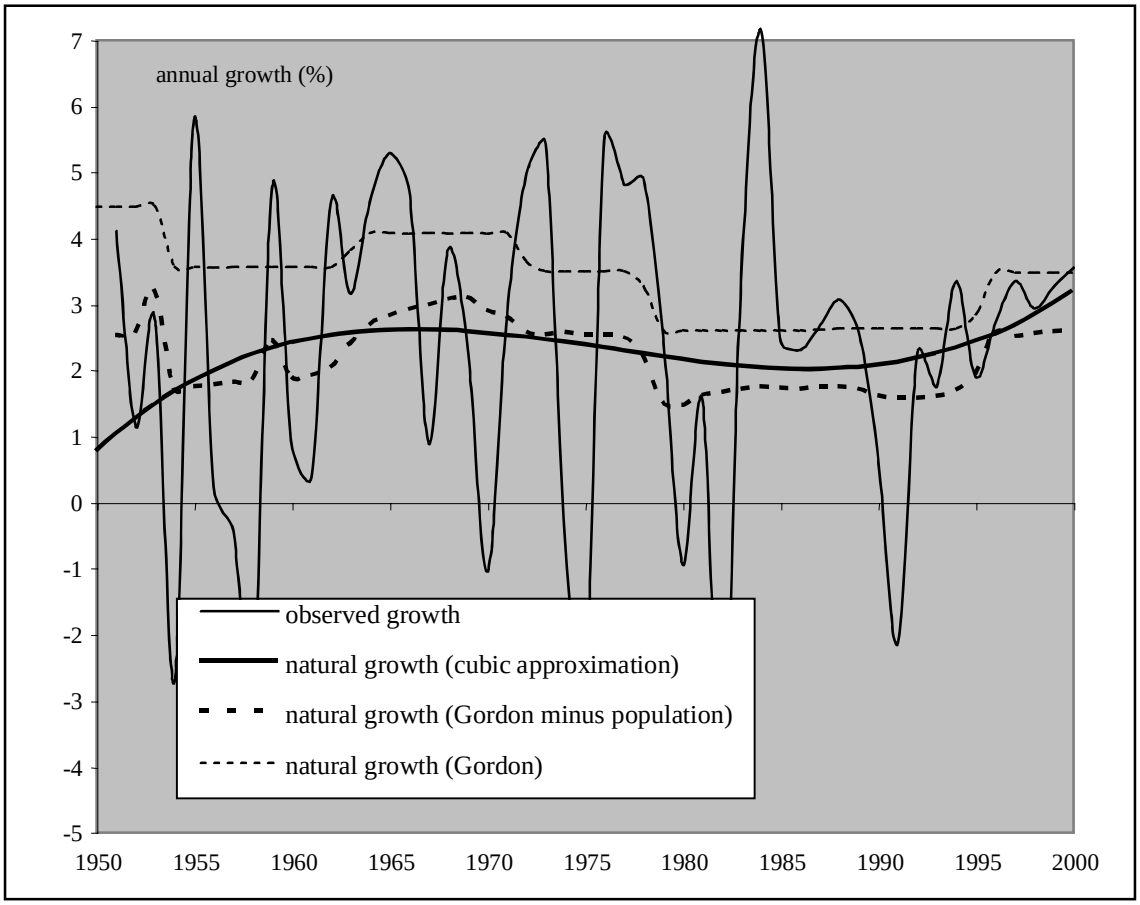
	symbol	definitions using PWT 6.1 variable names
real GDP per capita	Y_{it}	$RGDPCH_{it}$
natural real GDP per capita	Y_{it}^*	estimated by cubic smoothing
foreign output gap	$\tilde{y}_{it}$	$\ln\left(\sum_{j\neq i} Y_{jt} POP_{jt}\right) - \ln\left(\sum_{j\neq i} Y_{jt}^* POP_{jt}\right)$
growth rate	g_{it}	$\ln(RGDPCH_{it}) - \ln(RGDPCH_{it-1})$
implicit deflator	p_{it}	$\frac{PPP_{it}(CGDP_{it})}{PPP_{i96}(RGDPCH_{it})}$
inflation rate	π_{it}	$\ln(p_{it}) - \ln(p_{it-1})$
net exports	x_{it}	$(100 - CC_{it} - CI_{it} - CG_{it})\frac{Y_{it}}{Y_{it}^*}$
log of real exchange rate	z_{it}	$\ln\left(\frac{PPP_{it}}{XRAT_{it}}\right)$

Figure 1. Comparing US inflation rate statistics



The inflation rate is defined using the purchasing power parity and GDP estimates from the PWT. In Table 1 the numerator of the implicit deflator is GDP per capita measured in current local currency, and the denominator is the same quantity measured in real terms (1996 local currency units). As an example, Figure 1 compares this measure of inflation to official statistics for the US. It is clear that they are quite close and that the PWT measure can be interpreted as the rate of change in the implicit deflator, and thus is an appropriate indicator of macrostabilization.

Figure 2. Estimated natural growth and observations: US



Our models call for measures of macroeconomic disequilibrium and the underlying output trend. The published series include only real output per capita, and not its natural level. We estimate a smoothly evolving trend in potential output by fitting a cubic trend to the observed growth rates according to

$$\ln\left(\frac{Y_t}{Y_{t-1}}\right) = \beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3,$$

one cubic regression for each country. The predicted values from these regressions are used to estimate Y^* according to

$$\ln\left(Y_t^*\right) = \ln\left(Y_0^*\right)\left(\prod_{s=0}^{t} \hat{\beta}_0 + \hat{\beta}_1 s + \hat{\beta}_2 s^2 + \hat{\beta}_3 s^3\right).$$

We use the results to construct the required series, the output gap y and the trend growth rate g^*. This method makes the convenient assumption that macroequilibrium was achieved in the first year of

observation (1950 for most countries). Although this is unjustified, it is not serious since our sample is 1958-1998.

There are other smoothing methods. Gordon (1999) estimates the output gap by picking a list of benchmark dates when he judges that the US economy approximated macroequilibrium, and estimates the natural growth rate between these dates as constant.[7] His benchmark dates are: 1949Q1, 1954Q1, 1957Q3, 1963Q3, 1970Q2, 1974Q2, 1979Q3 1987Q3, 1990Q4, and 1995Q1. Figure 4 compares our estimated natural growth with Gordon's. To make the series comparable, we convert Gordon's statistics from an aggregate basis to per capita by subtracting US population growth (according to PWT). By definition the natural level changes over time as technology advances and as capital is accumulated. Assuming that these influences evolve slowly, natural output should also. Thus, it seems inconsistent that Gordon's natural growth is discontinuous at benchmark dates. Nevertheless, we do not find much difference between these two estimates for the US. Either method illustrates the fact that the underlying growth rate of the US economy has changed over time. Clearly, our methodology yields smoother changes in the natural growth, showing a slight slowing of growth for the US from the 1960s through the 1980s, with an acceleration in the 1990s.[8] Both methods give quite similar estimates of natural trend and the output gap for the US.

Our model of the inflation target allows ideological differences among governments. Budge et al. (2001) publish Left-Right scores for political parties during 1950-1998 derived from a content analysis of pre-election platforms and manifestos for a panel of democracies covering a long series of postwar elections; their scores range from –1 at the extreme Left to +1 at the extreme Right.[9] The government ideology score is defined as the score of the party in power. We define annual statistics for the years in which the government changes as averages weighted according to the months in office. Thus, for example, since the US president takes office in January, the out-going president's ideology is given a weight of $1/12^{th}$ for that year. By this measure Figure 3 shows that the second Reagan Administration was the farthest to the Right, while the Johnson and Carter Administrations were nearly tied for the farthest Left. This plot also

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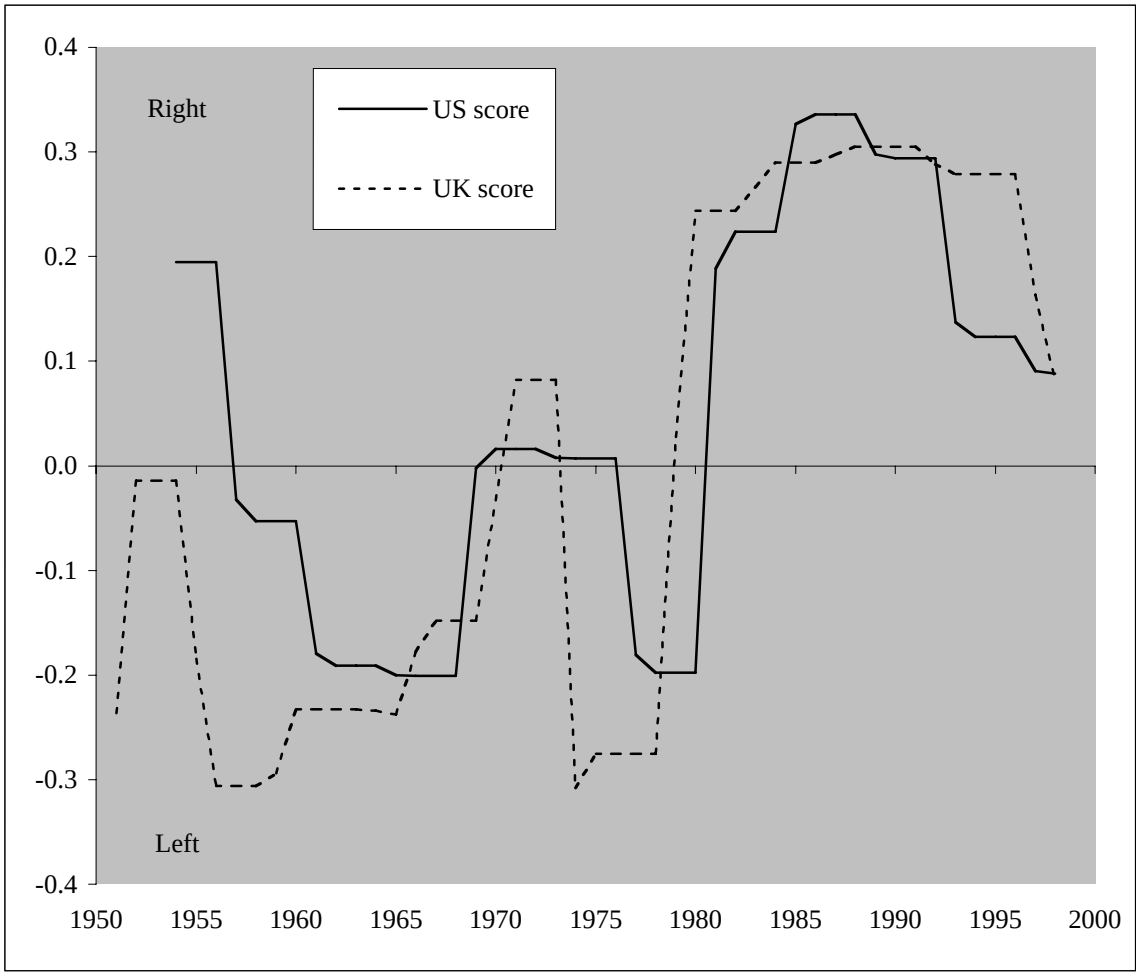
[7] Gordon(2003) compares his benchmark-interpolation method with alternatives based on the Kalman and Hodrick-Prescott filters.

[8] The bumpy appearance of Gordon's estimate is in part explained by subtraction of population growth. Although population growth should be quite smooth itself, the PWT reports anomalous population jumps in 1953 and 1958.

[9] We rescore Budge's –100 to +100 scale for convenience. These data are published online by Michael McDonald at www.binghamton.edu/polsci/research/mcdonalddata through 1995. We augment these data through 1998 and add Japan using Woldendorp et al. (2000) to code government dates and coalition membership.

shows the extent to which the Thatcher and Reagan governments shared similar ideological positions. In countries ruled by a coalition the governing ideology is estimated by the average of the parties in the coalition, weighted by their seats in the lower house of Parliament.

Figure 3. Budge's ideology scores for the US and UK governments



We also require an index of central bank independence. Cukierman et al. (1992) develop a formal index of legal independence, defined on (0,1).[10] According to this measure the German and Italian central banks achieve the greatest independence in our sample (.92 after 1998), and the Belgian central bank was the most dependent (.17 before 1992). Since the Cukierman index is unavailable before 1980, we fill in the

[10] See Cukierman et al (1992) and the update by Polillo and Guillén (2005).

missing values with the 1980 index.[11] We interpret this index as a measure of independence θ, even though its coding includes elements of conservativeness (whether price stability is the only objective).

Measuring the conceptual shock variable accurately is problematic. There are many potentially important types of shocks to consider, and different countries may experience different impacts. Here we consider only an energy cost shock. We measure energy cost shock as the difference between the US inflation rates of the CPI and of the CPI less energy, hoping that the US experience reflects that of other countries. Probably this indicator under-measures the energy shock in 1974-5 due to US price controls. We model the inflation shock as a proportion of this indicator, expecting a positive coefficient.

6. Regression results

For consistent estimation we define a two-equation regression model written as a reduced form for inflation and growth with four predetermined variables (natural growth, expected inflation, lagged output gap and inflation shock) in the functional form given by either (3) or (5), adding error terms. These regressions are linear in variables, but nonlinear in coefficients with cross-equation restrictions. We define our sample by availability; the US CPI-less-energy series is available only after 1958 and the ideology series extends only through 1998.

First for US annual data in model (a) of Table 2, we assume adaptive expectations according to (3). The second model (b) invokes strongly rational expectations according to (5). Judging by the log likelihood statistics, the adaptive model fits the US data much better than the rational version.[12] In both models the estimated slope of the Phillips curve is positive as expected, and statistically significant, although its magnitude is quite different in these two specifications. The estimated target variable implies positive equilibrium inflation rates of about 4%. The energy shock coefficients are positive, but statistically insignificant. Judging by the R^2 statistics, the model (a) predicts inflation more accurately than growth. Probably this is due to the inclusion in the adaptive model of lagged inflation.

[11] According to Cukierman (2005: 4), it is a "fact that during the forty years ending in 1989 there hardly had been [any]reforms in [central bank] legislation."
[12] It also fits better than a benchmark VAR(1) model that achieves a log likelihood of -164.

An examination of the Durbin-Watson *DW* statistics suggest that the implicit assumption of well-behaved errors is invalid.[13] The presence of serial correlation, more evident in the rational model, suggests that the economy does not completely reach its short-run equilibria within the one-year period of observation. Although we are reluctant to add additional structure to account for adjustment dynamics that is not part of our choice-theoretic development, we nevertheless hypothesize that solutions (3) and (5) define only targets, and that observed variables (denoted with tildes) adjust toward these targets according to

$$\begin{bmatrix} \tilde{\pi}_t \\ \tilde{g}_t \end{bmatrix} = \begin{bmatrix} 1-\delta_\pi & 0 \\ 0 & 1-\delta_g \end{bmatrix} \begin{bmatrix} \tilde{\pi}_{t-1} \\ \tilde{g}_{t-1} \end{bmatrix} + \begin{bmatrix} \delta_\pi & 0 \\ 0 & \delta_g \end{bmatrix} \begin{bmatrix} \pi_t \\ g_t \end{bmatrix} + \begin{bmatrix} e_{\pi t} \\ e_{gt} \end{bmatrix}$$

where the adjustment rates are restricted to $1 \geq \delta_\pi \geq 0$ and $1 \geq \delta_g \geq 0$.

Table 2. Regression results, US 1958-1998, 41 observations
(*t*-ratios in parentheses)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
expectations model	adaptive	rational	adaptive	rational	adaptive	rational	adaptive	rational
Phillips curve slope	0.51	1.71	0.95	0.96	0.54	1.64	0.89	0.85
	(4.72)	(4.85)	(4.21)	(4.42)	(5.54)	(4.96)	(4.51)	(4.41)
inflation target	4.01	3.91	3.96	4.03	4.31	4.00	4.18	4.34
	(7.21)	(13.90)	(9.49)	(8.72)	(8.66)	(13.95)	(10.30)	(9.00)
government ideology					-7.03	-2.03	-5.06	-7.11
					(-2.40)	(-1.34)	(-2.14)	(-2.26)
energy shock	0.51	0.22	1.57	2.37	0.35	-0.09	1.06	1.26
	(1.56)	(0.15)	(1.67)	(1.60)	(1.11)	(-0.06)	(1.40)	(0.97)
inflation adjustment rate			0.63	0.32			0.67	0.30
			(5.76)	(4.71)			(6.32)	(4.70)
growth adjustment rate			0.67	0.51			0.70	0.54
			(4.97)	(6.69)			(5.53)	(7.22)
DW (inflation)	1.82	0.50	2.07	1.95	2.05	0.57	2.25	2.20
DW (growth)	1.66	0.64	2.05	2.17	1.58	0.63	1.99	2.08
R^2 (inflation)	0.82	0.38	0.83	0.83	0.84	0.39	0.85	0.85
R^2 (growth)	0.18	0.20	0.21	0.26	0.19	0.20	0.22	0.28
log likelihood	-152	-185	-148	-146	-149	-184	-146	-143

If the adjustment parameters δ are small, then clearly governments ought to modify their stabilization policy accordingly. Nevertheless, we re-estimate models (a) and (b) by substituting (3) and (5) into this equation. The results for models (c) and (d) do indicate a better fit, especially the inflation

[13] We report the customary *DW* statistics even though this statistic is biased toward 2.0 when the model includes lagged dependent variables, as it does in (a), (c), (d), (e), (g) and (h).

equation in the rational model (d). The adjustment rate estimates suggest incomplete adjustment of both inflation and growth in the rational version. Probably the substitution of lagged inflation for expectations is informative about the dynamics of the macroeconomy in the adaptive version. Now the results favor the rational expectations hypothesis. We might take the view that this is support for the rational hypothesis, acknowledging slow rates of adjustment; or we might take the view that this *ad hoc* modeling can make even an inadequate model fit the data well. Apparently the incomplete adjustment modification resolves considerable uncertainty about the slope of the Phillips curve in our initial results.

Models (e) through (h) in Table 2 extend the definition of the inflation target according to (7), adding Budge's ideology score for as a linear determinant of the inflation-target parameter.[14] Our estimates are consistent with the hypothesis that rightwing governments aim for a lower inflation target.

With only 41 annual observations on the US economy, the generality of our inferences is questionable. Table 3 expands the sample to 659 observations on 17 OECD democracies, the same countries studied by Alesina and Roubini (1992).[15] We estimate the same models: models (i) through (l) repeat the adaptive and rational versions under the complete and partial adjustment specifications.[16] Again, the results favor the adaptive hypothesis assuming complete adjustment, and the rational hypothesis under incomplete adjustment. Again, the initial regressions (i) and (j) reveal that the autocorrelation problem is more serious with the rational specification, but now the estimated inflation adjustment rates are considerably slower than those estimated for the US.[17]

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[14] We do not account for central bank independence in the US because this version is not identified, as there is no variation in Federal Reserve independence over the sample period.

[15] They are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany (only after reunification), Ireland, Italy, Japan (only after 1961), Netherlands, New Zealand, Norway, Sweden, Switzerland and United Kingdom.

[16] For comparison the VAR(1) benchmark model achieves a log likelihood of –3085.

[17] The *DW* statistics in Table 3 is biased toward 2.0 by our failure to correct this statistic for the transitions between countries.

Table 3. Regression results, 17 OECD countries, 1958-1998, 659 observations (excluding the US)
(*t*-ratios in parentheses)

	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
expectations model	adaptive	rational	adaptive	rational	adaptive	rational	adaptive	rational
Phillips curve slope	0.23	1.93	1.98	0.89	0.24	1.93	2.03	0.95
	(10.18)	(7.99)	(6.49)	(7.05)	(9.78)	(8.14)	(6.61)	(6.80)
government target	5.30	5.31	6.45	5.43	7.05	6.78)	7.61)	6.73
	(13.12)	(34.55)	(15.78)	(12.85)	(7.05)	(17.28)	(9.13	(6.72)
central banker target					2.13	2.64	3.78	2.79
					(2.04)*	(4.40)*	(2.03)*	(1.62)*
government ideology					-2.43	-2.18	-7.11	-5.51
					(-0.73)	(-1.67)	(-2.72)	(-1.66)
energy shock	0.30	-1.18	-2.90	-0.89	0.29	-1.22	-2.75	-0.94
	(1.81)	(-2.00)	(-3.08)	(-1.42)	(1.79)	(-2.03)	(-2.89)	(-1.49)
inflation adjustment rate			0.24	0.22			0.25	0.23
			(8.54)	(10.13)			(9.13)	(10.20)
growth adjustment rate			0.42	0.46			0.42	0.46
			(27.58)	(35.64)			(28.29)	(35.15)
DW (inflation)	2.29	0.35	2.10	1.97	2.28	0.36	2.10	1.96
DW (growth)	1.74	0.45	2.10	1.82	1.75	0.45	2.11	1.82
R^2 (inflation)	0.65	0.03	0.63	0.64	0.65	0.06	0.63	0.64
R^2 (growth)	0.23	0.17	0.33	0.34	0.24	0.17	0.34	0.34
log likelihood	-3069	-3639	-3005	-2986	-3066	-3626	-2997	-2983

* Tests the hypothesis that the central bank's target differs from the government's.

While models (i) through (l) assume that all countries share a single inflation target (between 5% and 6%), models (m) through (p) relax this according to (7). These extensions investigate the notion that anti-inflation conservatism can be institutionalized into the central bank's legal terms of reference. Using the Cukierman index to measure θ, our estimates of the central bank's inflation target (about 3%) validate the presumption that central bankers are conservative. For example, model (o) implies that, if in 1992 the Belgian central bank had had the independence of the German bank after 1998, then Belgium's long-run inflation rate would have been 2.8% lower. We also investigate the impact of political ideology. Model (o) implies a significant effect of government ideology on stabilization policy; in other models this effect is less certain. We conclude that contributions of ideology and institutions to policy are plausibly revealed in these regressions.

7. An open economy extension

The openness ratio (exports plus imports as a percent of GDP) for the US averaged 15% during the sample period, and 60% for our sample of OECD countries. The estimates in Tables 2 and 3 contrast

along several dimensions: the OECD rates of adjustment are slower, the Phillips curve slope is even more uncertain, and the OECD energy shock effects have the wrong sign. Perhaps these differences are associated with their more open pattern of trade.

In open economies governments may also pay attention to their foreign trade balance. We extend endogenous stabilization theory to the open economy by adding the foreign balance to the list of policy targets. Specifically, we now suppose that the government's goals are given by

$$U_t = -\frac{1}{2}\left(\left(g_t - g_t^*\right)^2 + \left(\pi_t - \hat{\pi}\right)^2 + x_t^{\,2} \right), \tag{8}$$

where x is net exports as a fraction of natural GDP. This functional form specifies that the trade target is balance, and that deviations from all three targets weigh equally in policy-making. Of course, many other specifications are possible.

Again, the government exploits information and implementation advantages to lean against the macroeconomic wind, although its goals ($g_t = g_t^*$, $\pi_t = \hat{\pi}, x_t = 0$) may be unattainable. The government uses up-to-date information on both domestic and global shocks to pick the inflation rate. The government's options are still limited by the Phillips curve (1), and now they are also limited by a net export function,

$$x_t = \alpha_1 y_t + \alpha_2 \tilde{y}_t + \alpha_3 z_{t-1}, \tag{9}$$

where $\tilde{y}$ is the GDP gap in rest of the world and z is the natural logarithm of real exchange rate. The first two terms parameterize the conventional understanding that imports are related to domestic output (α_1<0), while exports are determined by foreign output (α_2>0). According to the Law of One Price the real exchange rate should eventually converge to purchasing power parity (z=0). Since a positive z encourages imports, we predict that α_3<0. The one-year delay is a simple version of *J*-curve dynamics. The econometric advantage of the lagged specification is that it makes z predetermined. One might think that the real exchange rate ought to be endogenous, since z depends on domestic inflation and the nominal exchange rate by definition. Our exogeneity assumption may be valid if the inherent delays are such that a change in the real exchange rate does not affect the current trade balance (or growth, or inflation), and if governments do not plan beyond one year. We report evidence of rather slow adjustment in the next section. To the extent that this simplification is invalid (the extent that z is jointly determined with π, g and x according to a multiyear policy plan), our estimates may suffer from simultaneity bias.

The long-run equilibrium is disturbed by exogenous shocks, ε_t and $\tilde{y}_t$. To derive the government's policy, we use the Phillips curve and the net export function to substitute for g_t and x_t in (8),

$$U_t = -\frac{1}{2}\left(\left(\frac{\pi_t - \pi_t^e - \varepsilon_t}{\psi} - y_{t-1}\right)^2 + \left(\pi_t - \hat{\pi}\right)^2 + \left(\alpha_1 z_{t-1} + \alpha_2 \frac{\pi_t - \pi_t^e - \varepsilon_t}{\psi} + \alpha_3 \tilde{y}_t\right)^2\right)$$

Maximizing with respect to π_t, the government's preferred economic outcome is

$$\pi_t = \frac{\left(1+\alpha_1{}^2\right)\left(\pi_t^e + \varepsilon_t\right) + \psi y_{t-1} + \psi^2 \hat{\pi} - \psi\alpha_1\left(\alpha_2 \tilde{y}_t + \alpha_3 z_{t-1}\right)}{1 + \psi^2 + \alpha_1{}^2} \tag{10}$$

$$g_t = g_t^* - y_{t-1} + \frac{y_{t-1} + \psi\left(\hat{\pi} - \pi_t^e - \varepsilon_t\right) - \alpha_1\left(\alpha_2 \tilde{y}_t + \alpha_3 z_{t-1}\right)}{1 + \psi^2 + \alpha_1{}^2}$$

$$x_t = \frac{\alpha_1\left(y_{t-1} + \psi\left(\hat{\pi} - \pi_t^e - \varepsilon_t\right)\right) + \left(1+\psi^2\right)\left(\alpha_2 \tilde{y}_t + \alpha_3 z_{t-1}\right)}{1 + \psi^2 + \alpha_1{}^2}$$

Assuming that the government can implement this policy, these equations define a reduced form regression model.

In long-run equilibrium purchasing power parity (z=0) holds, as does macroeconomic equilibrium in the rest of the world ($\tilde{y} = 0$). And, in the absence of shocks, the equilibrium inflation rate should occur where inflation is just high enough so that the government is not tempted to spring a policy surprise. Thus the long-run equilibrium is $x = 0, y = 0, g = g^*, \pi = \hat{\pi}$: foreign trade balance, macroeconomic equilibrium, the natural growth rate and a politically determined rate of inflation.

Again we consider two hypotheses about inflation expectations, an adaptive model ($\pi_t^e = \pi_{t-1}$) and a rational expectations model. A sophisticated typical agent should be able to predict the government's inflation target. She should also know the slope of the Phillips curve, the parameters of the net export function, the long-run trend in growth and the economic conditions of the previous year. However, she cannot predict the current inflation shock, nor can she predict current foreign GDP gap. Thus, her information set is $I_t = \left\{\hat{\pi}, g_t^*, \psi, \alpha_1, \alpha_2, \alpha_3, y_{t-1}, z_{t-1}\right\}$. Given these strong assumptions, the rational expectation of π is

$$\pi_t^e = E\left(\pi_t \mid I_t\right) = \hat{\pi} + \frac{y_{t-1} - \alpha_1\alpha_3 z_{t-1}}{\psi}, \tag{11}$$

the target inflation with adjustments for the business cycle and the real exchange rate. Substituting (11) into (10) gives a rational expectations solution

$$\pi_t = \hat{\pi} + \frac{\left(1+\alpha_1^{\,2}\right)\varepsilon_t - \psi\alpha_1\alpha_2\tilde{y}_t}{1+\psi^2+\alpha_1^{\,2}} + \frac{y_{t-1} - \alpha_1\alpha_3 z_{t-1}}{\psi} \tag{12}$$

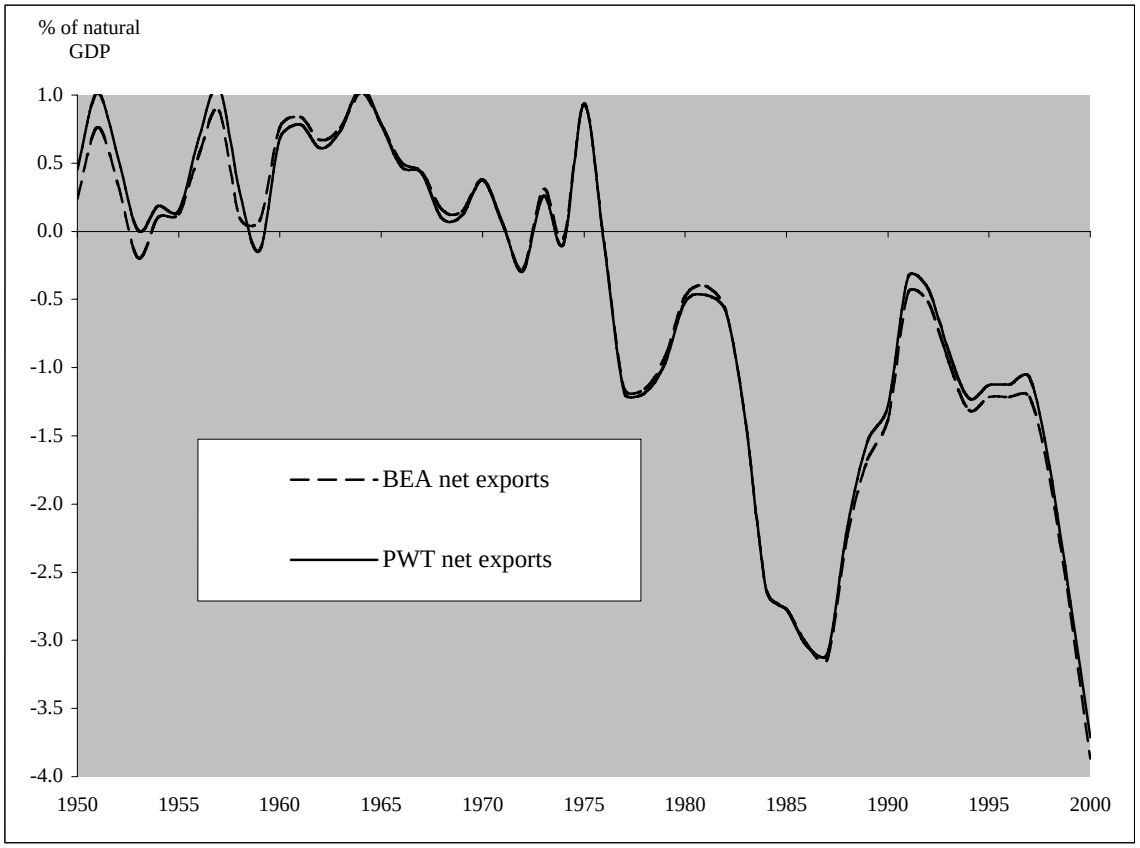
$$g_t = g_t^* - y_{t-1} - \frac{\psi\varepsilon_t + \alpha_1\alpha_2\tilde{y}_t}{1+\psi^2+\alpha_1^{\,2}}$$

$$x_t = \frac{-\alpha_1\psi\varepsilon_t + \alpha_2\left(1+\psi^2\right)\tilde{y}_t}{1+\psi^2+\alpha_1^{\,2}} + \alpha_3 z_{t-1}.$$

8. Foreign trade data definitions

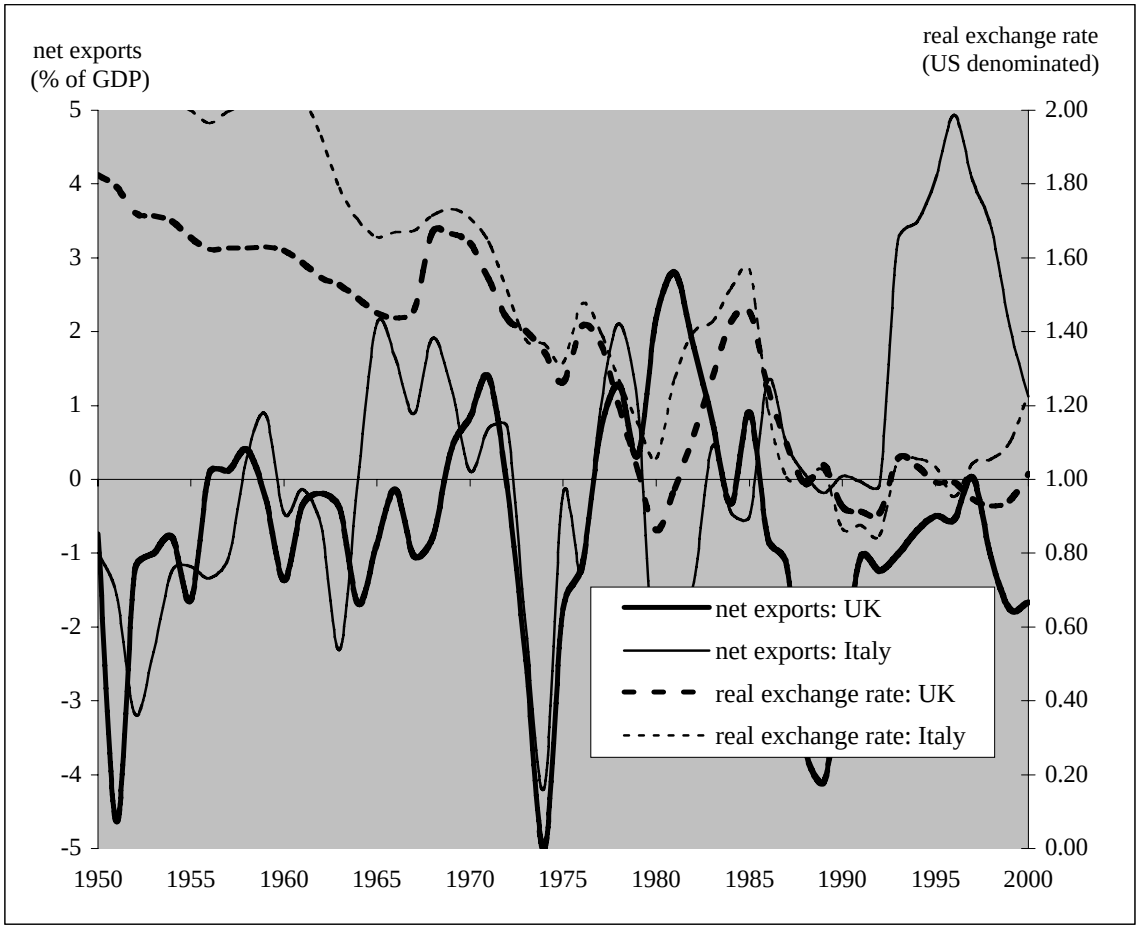
The PWT includes measures of all the variables added in our open economy extension; see Table 1 for the details. Figure 4 compares the official national accounts definition of US net exports with that derived from PWT; the two series track well. For modeling consistency we redefine the trade balance as a percent of natural GDP, rather than actual. We measure the foreign GDP gap by aggregating all observations of real GDP (except the particular country being studied) to obtain the rest of world total, which is compared to the similar aggregation for natural GDP to define the foreign output shock.

Figure 4. Comparing trade balance statistics: US



As examples Figure 5 shows the Italy and UK real trade balance series. These were volatile even before the end of the Bretton Woods system in 1973. It is hard to see much bivariate support for the inverse link between real exchange rates and net exports in these two countries, especially during Bretton Woods. We note that the PWT definition of real exchange rates is less than ideal because it takes US prices as its base. The PWT rate may be especially inaccurate for countries that trade little with the US. Although it would be better to recognize existing trading patterns with a trade-weighted average of the real exchange rates, this is infeasible with these data.

Figure 5. Trade balances and real exchange rate: Italy and the UK



9. Extension estimates

Table 4 reports estimation results for these extended models, (10) and (12) with and without (7), for the same 17 countries and years as in Table 3.[18] The adaptive expectations results for model (q) seem plausible.[19] By accounting for the linkage between net exports and output, our open economy extensions improve the R^2 of the growth equation. The estimates of the net export parameters are theoretically expected and statistically significant; model (q) suggests that a one percent increase in the GDP gap produces a decrease in net exports of 0.28%. Likewise, a one percent increase in the foreign gap produces an increase in domestic net exports of 0.32%.

[18] A US model is not estimated because the US is basis of comparison for all real exchange rates, so that by definition z=0 in all US observations.

[19] For comparison the VAR(1) benchmark model achieves a log likelihood of –4325. No doubt the benchmark fits better because of the poor fit for our trade balance equation..

Table 4. Open economy results, 1958-1998, 17 OECD countries, 659 observations
(*t*-ratios in parentheses)

	(q)	(r)	(s)	(t)	(u)	(v)	(w)	(x)
expectations model	adaptive	rational	adaptive	rational	adaptive	rational	adaptive	rational
Phillips curve slope	0.26	1.64	0.59	1.15	0.27	1.65	0.60	1.20
	(10.30)	(11.92)	(5.94)	(7.06)	(11.06)	(12.32)	(6.19)	(7.50)
government target	5.55	5.25	4.52	4.51	7.17	6.48	5.29	5.42
	(14.46)	(36.46)	(10.86)	(11.44)	(7.77)	(17.47)	(5.35)	(5.72)
central banker target					2.47	3.01	2.69	2.65
					(2.10)*	(3.92)*	(1.14)*	(1.26)*
government ideology					-3.88	-2.39	-7.11	-4.60
					(-1.27)	(-2.00)	(-2.22)	(-1.50)
domestic gap	-0.28	1.33	-1.17	2.35	-0.28	4.74	-1.17	2.67
	(-6.27)	(4.33)	(-7.11)	(3.77)	(-6.13)	(3.77)	(-7.45)	(3.80)
foreign world gap	0.32	4.61	0.91	-2.24	0.33	-1.64	0.90	2.35
	(4.01)	(4.04)	(8.47)	(-6.73)	(3.98)	(-4.01)	(8.49)	(4.19)
real exchange rate	-1.19	-1.60	3.47	-3.04	-1.16	-0.78	3.44	-2.22
	(-2.78)	(-4.11)	(5.28)	(-3.56)	(-2.63)	(-2.32)	(5.13)	(-7.22)
energy shock	0.21	-0.86	0.44	2.83	0.20	1.19	0.41	-3.06
	(1.24)	(-2.54)	(2.56)	(4.00)	(1.17)	(3.90)	(2.42)	(-3.86)
inflation adjustment rate			1	0.24			1	0.25
				(12.51)				(12.17)
growth adjustment rate			0.60	0.45			0.61	0.45
			(14.66)	(25.72)			(14.95)	(25.73)
trade adjustment rate			0.07	0.13			0.07	0.13
			(4.10)	(6.60)			(4.07)	(6.53)
DW (inflation)	2.27	0.44	2.27	2.12	2.25	0.44	2.26	2.12
DW (growth)	1.68	0.44	2.09	2.07	1.69	0.44	2.09	2.07
DW (trade)	0.35	0.37	2.01	1.93	0.34	0.37	2.01	1.93
R^2 (inflation)	0.64	0.08	0.66	0.65	0.65	0.10	0.66	0.66
R^2 (growth)	0.27	0.19	0.40	0.37	0.28	0.19	0.40	0.37
R^2 (trade)	0.02	0.04	0.71	0.73	0.02	0.04	0.71	0.73
log likelihood	-4757	-5259	-4210	-4204	-4753	-5247	-4207	-4201

* Tests the hypothesis that the central bank's target differs from the government's.

With respect to expectation formation, the results are mixed. By a small margin the rational model with partial adjustment has the best overall fit. However, this model is questionable for several reasons. For one, it implies a rather slow convergence to its long-run equilibrium. The adjustment rate is so slow in the trade equation that it is doubtful whether governments really pursue trade policies under either assumption about expectations. The slow convergence in the net exports equation contrasts with a rapid adjustment for inflation and growth under the adaptive model; in models (s) and (w) we restrict the inflation model to full

adjustment because in the unrestricted regressions δ_π exceed 1.[20] We have further doubts about the rational-adjustment model because three of the six trade parameters in models (v) and (x) have the wrong sign.[21] And finally, the three-equation adaptive model resolves the concern over the unexpected energy shock effects in Table 3 (possibly due to omitted variable bias), while the rational model does not.

Comparing the results in Tables 3 and 4 further, this extension reduces somewhat the specification uncertainty about Phillips curve, although estimates still range from steep to flat. The open economy extension validates our inference that central bank conservatism and government ideology affect stabilization policy, see model (u). Furthermore, the extension also validates the prediction that energy shocks have a positive effect on inflation, at least under the adaptive model of expectations.

Our preferred specification is (u) because all estimates have predictable signs, even though the government ideology and energy shock effects are insignificant. Because we are more concerned about understanding the determinants of growth and inflation than foreign trade, we ignore the evidence of slow adjustment in the trade equation. We view the poor fit of the trade equation as preferable to the *ad hoc* modification in model (w). Moreover, we have no explanation for the unexpected sign of the exchange rate effect in (w). We conclude that the adaptive expectation hypothesis is better supported by observation than the rational one despite better fitting, but theoretically questionable results for models (v) and (x).

10. Conclusion

This paper extends a theory of political and macroeconomic interaction to the open economy, and tests its relevance to the macroeconomic history in a sample of OECD countries. The extension adds a tradeoff between growth and trade balances and two additional exogenous variables, the state of the world economy and the country's real exchange rate. Although our three-equation regression model explains only a small fraction of the variation in net exports (unless we modify the model for partial adjustment), the open economy extension is interesting because it improves the fit of our growth equation. The slow adjustment rate suggests the need for a better model of endogenous foreign trade policy.

Noteworthy among the results is our evidence that independent central banks with conservative governors have reduced the inherent inflationary bias, and that rightwing governments ideology have lower

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[20] The unrestricted estimate of δ_π is 1.17 in model (s), and 1.12 in model (w).
[21] While only one of the six trade effects in models (u) and (w) are unexpected.

inflation targets. All versions of the partisan business cycle model fit the data well, as long as we invoke an adaptive, rather than a rational, theory of expectations. Even with careful modeling, the strongly rational model of expectations is a poor fit, unless we rewrite it as a model of incomplete adjustment and ignore the unexpected signs that result. We might infer that the rational expectations approach is more useful as a definition of the long-run tendency, than as an explanation of short-run macrodynamics. This is consistent with the result that both the adaptive and rational models converge to the same long-run equilibrium. Or, we might infer that economic agents are less sophisticated than the strongly rational model assumes.

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