

Some Preliminary Results on Capital and Unemployment

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Abstract

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This paper examines the role of capital in regulating the equilibrium unemployment rate in advanced capitalist countries. Under the assumption that the mark-up is conditioned by the rate of capacity utilization, the price-setting relationship in the standard conflict model of inflation depends on the amount of capital per active worker, or the capital-workforce ratio. A capital shortage will thus increase the inflation-neutral unemployment rate, temporarily in models with persistence, and permanently in models with path dependence. Depending on the nature of the wage-setting relationship, the real wage and the wage share can decline as well. We test these nested hypotheses in a panel of 20 OECD economies from 1960-2000, using a standard econometric specification with controls for institutional factors. The capital-workforce ratio appears to be significantly and negatively correlated with the unemployment rate, and positively correlated with the unadjusted wage share. However, it is not significantly related to the wage share adjusted for self-employment income. These results lend good support for the broader thesis that high unemployment in Europe over the last two decades of the sample is partly caused by a capital shortage, and at least some support for the thesis that the recent relative decline in the wage share in Europe stems in part from the same cause.

This paper is motivated by two stylized facts, one of which has given rise to a fairly extensive literature. First, the unemployment rate in the core European economies rose dramatically after the turbulence of the 1970s, overtaking the unemployment rate in the US, which rose much less. Second, the wage share in the European economies seems to have collapsed sharply, again after rising during the turbulent 1970s, while the wage share in the US has remained comparatively stable over the same period. A leading explanation for the first fact has been that the EC must have evolved some employment-unfriendly institutions (unions, generous unemployment insurance, etc.) that alone or in combination with various macroeconomic shocks drove up the unemployment rate by enhancing the bargaining power of workers. Some writers have stressed the role played by insufficient capital formation in the EC, either as a complementary or a stand-alone explanation. Few have considered the second stylized fact problematic for the Eurosclerosis hypothesis,¹ even though it would seem to contradict the putative effect of protective labor market institutions on worker bargaining power. Our goal is not to resolve the controversy over European unemployment. Instead we offer some new (it is hoped) insights into how to integrate these two underlying factors by investigating the behavior of the ratio of capital to the workforce, an analytical ratio that we believe deserves more attention from applied macroeconomists.²

1 Theory

We begin with a series of interrelated macroeconomic models to highlight the role of capital accumulation in the labor market. The objective is mainly to impose some minimal discipline and structure that we can take to the data in the form of a pair of nested hypotheses, but we also seek to identify some of the limitations of existing modelling efforts. It might seem that there is an almost trivial relationship between capital and unemployment, but that would be wrong. In the Solow growth model, for example, labor is supplied inelastically in each period, and by virtue of changes of technique along a well-behaved neoclassical production function labor remains fully employed no matter how much or little capital happens to have been accumulated.

1.1 Capital and unemployment

The technology is assumed to be well-approximated by the Leontief production function, or perhaps more accurately described here as a *utilization function* since firms operate within the engineering limits of capacity. We represent

¹Two exceptions are Stockhammer (2007) who points out that declining wage shares in Europe have not been associated with job growth and Blanchard (2006) who does try to reconcile the two facts and who also provides an up-to-date survey of the literature on these issues. For an older, but still relevant survey, see Bean (1994).

²The traditional method of operationalizing the capital shortage hypothesis has been to include the rate of capital accumulation in an econometric specification, usually of an employment equation. See Rowthorn (1995) or Stockhammer (2004).

the rate of capacity utilization by the symbol u , the employment rate by the symbol $e (= E/L)$, where E is employment and L is the workforce (aka the labor force), and the unemployment rate by $1 - e$. At the desired or normal rate of capacity utilization, which we can normalize to $u = 1$ when that is appropriate, the productivity of labor, $x = X/E$, and productivity of capital, $\rho = X/K$, determine the demand for labor created by the capital stock. Using $k = x/\rho$ to denote the capital-labor ratio, we have $E = K/k$. We are abstracting from technical change, but that can be introduced through trends in the parameters of the Leontief function, as we briefly discuss below en route to the empirical section.

In the event that the system operates away from its normal rate of utilization, the level of output will depend on the properties of the utilization function. Given the obvious fact that technology is engineered, it is reasonable to assume that the utilization function displays constant (or even increasing returns) to labor as long as we are operating below the engineering limits of technology. Thus, the level of employment will be $E = uK/k$.³

Defining the ratio of capital to the workforce (*not* to employment, which is why we use a Greek letter to denote the *capital-workforce ratio*) as $\kappa = K/L$, we have a relationship that will prove central to the development of this paper,

$$e = \left(\frac{u}{k}\right) \kappa,$$

for it brings out the mechanisms through which the equilibrium (un)employment rate can display persistence or even path dependency and hysteresis related to the capital-workforce ratio.

The relationship between capacity utilization and the unemployment rate, taking the technology and the capital-workforce ratio as (roughly) fixed at business cycle frequencies, can be derived from the utilization function given above:

$$u = \frac{k}{\kappa} - \frac{k}{\kappa}(1 - e)$$

This relationship (perhaps a distant cousin of the Beveridge curve?) can be given empirical content and used to interrogate the statistical record for signs of a capital shortage, which should show up as an outward shift/rotation. Any given utilization rate will be associated with a higher unemployment rate as the result of a shortfall in the capital-workforce ratio. Indeed, there is a tradition of citing precisely this dislocation as evidence that at least some of the increased European unemployment in the 1980s and 1990s was caused by insufficient investment: our Figure 1 updates a similar diptych presented in Bean (1994). It is clear that the EU suffered a more pronounced displacement in the 1980s than the US, and that the displacement continues through the subsequent decade, providing excellent *prima facie* evidence for the capital shortage hypothesis.

³Note that this treats changes in utilization as akin to Solow-neutral technical changes; they do not affect the productivity of labor but do change the observed output-capital ratio.

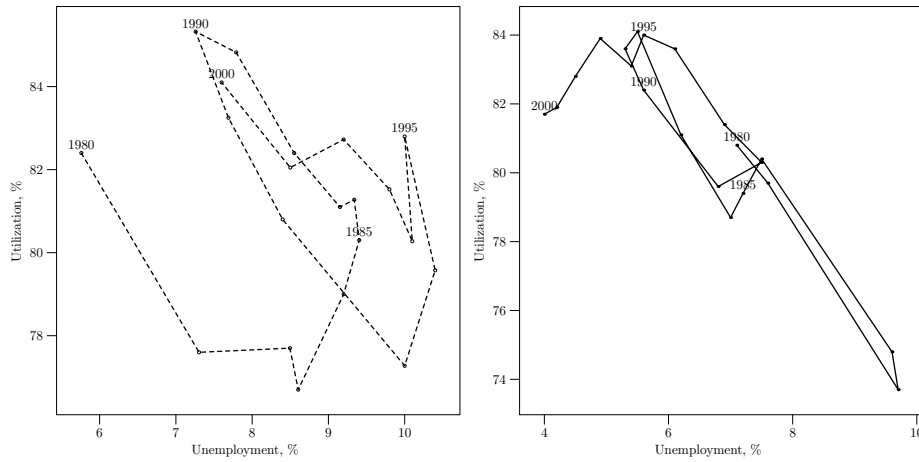


Figure 1: Utilization vs Unemployment in the EC15 (left panel) and US (right panel). Sources: European Commission (2007) for utilization in the EC15, Council of Economic Advisors (2007) for utilization in the US, Directorate General for Economic and Financial Affairs (2007) for unemployment rates.

1.2 A Model with Persistence

Our first model draws on the established literature on the natural rate of unemployment or NAIRU.⁴ As in Soskice and Carlin (1989), a seminal paper on the capital shortage hypothesis, this model has a unique natural rate and displays persistence. Subsequent models treat the labor market more abstractly in order to illustrate the more dramatic possibility of hysteresis or path dependence.⁵

1.2.1 Equilibrium employment

The wage-setting curve represents the target real wage, w^{WS} , as a function of a vector of institutional factors (union density, unemployment insurance, etc.) that have been identified in the empirical literature, \mathbf{z} , and the employment rate.

⁴Because there is some confusion over these terms, let us be clear. We use the natural rate of unemployment as a synonym for the equilibrium rate of unemployment, defined by stability of the inflation rate, so this is also synonymous with the NAIRU. Some authors reserve the term natural rate to refer to the absence of involuntary unemployment in the labor market, and in the conflict model of inflation, as Carlin and Soskice (2006) make clear, the NAIRU will typically exceed this version of the natural rate. Use of the term “natural” as a colorful stand-in for “long-run equilibrium” goes back to Adam Smith.

⁵The term hysteresis has fallen victim to etymological drift as it has been appropriated by economists from physics and mathematics. It is now routinely used as a synonym for path dependence (Carlin and Soskice, 2006, p. 117). But as Amable et al. (1993) explain, the original meaning of hysteresis requires that a shock to the system begets a permanent effect that remains (remanence) when the shock is reversed (loading-unloading). Path dependent discrete-time systems have unit roots (or zero roots in continuous time) and thus display sensitivity to initial conditions, but a shock that is reversed leaves no memory. (For this reason, even the term path dependence is a bit misleading; dependence on initial conditions might be more precise.) See also Dutt (1997).

We use a tilde diacritic ($\tilde{}$) to denote a structural coefficient, boldface to denote vectors, and describe more fully the precise institutional factors that might be included below. It will do little harm at this stage to linearize the wage-setting curve thusly,⁶

$$w^{WS} = \tilde{\mathbf{a}}_0 \mathbf{z} + \tilde{a}_1 e$$

The underlying premise is that wages are set under conditions of imperfect competition, so that workers have bargaining power, either individually as in efficiency wage models or collectively under trade unions.

The price-setting curve differs from much of the current literature by virtue of the inclusion of κ , the capital-workforce ratio. Prices are set by imperfectly competitive firms as a mark-up over marginal costs, here assumed to be reducible to labor costs. The mark-up responds to product market conditions reflected by the utilization rate, as in Soskice and Carlin (1989). The evidence on how it responds is discussed more fully in Carlin and Soskice (2006, pp. 614-616) and Rotemberg and Woodford (1999). While it is possible that the mark-up shrinks at high utilization rates because booms are propitious times to introduce new products, or enter existing lines, or because consumers are more price-sensitive during expansions, we will assume that during booms, competition between firms is less vigorous, inviting them to expand their profit margins in a seller's market.⁷

Using m to symbolize the mark-up, W the money wage, and x the (fixed) labor productivity, prices (P) are set just so:

$$P = (1 + m(u))W/x \quad m_u > 0$$

The price-setting function that pairs with the wage-setting function presented earlier can be derived easily. Let us reduce clutter by assuming that the Leontief coefficients are all unity ($x = k = \rho = 1$); we can always re-introduce them below as needed. One nice feature of this assumption is that the real wage and the wage share in value added will share the same numerical value even though they are measured in different units. Linearizing the price-setting function, we have

$$w^{PS} = \tilde{b}_0 - \tilde{b}_1 e + \tilde{b}_2 \kappa$$

Setting $w^{WS} = w^{PS}$ generates a pair of reduced-form equations for the inflation-neutral equilibrium values (indicated by an asterisk) that informs the

⁶Be assured that because there is some evidence that the wage curve is non-linear, we will experiment with some logarithmic forms when we get to the data. It is also possible that the institutional factors affect the slope of the wage-setting curve as well as its position. The empirical specification we have chosen to adapt from the existing literature does not incorporate this possibility, but as we discuss, there is a branch of the literature that does allow for interactions between macroeconomic shocks and institutions.

⁷It is worth remarking that this monotonic treatment of the mark-up rules out the possibility of multiple equilibria in the model of the natural rate of employment elaborated below, so this is not an innocent assumption.

empirical sections to follow. Using unadorned (no tilde) Roman letters to denote consolidating coefficients, we have

$$e^* = \mathbf{a}_0 \mathbf{z} + a_1 \kappa \quad (1)$$

$$w^* = \mathbf{b}_0 \mathbf{z} + b_1 \kappa \quad (2)$$

From this system, we can concisely state a pair of nested hypotheses. First, we expect to see the capital-workforce ratio directly related to the employment rate and inversely related to the unemployment rate, $(1 - e)$. This depends only on the parameter \tilde{b}_2 that measures the feedback from κ to the price-setting curve. Second, we expect to see the capital-workforce ratio directly related to the wage share in value added. This depends both on \tilde{b}_2 and on \tilde{a}_1 , the parameter that measures the sensitivity of the wage curve to (un)employment.

If we want to believe that the normal or desired utilization rate anchors the system at some time scale, the conflict theory of inflation, at least as presented here, limits the possible outcomes for the simple reason that our price-setting equation allows only one wage (and wage share) to be associated with normal utilization. A reduction in κ , for example, that lowers the wage and wage share will put the system in labor market equilibrium at an above-normal utilization rate (assuming we began at the normal rate). If there is a negative feedback mechanism through the investment equation (an “accelerator”), as in Soskice and Carlin (1989), this equilibrium can only be temporary, and the system will be driven back to its original position. Only if the wage setting curve is horizontal can the natural rate of employment change without violating our belief in a normal utilization rate. While there is good evidence that the wage setting curve is not horizontal (Blanchflower and Oswald, 1994) in the short run, we can legitimately ask if the data support this belief at lower frequencies.

In the conflict theory of inflation (Rowthorn, 1977), the actual real wage (w) will depend on the lag structure of prices and nominal wages, and could lie anywhere between w^{WS} and w^{PS} for any given level of employment. We might assume, for instance, that money wages are established after firms set their prices, so that the actual real wage (and wage share) will be equal to the bargained real wage, w^{WS} .⁸ Firms then adjust prices in order to close the aspirations gap and achieve their desired profit margin, triggering a wage-price spiral. This process has an inertial quality, either because inflation expectations are adaptive or because institutional frictions prevent instantaneous price adjustments. The inflation process can be described by an expectations-augmented Phillips curve or an inertia-augmented Phillips curve, and either way a good linear approximation can be written using p to represent the rate of growth of

⁸This assumption would be consistent with evidence that suggests (and this is the *mot juste*) that real wages are either acyclic or mildly procyclical, which is hard to explain if the mark-up is procyclical and firms achieve their desired mark-up. However, there is some evidence that the product real wage, as opposed to the consumption wage, is mildly countercyclical (Abraham and Haltiwanger, 1995), consistent with the polar assumption that the price-setting curve dominates.

the price level, leaving the time subscript implicit to cut down on clutter, and using the subscript +1 to represent $t + 1$,

$$p_{+1} = p + \alpha(e - e^*) \quad (3)$$

We now have a supply-side foundation upon which to construct a model of employment. What is needed is some account of capital accumulation and aggregate demand.

1.2.2 Aggregate demand

Drawing on the post-Keynesian and structuralist macroeconomic literature surveyed by Taylor (2004), we assume that all saving originates in profits, with s representing the saving rate out of profit. Let π represent the profit share, which is just $1 - w$ under our unit-technology ($x = 1$) assumption, and we have a saving equation normalized by the capital stock (and hence in growth terms), thus

$$g^s = s\pi u$$

Investment is assumed to depend on some autonomous component (animal spirits?), the rate of utilization (which captures accelerator effects as well as potential profitability effects), and the real rate of interest, R , thus.⁹

$$g^i = c_0 + c_1 u - c_2 R$$

Equality between planned investment and saving is achieved through changes in the utilization rate—the principle of effective demand that expresses itself formally in an IS curve.

In this case, because the profit share depends on the employment level through the wage-setting curve, the IS curve turns out to be a quadratic equation of form $u(\kappa, R) = 0$. (This is also true if we assume that the actual real wage is read off the price-setting curve.) For simplicity, let us linearize the IS curve, writing it

$$u = u_0 + u_1 \kappa - u_2 R \quad (4)$$

We assume that the interest rate is set by a monetary authority that targets the inflation rate (\bar{p}) and remains informed about the inflation-neutral rate of interest, R_n .¹⁰

$$R_{+1} = R_n + h(p - \bar{p}) \quad (5)$$

Finally, we follow convention and treat the workforce as fully exogenous, growing at the natural rate, n . This assumption together with equations (3) and (5) more or less forces accumulation to keep pace with population growth.

⁹Many writers in the structuralist literature expand this list to include the profit share, a more direct indicator of profitability. The classic reference is (Bhaduri and Marglin, 1990).

¹⁰If the monetary authority chooses the wrong value for R_n , they will miss their target inflation rate in the steady state, but otherwise the model performs similarly.

1.2.3 Persistence

Starting from the definition of κ and equations (1)—(5), this model reassembles itself into a system of nonlinear, autonomous first-order difference equations.¹¹ In the long run, assuming the stability conditions are satisfied by the monetary authorities choosing a suitable reaction parameter, h , it gravitates toward a unique natural rate of (un)employment, capital-workforce ratio, utilization rate and interest rate. There is nothing here to force the utilization rate toward some desired or normal level, making our earlier normalization of u moot.¹² The model does not display any exotic path dependent properties, but it does display persistence, and therein lies the significance of the capital-workforce variable that we have chosen to investigate.

We illustrate this point by the numerical example in Figure 2. In this example, we have incremented the parameter a_1 in order to dramatize the effect of the feedback from capital accumulation to the (temporary) natural rate of employment. We have also adjusted the values of a_0 in these examples for mathematical coherence; each simulation begins in a steady state. The scenario represented is a disinflation caused by a reduction in \bar{p} , which aptly corresponds to the historical record we investigate, particularly the European response (Ball, 1999) to the high inflation generated during the 1970s. What is happening here is that in each period there is a temporary equilibrium employment rate, described by equation (1), that evolves along with κ , pulling the inflation process along behind. Greater feedback slows the full adjustment process visibly.

These examples also illustrate the importance of stock-flow consistency, a topic that has attracted considerable attention among post-Keynesian and structuralist macroeconomists recently (Taylor, 2004; Godley and Lavoie, 2007). The accounting fact that today's investment shows up as tomorrow's capital lies at the root of the persistence generating mechanism.

1.3 Models with hysteresis

It is possible to alter the structure of this model so that it generates path dependence in κ and e . For brevity's sake, let us remove the labor market

¹¹To be more precise, the system takes the form

$$\begin{aligned} p_{+1} &= p(p, \kappa, R) \\ \kappa_{+1} &= \kappa(\kappa, R) \\ R_{+1} &= R(p) \end{aligned}$$

and will be stable when the determinate of the Jacobian lies within the unit circle. The first two equations identify the conditions for a stationary equilibrium in the state variables (i.e., $p_{+1} = p$ and $\kappa_{+1} = \kappa$), and because they do not collapse into one another they identify unique steady state values for R and κ .

¹²There is an on-going controversy between more classically inclined and more Keynesian economists about the proper treatment of the utilization rate in the long run, with the latter somewhat less concerned about making the utilization rate an endogenous variable. Lavoie et al. (2004) provide a fairly balanced survey of this debate and a defense of their own Keynesian position.

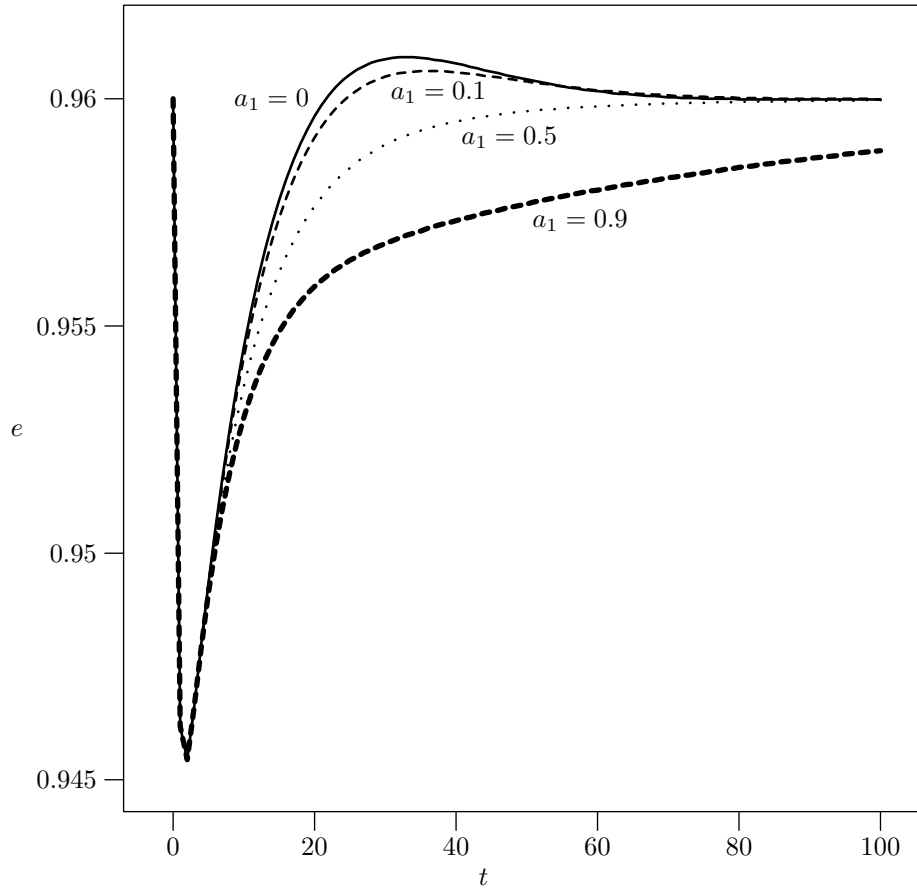


Figure 2: As the feedback coefficient (a_1) from the capital-workforce ratio (κ) increases, the persistence of a disinflationary shock intensifies, as illustrated by these transients for the employment rate, e . The system begins in a steady state with $e^* = 0.96$. Here as a_1 increments, we have also adjusted a_0 through these values: 0.96, 0.84, 0.48, 0.10. Other parameters are $n = 0.05$, $b_0 = 0.6$, $b_1 = 0.1$, $b_2 = 0.1$, $\alpha = 0.5$, $c_0 = 0.05$, $c_1 = 0.01$, $c_2 = 0.1$, $\bar{p} = 0.05$, $p(0) = 0.10$, and $R_n = 0.10$. We selected $u_0 = 1.048$, $u_1 = 0.25$, $u_2 = 2.88$ to approximate the true IS curve for $s = 0.125$, $\tilde{a}_0 = 0.5$ and $\tilde{a}_1 = 0.1$. Finally, we set $h = 0.10$, well below the determinant of the Jacobian, 0.75.

component, replacing it with the assumption that income shares are parametric, and let us replace the monetary authority with some more abstract expression capturing the homeostatic forcing process. We can do this fairly easily by writing the investment equation

$$g^i = c + c_1 u$$

where c (with time subscript suppressed) represents the injection components of aggregate demand that induce homeostasis. To give credit where due, this modeling device has been freely cribbed from Dutt (2006). Letting β represent the multiplier, the demand system reduces to

$$u = \beta c \quad g = s\pi\beta c$$

There is also a degree of freedom left in choosing a labor market closure. Heterodox economists have proposed that the labor supply should be considered an endogenous variable, much as the classical economists suggested, and we start with this closure.

1.3.1 Endogenous growth with a classical flavor

By linking the homeostatic process to the utilization rate, Duménil and Lévy (1999) have proposed a model that is Keynesian in the short run but classical in the long run. In terms of our simple model of aggregate demand and accumulation, we write the homeostatic process (sticking to the convention that the desired rate of utilization is 1, since that makes sense here),

$$c_{+1} = c - \theta_1(u - 1)$$

The idea is that low utilization will be associated with falling prices or falling inflation, which will allow the central bank to encourage the expansion of liquidity, thus stimulating aggregate demand.

The original Dumenil-Levy model was purely endogenous, with the labor supply implicitly treated as if there is a reserve of excess labor available to be mobilized as needed. We can formalize this process by assuming that the growth rate of the workforce responds to the growth rate of jobs (g_E) through an adjustment process such as

$$n_{+1} = n + \lambda(g_E - n)n$$

Now we have a model that gravitates toward a steady state with full or normal utilization ($u = 1$), and with growth described by the Cambridge equation, $g = s\pi$, which accounts for its long run classical flavor. However, the capital stock evolves along its own path, and the workforce more or less plays catch-up. As a result, the capital-workforce ratio will display path dependence.¹³ A temporary negative demand shock (reduction in c) will permanently reduce the level

¹³Consider two of the three state variables, n and κ , in the model. In the limit as the third state variable (whose equation of motion is decoupled since $u = \beta c$) achieves its steady state value ($c_{+1} = c$) the stationary conditions for the other two collapse to the same equation, $s\pi = n$. This is the signature of a unit root system with path dependence.

of capital even as it leaves its long run growth rate unchanged. This structure will express itself in the path of κ as well, and since $e = u\kappa$, the employment and unemployment rates will also display path dependence.¹⁴

1.3.2 Exogenous growth with a Keynesian flavor

By linking the homeostatic process to the growth (rather than to the level) of unemployment, Dutt (2006) offers a model of exogenous growth with distinctly Keynesian properties at every time scale. The homeostatic process is

$$c_{+1} = c + \theta_2(g_E - n)n$$

where the natural rate of growth is parametric. The idea is that rising unemployment ($g_E < n$) stimulates the monetary and/or fiscal authorities to respond in a stabilizing direction. This assumption also draws on the literature on labor market hysteresis induced, for example, by insider-outsider effects.

This model gravitates toward a steady state with the natural rate of growth ($g = n$) but the rate of utilization will be governed by the principle of effective demand so that $u = n/(s\pi)$ in the steady state. Thus, unlike the previous model, even in the long run this one exhibits the twin paradoxes of thrift and cost wherein an increase in the saving rate or the profit share (equivalently a reduction in the real wage) expresses itself in lower utilization.

Like the previous model, however, this model displays path dependence in κ and e .¹⁵ Again, a temporary demand shock will permanently lower the level of capital and employment. Since hysteresis in the labor market is built into the homeostatic process, it might be more accurate to say that the capital-workforce ratio sustains this path dependence rather than causing it.

1.4 Hysteresis with a neoclassical production function

While all the results surveyed rest on a fixed coefficient technology, Rowthorn (1999) offers a model that utilizes a traditional neoclassical production function, a generalization of work done by Layard et al. (1991) who conclude that with Cobb-Douglas technology, a capital shortage will not affect the natural rate of unemployment because of strong substitution effects. Their model generates a natural rate of employment through bargaining between monopolistically competitive firms and monopoly trade unions. The natural rate of employment

¹⁴Michl (2008) elaborates two versions of this model incorporating the central bank reaction function as in the previous section of this paper and a conflict model of inflation specialized to the case with a horizontal wage curve (which seems to be what it takes to get the inflation process tied to utilization rather than employment). One takes up a similar endogenous closure, but the other is premised on the assumption that $n = s\pi$, making it a special purpose tool that illustrates how even under the traditional closure with an exogenous workforce, it is possible to generate accumulation-driven path dependencies that might frustrate a central bank intent on implementing a Taylor rule.

¹⁵The two state variables are c and κ . Their stationary conditions collapse to the same equation, $s\pi\beta c = n$, signifying path dependence in κ . (The steady state value of c will be $n/(s\pi\beta)$.) Since $e = u\kappa$ it is clear that e will also be path dependent.

functions to reconcile the unions to the wage share they must come to accept in order to stabilize inflation. Since the wage share under Cobb-Douglas technology is unaffected by the capital-labor ratio, a capital shortage can not affect the natural rate. This conclusion depends critically on the Cobb-Douglas technology for as Rowthorn (1999) observes, if the elasticity of substitution between labor and capital is constant but less than unity (and he provides survey evidence that this is indeed the case), the conflict model of inflation can produce hysteresis from a capital shortage.¹⁶

Rowthorn's *sui generis* growth model effectively imposes Say's Law by suppressing the saving function; it utilizes an investment equation similar to ours but with the inclusion of the profit share. Imposing Say's Law puts the system at full utilization and renders the utilization rate moot in the investment equation. An increase in the interest rate will retard capital accumulation, and the reduced labor market pressure will lower the real wage and (with a less than unitary elasticity of substitution) the wage share. As a result, more unemployment is needed to reconcile the unions to the wage share available to them. As long as the interest rate stays high, offsetting the effect of a higher profit share on investment, the system can achieve the natural rate of growth indefinitely at a lower employment rate. All this is driven by changes in the capital-labor ratio, which would obviously be the variable of choice for an empirical implementation of the model, but it seems reasonable to believe that the capital-workforce ratio might be a close stand-in.

1.5 Some theoretical conclusions

The accumulation of capital can play an important role in the labor market in a broad variety of models (classical, Keynesian, and neoclassical), although to be frank it does not seem that any of these approaches has achieved an intellectually satisfying integration of the employment of capital and labor in both the short and long runs. In the standard conflict model of the labor market elaborated here, we show that if firms set their mark-up and target profit margin based on the rate of capacity utilization, there is an important role for capital in shaping the temporary labor market equilibrium. From this discussion, we nest two hypotheses: capital affects the equilibrium employment rate, and capital affects the wage share. Even though the capital-workforce ratio and the employment rate ultimately return to their unique long-run equilibrium levels, in the face of shocks the transient path displays persistence that reflects the feedback from capital to price formation as well as the stock-flow dynamics of capital accumulation. We also survey several somewhat more abstract models of accumulation in which capital plays a central role in creating or sustaining path dependence in the employment rate. These are relevant for the remaining sections because we are skeptical that empirical methods can discriminate well between persistence and full-blown hysteresis, which are more or less analogous

¹⁶Kapadia (2005) points out that the CES production function includes no underlying concept of capacity, and constructs an interesting model built around a "capital constrained" Cobb-Douglas function with a discrete kink at full capacity.

Table 1: **Summary Statistics for 20 OECD Countries**

	Mean	Std. Dev.	Min	Max
Unemployment Rate (%)	5.124	3.701	0.004	16.414
Wage Share (%)	57.161	5.504	43.555	70.692
Adjusted Wage Share (%)	70.090	4.987	53.677	85.574
Employment Protection (index)	1.025	0.584	0	2
Union Density (%)	41.5795	17.975	9	88.689
Bargaining Coordination (index)	2.068	0.608	1	3
Replacement Rate (%)	38.846	18.521	1.596	76.925
Benefit Duration (index)	0.445	0.343	0	1.041
Tax Wedge (%)	46.155	13.182	3.800	80.472
Home Ownership (%)	53.638	16.086	0	78
Δp (% per year)	0.041	1.093	-3.831	3.575
κ (1000 EUR per worker)	77.458	34.492	12.424	2000.060
adjusted κ (1000 EUR per effective worker)	141.7549	42.818	63.885	303.830

Notes: Sample includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway Portugal, Sweden, Switzerland, United Kingdom, United States. Sources: Baker et al. (2005), Directorate General for Economic and Financial Affairs (2007), Heston et al. (2006), and authors's calculations

to HIV and full-blown AIDS from the point of view of the unemployed. These efforts all suggest that the ratio of capital to the workforce would be a useful analytical ratio for applied macroeconomists puzzling over, for example, the differences in the behavior of unemployment and distribution in the US and Europe.

2 Empirical Strategy

Our strategy is to estimate some version of equation (1) first, and if that is successful, move on to equation (2), drawing on the existing literature on OECD unemployment for guidance in the choice of the control variables, econometric specifications, and techniques. There are also some thorny conceptual issues we need to tackle in order to implement this simple model, and we begin with these. While it has been convenient to arrange our discussion of theory around the employment rate, we now switch over to the traditional unit of observation, the unemployment rate.

A summary of the variables used is provided in Table 1 to accompany our discussion.

2.1 Technical change

The various models presented above all abstract from changes in technology due to improvements in knowledge. There is a well-established method for extending static models that works well under the assumption that technical change is Harrod-neutral, meaning that it does not disturb the productivity of capital. In this case, we can reconceptualize the workforce by measuring workers in effective labor units that are natural units (e.g., number of people) adjusted for the technical changes in the productivity of labor.

This methodology is usually applied to the technical coefficients themselves but we have extended it to our capital-workforce ratio by adjusting the workforce data using an index of labor productivity.¹⁷ Our adjusted ratio is thus the ratio $K/(xL)$, where x represents an index of labor productivity. We chose our baseline to be one U.S. worker in 2000, who we treat as equivalent to one effective unit of labor. For each country in each year, we divide by the value of x in that county and year to convert to capital per effective unit of labor. In this way, we re-express all the data in effective labor units both over time and across countries (relative to the putative technology frontier, the U.S.).

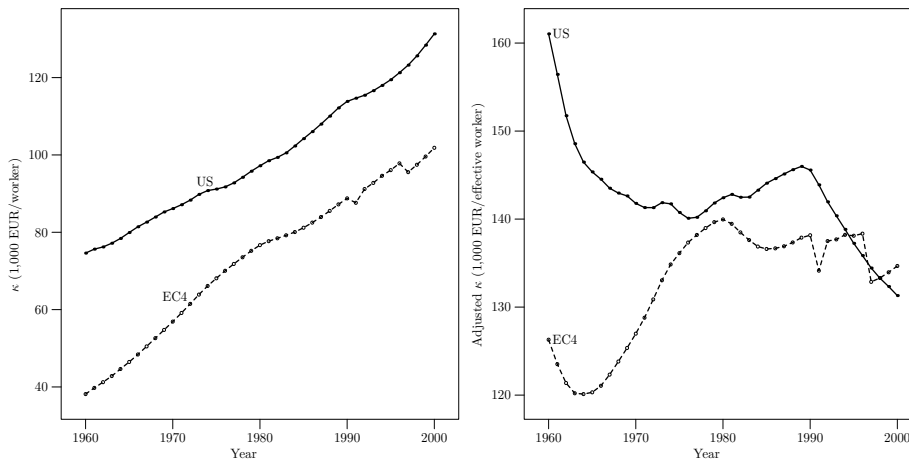


Figure 3: The capital-workforce ratio (left panel) and the adjusted capital-workforce ratio (right panel) in the US and core European countries (Germany, France, Italy, Spain). Source: Directorate General for Economic and Financial Affairs (2007), Heston et al. (2006), and authors's calculations.

While the assumption of neutral technical change is a convenient one, it also does not seem very well-motivated theoretically (why is technical change neutral) or empirically (the productivity of capital is not time-invariant). But it is

¹⁷To be more precise, we used the measure of real GDP chain (in PPP International dollars) per worker from the Penn World Tables (Heston et al., 2006) to produce an index of labor productivity. For each country, we fit a cubic function time trend to smooth out random variation and obtain predicted values of real GDP chain per worker. We divided the predicted value for each county in every year by the predicted value for the U.S. in 2000 to obtain the index of labor productivity in terms of worker effectiveness in the U.S. in 2000.

a start. The adjustments to κ should give us an instrument that better captures some of the time-series effects of accumulation, in particular the hypothesized capital shortage in the European countries post-1980. We can see this in Figure 3 showing both the unadjusted and adjusted κ data for the US and the core EC economies where the unemployment problem has been concentrated (Germany, France, Italy, Spain). The raw data don't reveal much, but there is a clear break in the adjusted data in the EC countries after 1980. While this provides visual support to the capital-shortage thesis, full disclosure requires that we admit that some of the individual countries do not fit quite so well. Ireland, a success story after the mid 1980s, and Spain, a notable problem country, zig when they should zag, for example.

One serendipitous corollary of the neutrality assumption is that the identification we made earlier between the real wage and the wage share goes through when the real (product) wage is measured in effective labor units. But even if technical change is not neutral, this identification seems reasonable as long as there is no strong causation between real wages and technology, and we will estimate equation (2) under that maintained assumption.

2.2 Labor force and wage share

The models presented above implicitly conflate the labor force and the population of workers, ignoring the role of inactive workers and the labor force participation rate. One data set that we rely upon, the Annual Macroeconomic (AMECO) Database produced by the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN), does include both the population of adults and the official labor force, and we initially constructed series for κ using both. However, as is well established, the labor force participation rate is strongly endogenous and almost certainly procyclical. Generations of labor economists, studying the relative strength of the "added worker" and "discouraged worker" effects, have concluded that the latter dominate the data at business cycle frequencies. (In fact, this is evident in the descriptive statistics. The participation rate in Europe drops off sharply during the stagnation of the early 1980s, for example.) As a result, we chose to use the adult population as the measure of the workforce. Since our econometric specification does include both time and country dummies (although sometimes using random effects), some of the effects of political, cultural, and institutional differences that might give rise to structural variations in participation rates might, it is hoped, be controlled for indirectly.

The AMECO database also includes the wage share adjusted, it appears, along lines suggested by Gollin (2002) for possible mismeasurement associated with self-employment. Gollin observes that the national income accounting category, labor compensation, often excludes the income of the self-employed. As a result, the share of wages in national income can be underestimated using the "naive" wage share that fails to compensate for this exclusion. Gollin argues that this problem becomes more severe for the poorer countries where large informal sectors proliferate, and shows that adjustments to the data increase

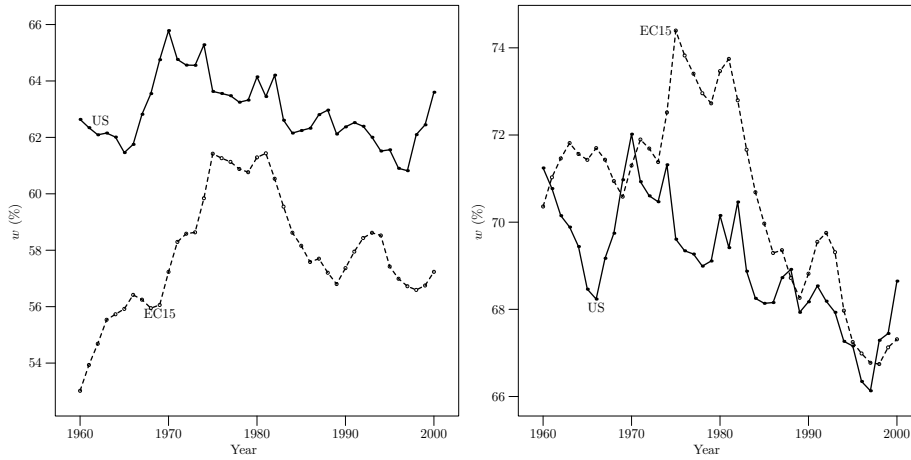


Figure 4: The naive wage share (left panel) and the adjusted wage share (right panel) for the EC15 and US present substantively different accounts of the decline in the wage share since 1980. Source: Directorate General for Economic and Financial Affairs (2007) and authors’s calculations.

their wage shares substantially more than those of developed countries. He offers several adjustment techniques, and the DG ECFIN has used one that is premised on the assumption that the self-employed earn a wage equal to the average wage.¹⁸ Because we are not sure that this assumption makes sense in rich OECD countries, we decided to reconstruct the “naive” wage share from the AMECO database and run all our tests in parallel on both the adjusted and unadjusted wage share data; this decision turned out to be consequential. Figure 4 presents both series; the adjusted wage share data decline much more dramatically than the unadjusted series.

2.3 The control variables

In choosing the institutional factors (i.e., the \mathbf{z} variables) that might affect the equilibrium unemployment rate, we have simply rounded up a list of the usual suspects identified by several prominent experts in the field (Layard et al., 1991; Nickell, 1997; Baker et al., 2005). We had the distinct benefit of access to the master data set (hereafter called the BGHS data set) that accompanies Baker et al. (2005), and that is constructed precisely in order to facilitate replication efforts by providing high-quality data that matches the choices made by the most prominent studies. Since this literature is well surveyed elsewhere (Blanchard, 2006; Nickell et al., 2005; Carlin and Soskice, 2006) we restrict our discussion to a few choice *obiter dicta* about which variables we include and exclude. There

¹⁸Details of the AMECO methodology are provided at the website http://ec.europa.eu/economy_finance/indicators/annual_macro_economic_database/ameco_en.htm. In brief, the naive wage share is multiplied by the ratio of total employment (including self-employed) to total employees (excluding the self-employed).

are broadly speaking three categories of variable: protective labor market institutions, active labor market institutions, and other. (Macroeconomic controls are discussed separately.)

Protective labor market institutions are generally thought to increase the bargaining power of workers and raise the aspirational wage for any given unemployment rate. Thus, a more heavily unionized workforce with more generous unemployment insurance will bargain for a higher wage all else equal. There are some variables in this category that in principle can work either way, however. Famously, the degree to which wage negotiations are co-ordinated and/or centralized (these are not the same) is one, for as Calmfors and Driffil (1988) argue, both a very high and a low level of coordination and centralization reduce the tendency for union negotiators to ignore the employment externalities created by aggressive wage claims, while a medium level maximizes the employment-reducing spillover effects.¹⁹ Employment protection legislation is another variable that in theory can either lower (because it makes firings harder) or raise (because it discourages hirings) the unemployment rate. Two distinct indices of bargaining coordination can be found in the BGHS dataset. Based on the discussion of the two variables in Baker et al. (2005) and the summary statistics presented there, we determine that they use the first one in their full time span regressions because it incorporates more variation over time. Similarly, we use the first index of bargaining coordination in all of our specifications.

Our list of protective labor market institutions comprises union density, bargaining coordination, unemployment benefit replacement rate, unemployment benefit duration, and employment protection legislation.

Active labor market institutions, such as job referral services and the like, increase the efficiency of the job market and lower the unemployment rate. We omit a measure of active labor market policies even though it is widely used in the studies on the subject. This decision rests on the fact that there is not enough independent time series variation in the two variables (the index and the instrument) available in the dataset. This leads to a significant collinearity problem between the active labor market policy measures and the time period dummies. Because the period dummies are crucial to capturing the panel nature of the data, we omit the active labor market policy factor. Baker et al. (2005) also drop the active labor market policy variable in all three models covering the same periods we examine.

Finally, there are some miscellaneous variables not elsewhere classified, and we have chosen two: the tax wedge and the extent of home ownership. The tax wedge between the product wage and the consumption wage is believed to directly contribute to higher product wage aspirations. The extent of home-ownership was suggested by Oswald (1997), and operates like sand thrown in the labor market mechanism, slowing down the geographical relocation that is necessary for modern economies to absorb structural shocks.

We should point out that there does not seem to be a clear consensus about

¹⁹This sounds like and is an argument for including these variables non-linearly but that is rarely done in the established literature.

the role that institutional factors play in the unemployment process, although that is not our central concern. While many writers (Nickell et al., 2005) seem impressed by the explanatory power of even fairly simple econometric models that include these factors, others (Baker et al., 2005; Howell et al., 2007) remain skeptical, citing the lack of robustness, the implausibility and the imprecision of the coefficient estimates across different specifications, time periods, and data sources.²⁰

2.4 Macroeconomic controls

Almost all of the literature focusses on testing the hypothesis that institutional factors account for the patterns of unemployment rates across OECD countries. Different writers choose different methods of controlling for macroeconomic factors and/or exogenous shocks. It is useful to distinguish between factors that influence the equilibrium unemployment rate and those that influence the deviation of actual unemployment from its equilibrium value, which can be called the output gap. Some studies (OECD, 2006, Ch. 7) simply use the output gap directly, that is to say an independently constructed measure of this deviation. But others use more specific measures of macroeconomic policies thought to influence the output gap such as the real interest rate or the terms of trade (real exchange rate). Perhaps the most elegant choice (Nickell, 1997; Baker et al., 2005) is the *change* in the inflation rate, which is suggested by an augmented Phillips curve like our equation (3), and we have elected to use this as our sole control variable for the output gap. It has the distinct advantage of requiring no independent reconstruction of potential output that would require an estimate (possibly wrong) of the equilibrium unemployment rate.

Some of the variables used in the literature are potentially related to the equilibrium rate of unemployment, at least to its temporary values, as is our focal point, the capital-workforce ratio. The relative price of oil (or imports) is often interpreted in this way, because an OPEC-style increase in raw material prices reduces the real value-added per worker and shifts the price-setting curve downward, resulting in a lower equilibrium employment rate. Deviation of labor productivity (sometimes “total factor productivity”) from its trend is also thought to have an effect on the equilibrium employment rate if workers take time to digest the news when a productivity slowdown ensues. Finally, several writers try to capture shifts in the putative labor demand curve by using the residuals from a labor demand curve (Nickell et al., 2005) or by using the wage share adjusted for changes in the real wage (Blanchard and Wolfers, 2000). Since this is more or less what κ is getting at, and since we have an alternative place for the wage share in our study design, we have elected to omit these last two controls from our model. Indeed we also elect to elide the other two variables at this stage of the investigation in order to maintain a clear analytical focus.

²⁰Howell et al. (2007) also raise the issue of reverse causation, since many of the protective institutions seem to have been strengthened by the political authorities as a consequence of high unemployment.

2.5 Specification and methods

Several alternative lines of attack can be discerned in the empirical literature, and we have chosen the most straightforward specification pioneered by Nickell (1997). His benchmark specification is a static model with the five-year average unemployment rate as the dependent variable, estimated in a panel data set with time and country dummies over as many five-year slices as the data support. In his case, that spanned 1983-1994. We have a larger data set that lets us push out the boundaries to the whole 1960-2000 period. We report results for the whole period as well as the smaller period from 1980-2000 on the grounds that according to Howell et al. (2007) the data are poorer quality in the early years due to international standardization and measurement issues.

Much of the more recent literature (Nickell et al., 2005; OECD, 2006) uses annual data (which means that the macroeconomic controls must bear a heavy load), a dynamic specification with a lagged dependent variable, and interaction terms between institutional controls. We prefer the use of period averages because equilibrium unemployment is the object of analysis thrown into relief by the theoretical preliminaries in this paper. We prefer the static specification because our underlying hypothesis suggests that if the capital-workforce ratio affects the temporary equilibrium unemployment rate in a substantive way, this will structure the dynamics in a substantive way. It makes some sense to investigate the former idea before exploring the latter in detail. For the sake of econometric modeling and presentation, we have resolved not to use interaction terms.²¹ There is also an important branch of the literature (Blanchard and Wolfers, 2000) that focusses on interactions between institutions and shocks, and again it seems sensible to test out our hypotheses under simpler conditions before venturing into these waters.

To account for the cross-sectional effects in our panel models we use fixed effects or random effects generalized least squares, a standard practice with the exception of OECD (2006, Ch. 7) which uses ordinary least squares. The choice between fixed and random effects is determined by a Hausman test for correlation between the cross-sectional effects and the other independent variables. In all models we use period dummies to capture the effects of shocks and other influences not picked up by the institutional controls or the macroeconomic factors of interest.

In sum, then, we look at both the full period from 1960-2000 and the shorter period from 1980-2000. We present two sets of results for each specification: first, using all eight periods with base 1960-1964 and second, using only the later four periods with base 1980-1984. We examine both the level and the logarithm of unemployment as dependent variable in equation 1. We examine both the adjusted and unadjusted wage share in equation (2). Finally, we use both the raw and adjusted capital-workforce ratios in all estimations.

²¹We experimented with incorporating interaction terms between the time period dummies and our variables of interest, the capital-to-workforce ratio and the adjusted capital-to-workforce ratio. Unfortunately, doing so either produces another collinearity problem with the period dummies or obscures the results of the Hausman tests.

3 Results

We present the results for our first hypothesis that the capital-workforce ratio affects unemployment before turning to the second hypothesis that it also affects the wage share.

3.1 The unemployment rate.

Our main empirical finding, presented in Tables 2 and 3, is a strong negative relationship between the capital-workforce ratio and the unemployment rate. In all four models where we use κ , we estimate a negative coefficient that is statistically significant at the 1% level. This result lends support to the argument that decreases in the capital-workforce ratio are associated with increases in the unemployment rate and provides evidence for the hypothesis that the systematic shift of the unemployment rate in the European countries is at least partially attributed to the capital shortage they suffered in the 1990s. The credibility of these results is confirmed by the robustness of coefficient estimates across specifications.

The models where we use adjusted κ provide another perspective on understanding the capital-workforce ratio. As can be observed in column 4 of Tables 2 and 3, in the regressions with the shorter time span 1980-2000, the coefficient estimates on adjusted κ are negative and statistically significant, which is consistent with the other findings. However, in the two regressions with the full time span 1960-2000 (column 2 in Table 2 and 3), the coefficients on adjusted κ are not statistically significant. This calls into question the effectiveness of the adjustment, but should not discredit the importance of the capital-workforce ratio in explaining the systematic changes in unemployment. Note that the choice of time span does not affect the statistical significance of the coefficients when the unadjusted ratio is used. In addition, we used the most intuitive and simple adjustment we could perform, and it is highly possible that a more advanced adjustment procedure could produce better results. Furthermore, the models in column 2 of Tables 2 and 3 are the only regressions on the unemployment rate that require fixed effects estimation according to the Hausman test. As opposed to random effects, fixed effects produces less precise estimates with larger standard errors because it uses only the within variation in the data and because the addition of cross-section fixed effects reduces the degrees of freedom. When the same models are reestimated using random effects, the coefficient on adjusted κ in Table 2 is negative and significant at the 1% level and in Table 3 it is negative and marginally significant at the 10% level (with P-value of 10.2%) As a whole, the empirical evidence about the relationship between the capital-workforce ratio and the unemployment rate supports our first hypothesis that capital decumulation in Europe provides key insight into the pattern of rising unemployment.

Another important result is that the coefficients on the largest part of the period dummies in all models in Tables 2 and 3 are positive and statistically significant. Moreover, those that are significant exhibit a pattern, where each

Table 2: **Regressions to explain level unemployment rate (%)**

	(1) 1960-2000	(2) 1960-2000	(3) 1980-2000	(4) 1980-2000
Employment Protection	-0.874* (1.76)	-1.161* (1.67)	-0.862 (0.87)	-0.091 (0.08)
Union Density	0.006 (0.39)	0.068** (2.26)	0.009 (0.42)	0.036 (1.34)
Bargaining Coordination	-0.056 (0.12)	-0.277 (0.32)	0.523 (0.68)	-0.158 (0.18)
Replacement Rate	0.003 (0.25)	-0.021 (1.35)	0.040* (1.78)	0.045* (1.78)
Benefit Duration	-2.721*** (3.16)	0.057 (0.03)	-3.625** (2.47)	-3.135* (1.78)
Tax Wedge	0.045** (1.96)	0.065* (1.71)	0.018 (0.47)	0.001 (0.02)
Home Ownership	0.082*** (4.91)	0.220*** (4.69)	0.106*** (4.07)	0.116*** (3.63)
Dummy for 1960-64				
Dummy for 1965-69	-0.029 (0.04)	-0.756 (1.13)		
Dummy for 1970-74	1.616** (2.16)	0.194 (0.25)		
Dummy for 1975-79	2.823*** (3.52)	0.427 (0.55)		
Dummy for 1980-84	5.644*** (6.85)	2.531*** (3.12)		
Dummy for 1985-89	6.461*** (7.40)	2.890*** (3.28)	0.894 (1.53)	0.568 (0.97)
Dummy for 1990-94	7.741*** (8.41)	3.596*** (4.02)	2.245*** (3.51)	1.451** (2.36)
Dummy for 1995-2000	7.980*** (8.45)	3.337*** (3.67)	2.634*** (3.52)	1.215* (1.74)
Δp (% per year)	-0.428* (1.91)	-0.399* (1.88)	-0.538 (1.43)	-0.585 (1.52)
κ	-0.061*** (6.44)		-0.072*** (4.72)	
adjusted κ		-0.009 (0.66)		-0.036*** (2.88)
R^2	0.718	0.329	0.662	0.535
Hausman P-value	0.016	0.451	0.002	0.001
RE or FE	RE	FE	RE	RE
N	148	148	80	80

Notes:
absolute t-statistic in parenthesis
* significant at 10%
** significant at 5%
*** significant at 1%

Table 3: Regressions to explain log of unemployment rate

	(1)	(2)	(3)	(4)
	1960-2000	1960-2000	1980-2000	1980-2000
Employment Protection	-0.061 (0.33)	-0.387 (1.60)	0.036 (0.20)	0.190 (0.92)
Union Density	0.001 (0.17)	-0.006 (0.55)	0.002 (0.50)	0.007 (1.35)
Bargaining Coordination	-0.315* (1.80)	-0.697** (2.34)	-0.078 (0.55)	-0.207 (1.30)
Replacement Rate	0.014*** (3.00)	0.019*** (3.61)	0.004 (1.12)	0.007 (1.43)
Benefit Duration	-0.142 (0.45)	0.423 (0.66)	-0.142 (0.53)	-0.017 (0.05)
Tax Wedge	0.006 (0.69)	-0.028** (2.11)	0.004 (0.51)	-0.002 (0.24)
Home Ownership	0.017*** (2.79)	0.012 (0.76)	0.015*** (3.21)	0.017*** (2.88)
Dummy for 1960-64				
Dummy for 1965-69	-0.032 (0.13)	0.139 (0.60)		
Dummy for 1970-74	0.027 (0.10)	0.336 (1.24)		
Dummy for 1975-79	1.010*** (3.42)	1.155*** (4.26)		
Dummy for 1980-84	1.426*** (4.71)	1.535*** (5.42)		
Dummy for 1985-89	1.539*** (4.79)	1.594*** (5.17)	0.142 (1.27)	0.098 (0.89)
Dummy for 1990-94	1.809*** (5.34)	1.701*** (5.44)	0.395*** (3.25)	0.283** (2.46)
Dummy for 1995-2000	1.845*** (5.31)	1.645*** (5.17)	0.521*** (3.68)	0.319** (2.46)
Δp (% per year)	0.039 (0.47)	0.009 (0.12)	-0.098 (1.36)	-0.100 (1.39)
κ	-0.012*** (3.49)		-0.011*** (3.74)	
adjusted κ		0.005 (0.91)		-0.005* (1.94)
R^2	0.603	0.229	0.628	0.498
Hausman P-value	0.000	0.441	0.005	0.011
RE or FE	RE	FE	RE	RE
N	148	148	80	80

Notes:
absolute t-statistic in parenthesis
* significant at 10%
** significant at 5%
*** significant at 1%

consecutive coefficient estimate is larger than the coefficient for the previous period. Since these coefficients are interpreted as a change in unemployment in comparison with the base, which is the first period in the sample, the pattern of increasing magnitudes represents a trend of increasing unemployment through time in all 20 OECD countries in the sample. This means that the systematic shift in unemployment cannot be fully explained by the changes in the macroeconomic variables in our models and is, therefore, at least partially attributed to a rising time trend.

Comparing the magnitudes of the estimates between the specifications using κ and those using adjusted κ provides further insight into the relationship between the unemployment rate, the capital-workforce ratio, and the time trend. It can be observed very clearly in Table 2 and in the later periods in Table 3 that the coefficients on the period dummies in column 2 are smaller than those in column 1, and the ones in column 4 are smaller than those in column 3, i.e. when using adjusted κ , a smaller portion of the rise in the unemployment rate is attributed to the time trend. This suggests that adjusted κ explains the patterns of change in the unemployment rate better than κ and supports our adjustment of the capital-workforce ratio. Hence, using adjusted κ allows us to provide a better macroeconomic account of the changes in the unemployment rate instead of attributing the systematic rise to an exogenous time trend.

In seven out of the eight models in Tables 2 and 3 the coefficient on the home ownership ratio is positive and significant at a 1% level. These results point to a strong positive relationship between the unemployment rate and the barriers to regional mobility. They suggest that the greater reluctance of the unemployed to seek jobs in other geographical areas leads to higher levels of unemployment. This finding is fully consistent with the theoretical foundations of the Beveridge curve.

Our empirical models turn out little evidence in support of the institutional explanation for the shifts in European unemployment. Among all the institutional factors, benefit duration is the only variable that appears to offer some robust results. It is statistically significant in three out of the four models in Table 2 (though it is not significant in any of the regressions in Table 3). Contrary to theoretical expectations, in all three cases its coefficient estimate is negative, which suggests that an increase in benefit duration should decrease the unemployment rate. This contradicts most findings in the literature on this topic, which claim that the longer duration of benefits in Europe is one of the reasons for the systematic shift in unemployment. Similarly, the coefficients on employment protection and bargaining coordination have the “wrong” negative signs and are statistically significant only in two out of the eight regressions. Even though the benefit replacement rate and union density have positive coefficients as expected, they are statistically significant in only one and two models, respectively. The tax wedge is significant in three of the regressions. It has the “correct” positive sign in two of them, but in the third one it has a negative sign. This ambiguous result does not lend itself to a meaningful interpretation. We cannot draw a consistent conclusion about the relationship between the unemployment rate and any of the institutional variables. The empirical evidence

is not robust and it is, at best, mixed.

3.2 Wage share

Tables 4 and 5 require separate discussions because there is an essential difference between the two dependent variables. The adjusted wage share takes into consideration the earnings of self-employed people, as previously explained. Therefore, the two variables provide different information and results.

3.2.1 Unadjusted wage share

As Table 4 shows, in all regressions of the unadjusted wage share, the coefficient on the capital-workforce ratio (κ in columns 1 and 3, and adjusted κ in columns 2 and 4) is positive and statistically significant at the 1% level. The consistency of the estimates across different specifications indicates that these results are robust. Therefore, these four regressions provide strong evidence that corroborates our second hypothesis about κ and the wage share; in short, it supports the widely held belief in the existence of a wage-setting curve. The coefficient on the capital-workforce ratio implies a positive relationship between changes in the wage share and the capital-workforce ratio, as predicted by our theoretical model. This supports the argument that the steady decrease of the wage share is associated with the decumulation of capital in Europe after the late 1970s. Thus, the capital-workforce ratio provides analytical insight not only into the pattern of growing unemployment, but also into the decline of the wage share in Europe.

The estimates for the period dummies from 1960 to 2000 in the regressions in columns 1 and 2 of Table 4 correspond to the hump-shaped pattern of the wage share levels in Europe. From 1960 to 1979, all the coefficient estimates are statistically significant, positive, and increasing. This rising pattern matches the upward slope of the hump, where the wage share is increasing. After 1980 in column 2, the dummies are again positive and significant, but their magnitude progressively decreases. In column 1, the coefficient for the period from 1980 to 1984 again is significant, positive, and smaller than that for the previous period. For the last 3 periods in column 1, the coefficients are not statistically different from zero, which also marks a decline compared to the previous positive values. Furthermore, the period dummies in columns 3 and 4 are all statistically significant, negative, and decreasing. They form a pattern of steady decrease from the base year 1980 until 2000. Therefore, in all regressions, the estimates for the dummies after 1980 suggest a decrease in the wage share consistent with the second downward sloping portion of the European wage share hump. Thus, the econometric models for the 20 OECD countries support the existence of a common general pattern of increase in the wage share with a peak around 1980 and a subsequent decline that is very similar to the hump observed in the evolution of the wage share in Europe.

In column 2 of Table 4, we obtain a statistically significant negative coefficient estimate for the relationship between home ownership and the wage share.

Table 4: **Regressions to explain unadjusted wage share at factor prices**

	(1) 1960-2000	(2) 1960-2000	(3) 1980-2000	(4) 1980-2000
Employment Protection	-1.017 (1.21)	-0.925 (1.02)	0.373 (0.14)	1.577 (0.60)
Union Density	0.009 (0.24)	-0.000 (0.01)	0.064 (1.04)	0.086 (1.41)
Bargaining Coordination	-1.350 (1.29)	0.045 (0.04)	-2.224 (1.79)	-0.996 (0.79)
Replacement Rate	0.014 (0.79)	0.001 (0.07)	0.071** (2.06)	0.049 (1.37)
Benefit Duration	1.159 (0.54)	0.873 (0.38)	-0.192 (0.06)	0.367 (0.11)
Tax Wedge	0.043 (0.94)	0.015 (0.30)	0.026 (0.39)	-0.022 (0.32)
Home Ownership	-0.073 (1.25)	-0.120* (1.96)	-0.105 (0.75)	-0.125 (0.89)
Dummy for 1960-64				
Dummy for 1965-69	1.632** (2.08)	3.221*** (3.78)		
Dummy for 1970-74	4.023*** (4.21)	6.310*** (6.49)		
Dummy for 1975-79	5.565*** (5.14)	8.695*** (8.78)		
Dummy for 1980-84	3.731*** (3.06)	7.500*** (7.22)		
Dummy for 1985-89	1.150 (0.83)	5.574*** (4.91)	-2.407*** (3.72)	-1.657*** (2.93)
Dummy for 1990-94	0.425 (1.28)	5.544*** (4.78)	-2.822*** (3.02)	-1.372** (2.04)
Dummy for 1995-2000	-1.755 (1.07)	4.398*** (3.73)	-5.041*** (3.81)	-2.402*** (2.91)
Δp (% per year)	-0.109 (0.42)	-0.085 (0.31)	0.264 (0.73)	0.118 (0.33)
κ	0.095*** (5.33)		0.088*** (2.74)	
adjusted κ		0.060*** (3.44)		0.057** (2.57)
R^2	0.495	0.312	0.301	0.147
Hausman P-value	0.857	0.362	0.958	0.631
RE or FE	FE	FE	FE	FE
N	149	149	80	80

Notes:
absolute t-statistic in parenthesis
* significant at 10%
** significant at 5%
*** significant at 1%

Table 5: Regressions to explain adjusted wage share at factor prices

	(1) 1960-2000	(2) 1960-2000	(3) 1980-2000	(4) 1980-2000
Employment Protection	-0.673 (0.72)	-1.186 (1.15)	-2.073 (1.13)	-4.796 (1.46)
Union Density	0.011 (0.32)	-0.010 (0.23)	0.006 (0.15)	-0.049 (0.64)
Bargaining Coordination	-1.720* (1.75)	-6.414*** (5.03)	-1.292 (1.05)	-3.788** (2.43)
Replacement Rate	-0.037 (1.51)	-0.035 (1.34)	0.028 (0.76)	0.053 (1.12)
Benefit Duration	-3.328* (1.78)	-1.148 (0.45)	-6.280** (2.34)	-7.154 (1.67)
Tax Wedge	-0.048 (0.99)	0.055 (0.95)	0.015 (0.23)	0.032 (0.38)
Home Ownership	-0.075* (1.80)	0.022 (0.32)	-0.094 (1.53)	-0.123 (0.73)
Dummy for 1960-64				
Dummy for 1965-69	0.687 (0.67)	0.263 (0.27)		
Dummy for 1970-74	2.776** (2.35)	2.021* (1.74)		
Dummy for 1975-79	4.602*** (3.53)	3.653*** (3.08)		
Dummy for 1980-84	3.065** (2.24)	1.626 (1.31)		
Dummy for 1985-89	0.626 (0.42)	-1.063 (0.79)	-2.464*** (3.43)	-2.722*** (3.87)
Dummy for 1990-94	0.592 (0.37)	-1.433 (1.05)	-2.636*** (3.05)	-3.166*** (3.77)
Dummy for 1995-2000	-1.384 (0.83)	-3.841*** (2.79)	-5.211*** (4.64)	-6.220*** (6.05)
Δp (% per year)	-0.308 (0.89)	-0.231 (0.72)	0.286 (0.63)	0.588 (1.31)
κ	-0.027 (1.40)		-0.008 (0.30)	
adjusted κ		-0.008 (0.43)		0.016 (0.58)
R^2	0.290	0.022	0.223	0.090
Hausman P-value	0.033	0.666	0.023	0.103
RE or FE	RE	FE	RE	FE
N	138	138	75	75

Notes:
absolute t-statistic in parenthesis
* significant at 10%
** significant at 5%
*** significant at 1%

This implies that greater barriers to regional mobility are associated with lower levels of the wage share. This finding agrees with the argument that the less willing the unemployed to seek jobs outside their geographical area, the greater the power of the employed to exert wage pressure. However, the corroborating results are weak because the estimates in the other three models are not statistically significant.

We find surprisingly little evidence for the influence of institutional factors on the wage share. In the third column of Table 4, the coefficient on the benefit replacement rate is positive and statistically significant at the 5% level. This estimate supports the idea that larger benefits place workers in a better position to bargain for higher wages. However, the coefficient on the replacement rate is not statistically significant in any of the other models, which means that this result is inconclusive. Furthermore, the other institutional variables are not statistically significant anywhere in the four models. The lack of statistically significant empirical results suggests that labor market institutions do not have a strong directional effect on the wage share, and is consistent with our results on their effects on unemployment.

3.2.2 Adjusted wage share

The estimates for the period dummies in Table 5 are very similar to those in Table 4. In columns 1 and 2, most of the coefficients for the periods before 1980 are positive and statistically significant, forming an increasing pattern as described before. In column 1, the dummy for the period 1980 - 1984 is positive, but smaller than the previous one, marking a drop from the peak in 1980. The estimates for the subsequent periods are not statistically different from zero, indicating a further decrease. In column 2, the coefficients for the periods between 1980 and 1994 also are not statistically significant from zero, and compared to the positive value for the previous periods, they confirm the decrease of the wage share. The statistically significant negative dummy for 1995-2000 denotes another drastic drop. In addition, the period coefficients in columns 3 and 4 confirm the progressive decline of the wage share after the peak because they are statistically significant, negative, and continuously decreasing after 1980. Thus, all the dummies in Table 5 support the hump-shaped pattern of change in the wage share over time observed in Europe and consistent with the data for the 20 OECD countries in our sample.

The regressions on the adjusted wage share offer weak evidence in support of a negative relationship between the barriers to regional mobility and the wage share. As in Table 4, here only one of the coefficients on home ownership is negative and statistically significant at 10% level, while the rest are insignificant. These results are inconclusive and we do not gain any further insight into the effects of the barriers to regional mobility from the regressions on the unadjusted wage share.

In contrast to the previous set of results, these four models offer a different view of the relationship between labor market institutions and the wage share. The coefficients on bargaining coordination are negative and statistically sig-

nificant in columns 1, 3, and 4. These estimates offer some robust evidence to bolster the idea that greater coordination leads to moderation of wage demands because unions take into consideration the effects of collective wage pressure on prices. This is consistent with the idea that OECD labor markets operate along the downward portion of the Calmfors-Driffill hump. However, some of the other evidence on the labor institutions is less consistent with the theoretical predictions. In two of the models, we obtain a negative coefficient on benefit duration, which indicates that increases in benefit duration are associated with decreases in the wage share. Such a negative relationship contradicts the notion that greater labor market rigidity creates a disincentive for the unemployed to seek jobs and empowers workers to bargain for higher wages. This puzzling finding along with the fact that the coefficients on all other institutional factors are insignificant poses some questions about the quality of the models and the data.

The coefficients on the capital-workforce present another problematic result that raises further doubt. Since we find an important positive relationship between the capital-workforce ratio and the unadjusted wage share in all four regressions in Table 4, it is surprising that κ and adjusted κ are not significant in any of the regressions of the adjusted wage share. These results are consistent with the view that the wage-setting curve may be horizontal at lower frequencies, or that it may not be as stable a fixture as is commonly believed. This is the major distinction between the two sets of results and it begs for examination of the difference between the adjusted and the unadjusted wage share since any conclusion about the impact of the capital-workforce ratio on the wage share is highly dependent on this adjustment.

4 Conclusions and future research

A broad range of economic theories predicts that the capital-workforce ratio should condition the equilibrium employment and unemployment rates, either temporarily as in models with persistence or permanently as in models with hysteresis. Our core model embeds capital in the standard conflict model of inflation by means of the assumption that price mark-ups respond positively to the capacity utilization rate. This leads straightaway to the main hypothesis, that the capital-workforce ratio affects the equilibrium unemployment rate, and to the secondary hypothesis that it also affects the wage share. We find fairly strong support for the main hypothesis but on the secondary hypothesis we reach a Scotch verdict of not proved. Here the results using official published wage share data adjusted for the prevalence of self-employment were statistically insignificant, while those using unadjusted data found the predicted effect. Again, one obvious implication is that further scrutiny of the quality of these data adjustments might be in order.

The robust results for the capital-workforce ratio endorse further research using this little-noticed analytical ratio, both empirically as in our econometrics and theoretically as in the models sketched out in the first section above.

These results are particularly remarkable in light of the well known difficulties faced by national income accountants in constructing accurate capital stock data by the perpetual inventory method; measurement error in an independent variable often works against finding significant point estimates for its coefficient. There isn't much that can be done about these difficulties, but there are other measurement issues to tackle. For example, we found that adjusting the capital-workforce ratio for Harrod-neutral technical change seemed to improve the ability of our econometric model to capture the temporal structure of unemployment. Elaborating on this adjustment under more general conditions (i.e., non-neutral technical change) might pay dividends. There is also room for more sophisticated treatments of the denominator in this ratio; we used the adult population because of the endogeneity of labor force participation rates.

These results also inform the on-going controversy over whether European unemployment has been driven up primarily by institutional factors or primarily by macroeconomic factors. We find little statistical support for the institutional factors even though we utilize standard specifications and variable definitions. It may be that a more elaborate assault on the data, incorporating interactions between these factors for example, would produce a different outcome. And since it seems so hard to square with the Eurosclerosis thesis that employment-unfriendly institutions have elevated worker bargaining power there, we agree with Blanchard (2006) that the relative decline in the European wage share ought to be an integral part of future study designs. In sum, our results provide some support for a capital-shortage explanation of high unemployment in Europe but they hardly settle the question of assigning blame. For that, (as Zhou Enlai reputedly said about the significance of the French Revolution), it is still too soon to say.

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