Policy Stances and the Crisis. The OECD Beveridge Curve

[PRELIMINARY DRAFT. PLEASE DO NOT QUOTE WITHOUT AUTHORS' APPROVAL]

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ABSTRACT:
This paper tests the existence of a Beveridge Curve across the economies of nineteen OECD countries from 1980 to 2007, and investigates whether and how technological progress and globalisation affect the unemployment-vacancies trade-off. Results can be summed up as follows: a) we find largely favourable evidence for the existence of a OECD Beveridge Curve; b) lagged values of technological progress shift the Beveridge Curve outwards, producing evidence in support of the creative destruction effect; c) lagged values of a globalisation index also shift the Beveridge Curve outwards; d) a critical econometric issue, extremely neglected by the previous literature, is represented by endogeneity, as shown by tests and other kinds of evidence.

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1. Introduction

In the last two decades, a very rich literature (both theoretical and empirical) developed from the theory of matching proposed in Pissarides (1990). In this literature, labour market are characterised by high transactions costs and co-ordination problems, originating difficulties in the matching between jobs and workers and bringing about the existence of unemployment and vacancies in the same labour market. Matching functions, often re-parametrised as unemployment-vacancy loci, or Beveridge Curves, have been specified and estimated in order to assess the impact of institutional changes on matching efficiency. Yet only a few contributions have examined the role of technological progress as a significant shift factor in this ambit, and none, to the the best of our knowledge, has directly touched upon the impact of globalisation, that is the growing international interdependence in communications, trade, finance, labour markets (migration), social systems.

This relative neglect starkly contrasts with the huge literature that has been dealing with the impact of technological change and globalisation on the wage structure (see Koeniger *et al.*, 2007; Machin, 2008). But if the wage structure is believed to evolve mainly out of the impact of technological change or globalisation on the skill demand mix, there is no reason why matching between jobs and workers should not also heavily suffer from these underlying factors.

The aim of this paper is to estimate a Beveridge Curve for nineteen OECD countries from 1980 to 2007, and to investigate whether and how technological progress and globalisation affect the unemployment-vacancies trade-off. The empirical set-up draws inspiration from Nickell *et al.* (2003), that analysed the Curve for a similar OECD sample, but did not allow for technological progress and globalisation. Our main aim is to look at the structural factors influencing the Curve and for this reason, our main period of analysis is 1980-2007. Yet, we carry out some predictive exercises for the 2007-2010 period, assessing the impact of the crisis on the OECD Beveridge Curve and its determinants.

The paper has the following structure. In Section 2 we present some recent contributions focusing on the impact of technological progress and globalisation on unemployment; in Section 3 we examine some empirical literature on OECD countries providing further motivation to our study; in Section 4 we present the empirical specification and the data; the results are commented in Section 5,. where we also report some predictive exercises for the 2007-2010 period. Section 6 contains some concluding remarks.

2. Labour market matching, technological progress and globalisation

In the conventional matching model with technological change (Pissarides, 1990; Mortensen and Pissarides, 1998), a higher rate of growth implies a higher present value of jobs, which spurs the recruiting activity and raises the job finding rate of unemployed workers. This so-called capitalisation effect should increase the willingness of employers to open new positions and the matching efficiency, which shifts the Beveridge Curve inwards. On the contrary, the Schumpeterian model from Aghion and Howitt (1994) implies a creative-destruction effect: faster technological change is accompanied by faster obsolescence of skills and technologies, and more intense labour turnover. In terms of Beveridge Curve, a faster obsolescence should worsen matching efficiency, regardless of search intensity, which shifts the curve outwards.

According to Mortensen and Pissarides (1998), faster growth reduces the long-run unemployment rate through the capitalisation effect, or leads to a rise in long-run unemployment through the creative destruction effect, depending on the particular technological assumptions adopted. The capitalisation effect rests on the assumption that firms are able to update their technology continuously and at no expense, which precludes technological obsolescence, whereas creative destruction arises from the extreme opposite assumption of total irreversibility in the firms' technological choices.

Critics of the Schumpeterian view usually maintain that there is very convincing evidence according to which unemployment rates respond negatively to changes in the productivity growth rates. For instance, the productivity slowdown of the mid-1970's was accompanied by a rise in unemployment in most OECD countries. However, this argument implicitly ignores the possible differences among short-run and long-run predictions of the model. Postel-Vinay (2002) has compared the short- and long-run effects of technological progress on employment in a Schumpeterian model. He studies the steady state and comparative static properties of a simple model of job destruction, proceeds to a theoretical study of its dynamics, and presents some numerical simulations of the model. The latter confirm that the short-run adjustment of unemployment goes the "wrong way" with respect to long-run outcomes and point out that impact effects are of potentially great magnitude.

Pissarides and Vallanti (2007) start from some econometric estimates of the impact of TFP growth on steady-state unemployment for the period 1965-1995 for the countries of the European Union (except for Spain and Greece), the USA and Japan. Their conclusion is that the negative impact of TFP growth on unemployment is substantial, both in terms of the estimated elasticities and in terms of the contribution of TFP growth to the explanation of the evolution of the unemployment rate in the last thirty years. Consequently, Pissarides and Vallanti evaluate a matching model with

embodied and disembodied technology, capitalisation and creative destruction effects and verify whether this model matches the estimated impacts. They also allow for capital deepening and find that: a) consistency between the empirical evidence and the model requires totally disembodied technology, because when technology is embodied creative destruction effects have a much bigger quantitative impact on unemployment than capitalisation effects; b) with entirely disembodied technology, the capitalisation effect of faster growth is quantitatively sufficiently strong to explain alone the full impact of TFP growth on unemployment when two other conditions are satisfied: wages are insulated from labour market conditions, in particular the vacancy-unemployment ratio, and firms discount the revenues from new jobs over an infinite horizon.

Few economists would deny that globalisation, that is the growing international interdependence in communications, trade, finance, labour markets (migration), social systems, is one of fundamental socio-economic phenomena of this turn of century. Consequently, globalisation is another factor which is expected to impact on the Beveridge Curve. Indeed, if employment and income prospects have worsened for unskilled workers as their jobs have been exported to low-wage countries (Freeman, 1995; Nickell and Bell, 1995), the Beveridge Curve for unskilled workers ought to have shifted outwards in recent years, and a corresponding shift is also likely to have occurred in the aggregate curve (Song and Webster, 2003).

The opposite view is that globalisation (e.g. through foreign investment, trade, new technology and liberalisation) contributes to growth, which is the key to employment. Unemployment, on the other hand, is mainly due to governments' failure to adopt sound macroeconomic and labour market policies. In particular, IMF and OECD[1] share the opinion that structural adjustment policies and globalisation, far from being sources of unemployment, can be pillars of in a strategy for better growth and employment.

Below we proceed to set up a framework for empirical analysis where the effects of globalisation and technological progress on job matching are jointly measured and appraised.

3. The empirical literature on OECD countries

Our framework for empirical analysis draws inspiration chiefly from a paper by Nickell *et al.* (2003), which analyses empirically the unemployment patterns in the OECD countries from the 1960s to the 1990s, through a detailed study of changes in real wages and unemployment for twenty countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy,[2]

1 See for example IMF (1996) and OECD (1997).

2 Actually, Ireland and Italy are excluded from the Beveridge Curve estimation, because of the lack of vacancy data.

Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States). As far as the Beveridge Curve is concerned Nickell *et al.* aim was to ascertain if its shifts could be explained by changes in those labour market institutions which might be expected to impact on equilibrium unemployment. Actually, Nickell *et al.* included in their regression analysis both a set of institutional variables expected to influence equilibrium unemployment in the long run, and a set of other structural factors (changes in the rate of growth of the nominal money stock, changes in TFP growth or deviations of TFP growth from trend, labour demand shocks measured by the residual from a simple labour demand model, proportional changes in real import prices weighted by the trade share, the ex-post real interest rate) which might explain the short-run deviations of unemployment from its equilibrium level.

Table 1. Factors affecting equilibrium unemployment, Nickell *et al.* (2003)

Institutional variables	Unemployment benefit replacement ratio Benefit duration index Bargaining coordination index Collective bargaining coverage Union density Employment protection legislation Labour taxes Owner occupation rate
Structural variables	Rate of growth of nominal money stock TFP growth Labour demand shocks Real import prices weighted by trade share Ex-post interest rate

What is however remarkable from our point of view is that, without any theoretical or empirical justification, no structural factor is included in the Beveridge Curve estimates. This obviously also includes variables which may be linked to the role of technological progress or globalisation. On the other hand, an important role is played in the estimates by the inflow rate, defined as the monthly inflow into unemployment divided by employment. Given that the Beveridge Curve equation is estimated through LSDV, and that the inflow rate is likely to be determined jointly with unemployment, there is some concern that the Nickell et al. estimates may be affected by endogeneity issues[3]

3 In our opinion, endogeneity issues are also likely to concern the vacancy rate, as well as the institutional variables. It is anyway true that neglect of the issues is quite pervasive in the Beveridge Curve empirical literature.

In any case, the Nickell *et al.* results indicate the Beveridge Curves of all the countries except Norway and Sweden shifted to the right from the 1960s to the early/mid 1980s. At this point, the countries divide into two distinct groups, those whose Beveridge Curves continued to shift out and those where they started to shift back. Second, these movements in the Beveridge Curves are partly explained by changes in labour market institutions. In particular, union density, unemployment benefit duration and owner occupation shift the Curves to the right whereas stricter employment protection shift them to the left. Indeed, stricter employment laws may lead to an increased professionalisation of the personnel function within firms, as was the case in Britain in the 1970's (see Daniel and Stilgoe, 1978), which can increase matching efficiency. The possibility that the estimates are affected by endogeneity and omitted variable bias raises however some doubt about the soundness of these results.

Further inspiration for our empirical framework was also drawn from a paper by Koeniger *et al.* (2007). This paper first shows in a simple model of bilateral monopoly how labour market institutions affect labour demand, the surplus of the firms and workers and thus the wage differential, then uses panel data from eleven OECD countries (Australia, Canada, Finland, France, Germany, Italy, Japan, Netherlands, Sweden, UK and USA) to determine how much of the increase in wage inequality across countries can be attributed to changes in institutions within countries, employing an empirical set-up similar to Nickell *et al.* (2003). Crucially, from our point of view, this paper also directly relates wage inequality to a set of variables related to technological progress and globalisation: R&D intensity and import (from non-OECD countries) intensity as well.

Table 2. Factors affecting wage inequality, Koeniger *et al.* (2007)

	Koeniger *et al.* (2007)
Institutional variables	Unemployment benefit replacement ratio Benefit duration index Bargaining coordination index Union density Employment protection legislation Tax wedge Minimum wage
Other variables	R&D intensity Import (from non-OECD countries) intensity

From the joint analysis of these two papers, we have then drawn the idea of assessing the impact of institutional variables on the Beveridge Curves of various OECD countries, also allowing for the impact of globalisation and technological progress.

4. The econometric analysis: empirical specification and data

4.1. The model

The steady-state Beveridge Curve is based on the matching function M = ε m (cU, V) where M is the number of matches or hires from unemployment, U is unemployment, V is vacancies, ε is matching efficiency and c is the search effectiveness of the unemployed. The function is increasing in both arguments and is often assumed to have constant returns. If sN is the flow into unemployment, where s is the exogenous exit rate from employment into unemployment and N is employment, then in steady state we have sN = M and hence the Beveridge Curve is

(1) s = ε m (cU / N, V / N) = ε m (cu, υ)

where s is the exit rate from employment into unemployment, u is the unemployment rate, υ is the vacancy rate, ε is the level of matching efficiency and c is the level of search intensity. Noting that ε, c depend on some institutional variables, z, we estimate a dynamic (non-steady-state) version of (1), conditional on the inflow rate:

$$
\begin{aligned}
(2)\ u_{it} = {} & \beta_1 u_{it-1} + \beta_2 u_{it-2} + \beta_3 v_{it} + \beta_4 v_{it-1} + \beta_5 inf_{it} + \\
& \beta_6 inf_{it-1} + \beta_7 glob_{it} + \beta_8 glob_{it-1} + \beta_9 tp_{it} + \\
& \beta_{10} tp_{it-1} + \beta_{11} k_{it} + \beta_{12} k_{it-1} + \beta_{13} tfp_{it} + \\
& \beta_{14} tfp_{it-1} + z_{it}\gamma_1 + z_{it-1}\gamma_2 + D\delta_i + E\theta_t + \tau_{i1} t + \\
& \tau_{i2} t^2 + \varepsilon_{it},
\end{aligned}
$$

where $i = 1, \ldots, N$ stands for the country, and $t = 1, \ldots, T$ stands for the time period (year). We posit a simple fixed-effects AutoRegressive-Distributed Lags (2,1) specification, with a Cobb-Douglas functional form. u is the natural log of the unemployment rate, v the natural log of the vacancy rate, inf the natural log of the inflow rate, glob the natural log of the globalisation index, tp the technological progress index, k the natural log of capital per worker, tfp the total factor productivity, z a vector of institutional variables which are expected to influence unemployment either because of

their impact on the effectiveness with which the unemployed are matched to available jobs or because of their direct effect on wages, D and E are vectors of country and yearly dummies respectively, t a time trend, ε a stochastic variable assumed to be independently and identically distributed. We follow Pissarides and Vallanti (2007) in introducing two lags for unemployment and in including capital per worker and TFP in the model. We expect capital stock and TFP to have different effects on unemployment, because the costs of adjustment in capital are different from the technology implementation lags: as job destruction reacts faster than job creation to shocks, the impact effect of TFP growth (capital stock) on unemployment should be positive (negative) in the short run and turn negative (positive) in the medium to long run.

In selecting our institutional variables, we relied on those considered in Nickell *et al.* (2003). In particular, we introduce: a) union density and bargaining coordination, as trade union power in wage setting has a significant positive impact on unemployment, but highly coordinated bargaining may completely offset the negative impact of unionism on employment;[4] b) employment protection legislation, whose overall impact is an empirical issue: actually, on the one hand it tends to make firms more prudent about filling vacancies, which slows the speed at which the unemployed move into work, reducing the efficiency of job matching; on the other hand, however, employment protection laws often lead to an increased professionalisation of the personnel function within firms and lean to reduce involuntary separations and consequently reduce inflows into unemployment; c) unemployment benefits, which negatively affect the willingness of unemployed to fill vacancies; d) the total tax wedge including employer payroll taxes.

Finally, we would like to stress that, unlike in many macroeconometric studies (including Nickell et al., 2001, and Koeniger et al., 2004), we do not restrict a priori the dynamic specification of our structural and institutional variables. All of them enter (4) with a current *and* a lagged value.

4.2. The data

The sample is formed by nineteen OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States. We consider a 28-year period, from 1980 to 2007.

The unemployment rates are based on OECD standardised rates and are an extension of those used in Nickell and Nunziata (2001). The vacancy rates are taken from Nickell and Nunziata (2001) and extended with data from OECD Main Economic Indicators (various years). For Italy, vacancies data

4 See Nickell and Layard (1999) and Booth *et al.* (2000) for example.

derive from the survey on the help-wanted advertisements published in some important daily newspapers, carried out by CSA (Centro di Studi Aziendali, Florence) and ISFOL (Istituto per lo Sviluppo della Formazione Professionale dei Lavoratori, Rome). The inflow rate is measured by the ratio of inflow into unemployment to total employment (see again Nickell and Nunziata, 2001). However, the data for Italy are derived from the ISTAT MARSS Database (http://marss.istat.it/), and those for Switzerland from the OECD Database on Unemployment by Duration.

TFP is computed using the formula from Pissarides and Vallanti (2007) and a smoothed share of labour following the procedure described in Harrigan (1997). The measure of capital we use is the ratio of the private non-residential net capital stock (i.e. the capital stock of the business sector) to the total employment. The source of the private non-residential net capital stock is the OECD Analytical Database (various years), whereas gross domestic output is drawn from OECD.Stat Extracts and the smoothed share of labour from the OECD Unit Labour Costs Dataset (various years).

Notice at any rate that TFP, a variable whose measurement notoriously gathers many different influences, is *not* our preferred measure of technological progress. We rather include it in the estimates as a control variable for macroeconomic shocks. Our preferred measure of technological progress, like in Koeniger *et al.* (2007), is the ratio of R&D expenditure over value added in the manufacturing sector (both variables at current prices). Data for R&D expenditure are taken from the OECD Research and Development Expenditure in Industry Database (various years). The globalisation index, also like in Koeniger *et al.* (2007), is given by the ratio of total manufacturing imports from non-OECD countries to manufacturing value added (both variables at current prices). Total manufacturing imports from non-OECD countries are drawn by the OECD STAN Bilateral Trade Database and International Trade by Commodity Statistics (various years), and value added by the OECD STAN Database for Industrial Analysis (various years). We would like to rely on at least another globalisation index, allowing for capital flows and outsourcing, but problems of data availability prevent us from doing so.

For institutional variables, the main data source is the CEP-OECD Institutions Data Set by Nickell (2006), updated by OECD datasets or integrated by other sources where gaps come out, especially for the latest years or for single variables in given countries. Employment protection legislation series follow those from Allard (2005a): they use the OECD methodology generating an index increasing on the range {0,5}. Union density is calculated using administrative and survey data from the OECD Labour Market Statistics Database and extending them by splicing in data from Visser (2006). The index of bargaining coordination is taken from OECD (2004), has range {1,5} and is

increasing in the degree of coordination in the bargaining process on the employers' as well as the unions' side. Unemployment benefits series follow Allard (2005b), who develops an indicator which combines the amount of the subsidy with their tax treatment, their duration and the conditions that must be met in order to collect them. Finally, the total tax wedge is drawn from OECD.Stat Extracts.

5. The estimates

Before discussing our results, we recapitulate in Table 3 the main predictions about the role of globalisation and technological progress within the Beveridge Curve.

Table 3. Expected shifts of the Beveridge Curve: institutional variables, globalisation and technological progress.

	Expected Shifts
Tax wedge	Outward shift: Nickell *et al.* (2003)
Unemployment benefits	Outward shift: Nickell *et al.* (2003)
Employment protection legislation	Outward **or** inward shift: Nickell *et al.* (2003)
Bargaining coordination	Inward shift: Nickell *et al.* (2003)
Union density	Outward shift: Nickell *et al.* (2003)
Globalisation	Outward shift (Song and Webster, 2003) **or** Inward shift (IMF, OECD)
Technological progress	Outward shift (creative-destruction effect: Aghion and Howitt, 1994, Postel-Vinay, 2002) **or** Inward shift (capitalisation effect: Pissarides, 1990; Mortensen and Pissarides, 1998; Pissarides and Vallanti, 2007)
Capital deepening	Inward shift (short run) **and** Outward shift (medium-long run): Pissarides and Vallanti (2007)
TFP growth	Outward shift (short run) **and** Inward shift (medium-long run): Pissarides and Vallanti (2007)

We have an unbalanced panel with T = 28. Thus, following mainly Judson and Owen (1999) and Soto (2007), we have utilised in our estimation Arellano and Bond's GMM estimator. In principle, the system GMM estimator proposed by Blundell *et al.* (2001) has a lower bias and higher efficiency than all the other estimators. For purposes of comparison, and for assessing the role of endogeneity, we also provide estimates obtained with the Least Squares Dummy Variable and the

one-step difference GMM estimators. Moreover, we consider the useful advices provided by Roodman (2009a, 2009b) in order to make appropriate specification choices for the system GMM estimator and correctly face up to the econometric problems which may emerge, particularly autocorrelation and endogeneity.

Table A.1 shows the LSDV estimation results, which confirm the existence of a Beveridge Curve for the countries considered and reveal a significant positive effect of both current and lagged technological progress, which tends to shift the curve outwards through the creative destruction effect, whereas the coefficients of the globalisation index are not significant. Among the institutional variables, just union density and bargaining coordination are significant and have the expected impact on unemployment. The Durbin-Watson statistic indicates the absence of autocorrelation, whereas the Hausman test reveals that regressors are not exogenous.

In Table A.2 one-step difference GMM estimation results are considered. We notice that the Beveridge trade-off is again confirmed, but now a significant positive impact of the lagged values of both globalisation and technological progress comes out. Furthermore, employment protection legislation shows a negative effect on unemployment: stricter legislation shifts the Beveridge Curve inwards. Interestingly, the previously significant inflow rate wholly loses significance, shedding doubts on the specification proposed in Nickell *et al.* (2003). The Arellano-Bond test for autocorrelation is not significant, and Sargan and Hansen tests for endogeneity produce very high p-values. For the latter, as pointed out by Roodman, this is a potential signal of trouble.[5]

One-step system GMM estimation results are presented in Table A.3. In terms of Beveridge Curve, globalisation and technological progress, these results are similar to those achieved by difference GMM estimation, whereas among institutional variables coordination bargaining and unemployment benefits are significant and have the expected impact on unemployment. Capital deepening gains however significance, while TFP growth heavily loses it. The inflow rate is again insignificant. Also, higher employment protection legislation shifts now the Beveridge Curve outwards. Tests for correlation and endogeneity confirm the previous results as well, and Difference-in-Hansen tests of exogeneity of instrument subsets proves the validity of the additional instruments in system GMM.

Tables A.4, A.5 and A.6 contain similar estimates, which however exclude the institutional variables from the model. We can notice that including the labour market institutions help to improve considerably the estimates, as technical progress, globalisation and capital deepening coefficients gain significance. Even more importantly, the vacancy rates lose all significance in the system

5 Too many instruments can overfit endogenous variables and fail to expunge their endogenous components. Thus, we have to be way of taking comfort in a Hansen test p-value below 0.1, whereas higher values, such as 0.25, may represent a problem.

GMM estimates. Also the RESET test from the LSDV regression suggests that specifications omitting institutional variables are not well-behaved.

Summing up, we notice some common results across the various estimation methods: a) a Beveridge trade-off is found, also without a significant role of the inflow rate; b) institutional variables are not always significant, but seem to play a fundamental role for a correct specification; c) lagged values of technological progress have a significant positive impact on unemployment and shift the Beveridge Curve outwards (creative destruction effect). Thus, the empirical analysis does not support the predictions of Postel-Vinay's simulations about the short-run adjustment of unemployment to technological progress. Indeed, the coefficient of current and lagged technological progress have the same sign in LSDV estimation, whereas in GMM estimations current technological progress is not significant at all.

However, there are some different points as well: a) the vacancy rate coefficient is considerably higher in GMM estimates (0.231 in difference GMM, 0.251 in system GMM) than in LSDV (0.159); b) in GMM estimates, the position of the Beveridge Curve is influenced by lagged values of globalisation as well: the process of economic integration has a positive impact on unemployment and shifts the Curve outwards; c) in system GMM estimation, the coefficients of capital deepening are significant and have the expected sign: its effect on unemployment is negative in the short run and turns positive in the long run.

Moreover, endogeneity is a non trivial problem in our model, as shown by the overidentifying restrictions tests, by the loss of significance of the inflow rate in the GMM models, and by the changing signs of various institutional factors. This leads to the conclusion that endogeneity is underestimated in the literature, which very often does not deal with this matter properly.

We have gathered sufficient evidence according to which globalisation and technological progress have significant effects on the Beveridge Curve. However, it could be thought that these impacts are not statistically significant. We address this issue in Table A.7, A.8 and A.9, showing the percent changes in the dependent variable brought about by a one-standard deviation change in a given independent variable. We notice that technological progress and capital deepening have a very strong impact in all the estimations, especially in FD GMM: the impact of capital deepening is more pronounced at the beginning and end of the period, whereas technological progress has constant effects over time. Globalisation has a lower and more discontinuous in time impact compared to technological progress, whereas the institutional variables considered due to their significance in the regressions present very different values depending on the estimation methods.

We now proceed to show how our preferred equation predicts the unemployment rate throughout the 2000-2010 period. Note that values from 2008-2010 are not included in our estimation and consequently, we haven't estimated the time effects coefficients (γ_t) for the years 2008, 2009 and 2010. To include them in our prediction we calculate them following Greene (2002): $\gamma_t = \bar{y}_t - b\bar{x}_t$, being $\bar{y}_t$ and $\bar{x}_t$ the means of the dependent and independent variables, respectively, over countries observations on the year t, and b the vector of coefficients (see Table A.10).[6] Adding this period, that has been affected by the financial crisis, and is believed to have had important effects on the labour market of some countries, provides a significant additional check on the robustness of our estimates.

In Figure A.1, we observed that the fitted values adjust quite well to the actual values of unemployment rate for every country. Obviously predictions are less accurate for the 2008-2010 period, but even in this case we do not observe persistent prediction errors for unemployment rates in most countries.

6. Concluding Remarks

In this paper we considered the economies of nineteen OECD countries in 1980-2007 period in order to appraise the existence of a OECD Beveridge Curve and to investigate whether and how technological progress and globalisation affect the Curve. To the best of our knowledge, although in the literature various hints are dropped to the effect that these two factors should influence the unemployment-vacancies trade-off (even if there is not unanimity on the sign of their respective impacts), no formal tests of this kind had been carried out so far.

We can sum up our main results as follows: a) we find largely favourable evidence for the existence of a Beveridge Curve; b) lagged values of technological progress impact positively on unemployment and shift the Beveridge Curve outwards, which produces evidence in support of the creative destruction effect; c) lagged values of globalisation index have a positive impact on unemployment: globalisation caused an outward shift of the Beveridge Curve as well; d) a critical econometric issue, extremely undervalued by the previous papers, is represented by endogeneity, as consistently shown by the appropriate tests. A predictive exercise carried out for the 2007-2010 period does not reveal any significant misspecification in our preferred model.

6 We obviously assume the coefficients of our model are also valid for the period 2008-2010.

Appendix

Table A.1. LSDV estimation (dependent variable: natural log of current unemployment)

	Coefficients	**p-values**
u_{it-1}	0.966	0.000
u_{it-2}	-0.296	0.000
v_{it}	-0.159	0.000
v_{it-1}	0.064	0.074
inf_{it}	0.099	0.004
inf_{it-1}	0.027	0.345
$glob_{it}$	0.052	0.387
$glob_{it-1}$	0.088	0.135
tp_{it}	1.755	0.000
tp_{it-1}	1.168	0.021
k_{it}	-0.169	0.173
k_{it-1}	0.076	0.467
tfp_{it}	4.022	0.006
tfp_{it-1}	-4.728	0.000
nrw_{it}	0.202	0.502
nrw_{it-1}	0.463	0.134
epl_{it}	-0.038	0.308
epl_{it-1}	0.020	0.569
co_{it}	-0.280	0.000
co_{it-1}	-0.208	0.004
ud_{it}	2.120	0.002
ud_{it-1}	-2.313	0.001
t_{it}	-0.256	0.502
t_{it-1}	-0.253	0.528
R-squared	0.943	
Breusch-Pagan test (P-value)	0.358	
Durbin Watson statistic (P-value)	1.934	
Hausman test (P-value)	0.000	
RESET test (P-value)	0.608	

Table A.2. One-step difference GMM estimation (dependent variable: natural log of current unemployment)

	Coefficients	**p-values**
u_{it-1}	1.109	0.000
u_{it-2}	-0.328	0.003
v_{it}	-0.231	0.003
v_{it-1}	0.185	0.003
inf_{it}	0.040	0.371
inf_{it-1}	0.006	0.895
$glob_{it}$	-0.114	0.415
$glob_{it-1}$	0.278	0.001
tp_{it}	1.284	0.442
tp_{it-1}	2.467	0.022
k_{it}	0.048	0.940
k_{it-1}	-0.126	0.829
tfp_{it}	5.263	0.397
tfp_{it-1}	-13.035	0.011
nrw_{it}	0.307	0.758
nrw_{it-1}	0.331	0.655
epl_{it}	-0.237	0.002
epl_{it-1}	0.130	0.142
co_{it}	-0.285	0.096
co_{it-1}	0.275	0.014
ud_{it}	1.850	0.167
ud_{it-1}	-1.460	0.211
t_{it}	0.735	0.620
t_{it-1}	-1.744	0.189
AR (1) (P-value)	0.027	
AR (2) (P-value)	0.125	
Sargan Test (P-value)	0.981	
Hansen Test (P-value)	1.000	

Table A.3. System GMM estimation (dependent variable: natural log of current unemployment)

	Coefficients	**p-values**
u_{it-1}	1.147	0.000
u_{it-2}	-0.391	0.003
v_{it}	-0.251	0.000
v_{it-1}	0.122	0.028
inf_{it}	-0.029	0.537
inf_{it-1}	-0.017	0.701
$glob_{it}$	-0.146	0.177
$glob_{it-1}$	0.197	0.030
tp_{it}	-0.179	0.851
tp_{it-1}	2.370	0.033
k_{it}	-2.890	0.039
k_{it-1}	2.825	0.043
tfp_{it}	3.659	0.418
tfp_{it-1}	-4.268	0.382
nrw_{it}	0.873	0.017
nrw_{it-1}	-0.563	0.189
epl_{it}	-0.098	0.138
epl_{it-1}	0.109	0.046
co_{it}	-0.248	0.013
co_{it-1}	0.288	0.000
ud_{it}	0.300	0.859
ud_{it-1}	-0.780	0.641
t_{it}	0.103	0.911
t_{it-1}	-0.899	0.223
AR (1) (P-value)	0.010	
AR (2) (P-value)	0.082	
Sargan Test (P-value)	0.419	
Hansen Test (P-value)	1.000	
D-i-H Test (P-value)	1.000	

Table A.4. LSDV estimation, no institutional variables (dependent variable: natural log of current unemployment)

	Coefficients	**p-values**
u_{it-1}	1.036	0.000
u_{it-2}	-0.368	0.000
v_{it}	-0.161	0.003
v_{it-1}	0.067	0.221
inf_{it}	0.104	0.024
inf_{it-1}	0.023	0.556
$glob_{it}$	0.027	0.795
$glob_{it-1}$	0.100	0.120
tp_{it}	1.441	0.070
tp_{it-1}	2.671	0.019
k_{it}	-0.275	0.013
k_{it-1}	0.060	0.250
tfp_{it}	2.634	0.062
tfp_{it-1}	-1.570	0.410
R-squared	0.935	
Breusch-Pagan Test (P-value)	0.145	
Durbin Watson statistic (P-value)	1.938	
RESET Test (P-value)	0.024	

Table A.5. One-step difference GMM estimation, no institutional variables (dependent variable: natural log of current unemployment)

	Coefficients	**p-values**
u_{it-1}	1.257	0.000
u_{it-2}	-0.470	0.019
v_{it}	-0.239	0.044
v_{it-1}	0.188	0.027
inf_{it}	-0.016	0.862
inf_{it-1}	0.035	0.642
$glob_{it}$	0.149	0.374
$glob_{it-1}$	0.077	0.582
tp_{it}	2.834	0.174
tp_{it-1}	8.420	0.758
k_{it}	0.144	0.867
k_{it-1}	-0.093	0.894
tfp_{it}	13.868	0.106
tfp_{it-1}	-20.533	0.041
AR (1) (P-value)	0.063	
AR (2) (P-value)	0.798	
Sargan Test (P-value)	0.983	
Hansen Test (P-value)	1.000	

Table A.6. System GMM estimation, no institutional variables (dependent variable: natural log of current unemployment)

	Coefficients	**p-values**
u_{it-1}	1.162	0.000
u_{it-2}	-0.434	0.000
v_{it}	-0.113	0.257
v_{it-1}	0.088	0.156
inf_{it}	-0.051	0.293
inf_{it-1}	0.040	0.450
$glob_{it}$	0.050	0.789
$glob_{it-1}$	-0.011	0.954
tp_{it}	-1.174	0.255
tp_{it-1}	1.138	0.378
k_{it}	-6.368	0.037
k_{it-1}	6.293	0.039
tfp_{it}	4.340	0.515
tfp_{it-1}	-6.800	0.328
AR (1) (P-value)	0.019	
AR (2) (P-value)	0.149	
Sargan Test (P-value)	0.212	
Hansen Test (P-value)	1.000	
D-i-H Test (P-value)	1.000	

Table A.7. Percent changes in unemployment rate, LSDV estimation

year	glob	tp	k	tfp	co	epl
1980	0.14	0.33	-0.52	-0.01	-0.88	-0.02
1981	0.09	0.31	-0.49	-0.01	-0.99	-0.02
1982	0.10	0.30	-0.45	-0.01	-1.11	-0.02
1983	0.12	0.30	-0.42	-0.01	-0.96	-0.02
1984	0.10	0.30	-0.39	-0.01	-0.82	-0.01
1985	0.09	0.30	-0.35	-0.01	-0.70	-0.02
1986	0.09	0.29	-0.31	-0.01	-0.60	-0.02
1987	0.06	0.30	-0.28	-0.01	-0.54	-0.02
1988	0.09	0.29	-0.24	-0.01	-0.36	-0.02
1989	0.14	0.28	-0.18	-0.01	-0.19	-0.01
1990	0.10	0.31	-0.12	-0.01	-0.16	-0.01
1991	0.07	0.31	-0.03	-0.04	-0.30	-0.01
1992	0.04	0.33	-0.02	-0.01	-0.48	-0.01
1993	0.05	0.34	-0.07	-0.01	-0.48	-0.01
1994	0.04	0.34	-0.11	-0.01	-0.48	-0.01
1995	0.05	0.34	-0.15	-0.01	-0.48	-0.01
1996	0.06	0.33	-0.19	-0.01	-0.48	-0.01
1997	0.06	0.29	-0.24	-0.01	-0.48	-0.02
1998	0.07	0.30	-0.29	-0.01	-0.48	-0.02
1999	0.07	0.30	-0.33	-0.01	-0.48	-0.02
2000	0.06	0.28	-0.38	-0.01	-0.48	-0.02
2001	0.06	0.27	-0.43	-0.01	-0.48	-0.02
2002	0.08	0.28	-0.48	-0.01	-0.48	-0.02
2003	0.09	0.31	-0.53	-0.01	-0.48	-0.02
2004	0.10	0.35	-0.58	-0.01	-0.48	-0.02

Table A.8. Percent changes in unemployment rate, One-step difference GMM

year	glob	tp	k	tfp	co	epl
1980	0.24	0.64	-0.66	-0.15	-0.03	-0.22
1981	0.15	0.59	-0.61	-0.20	-0.03	-0.22
1982	0.18	0.59	-0.57	-0.15	-0.03	-0.21
1983	0.22	0.59	-0.54	-0.13	-0.03	-0.21
1984	0.18	0.58	-0.49	-0.12	-0.03	-0.13
1985	0.15	0.58	-0.45	-0.14	-0.02	-0.16
1986	0.15	0.56	-0.39	-0.17	-0.02	-0.16
1987	0.10	0.57	-0.35	-0.14	-0.02	-0.16
1988	0.15	0.55	-0.30	-0.10	-0.01	-0.17
1989	0.24	0.55	-0.23	-0.14	-0.01	-0.11
1990	0.18	0.60	-0.15	-0.09	0.00	-0.09
1991	0.12	0.60	-0.04	-0.72	-0.01	-0.09
1992	0.07	0.65	-0.03	-0.20	-0.01	-0.08
1993	0.10	0.66	-0.08	-0.11	-0.01	-0.09
1994	0.08	0.65	-0.14	-0.15	-0.01	-0.08
1995	0.09	0.65	-0.19	-0.10	-0.01	-0.13
1996	0.10	0.63	-0.24	-0.09	-0.01	-0.13
1997	0.10	0.57	-0.30	-0.17	-0.01	-0.17
1998	0.12	0.58	-0.37	-0.16	-0.01	-0.17
1999	0.11	0.59	-0.42	-0.10	-0.01	-0.17
2000	0.10	0.54	-0.48	-0.14	-0.01	-0.17
2001	0.11	0.52	-0.55	-0.14	-0.01	-0.17
2002	0.13	0.54	-0.61	-0.10	-0.01	-0.17
2003	0.15	0.60	-0.67	-0.08	-0.01	-0.17
2004	0.18	0.68	-0.73	-0.09	-0.01	-0.17

Table A.9. Percent changes in unemployment rate, System GMM estimation

year	glob	tp	k	tfp	co	epl
1980	0.07	0.33	-0.49	-0.01	0.10	0.02
1981	0.04	0.31	-0.46	-0.01	0.11	0.02
1982	0.05	0.31	-0.43	-0.01	0.12	0.02
1983	0.06	0.31	-0.40	-0.01	0.11	0.02
1984	0.05	0.30	-0.37	-0.01	0.09	0.01
1985	0.04	0.30	-0.33	-0.01	0.08	0.02
1986	0.04	0.30	-0.30	-0.01	0.07	0.01
1987	0.03	0.30	-0.26	-0.01	0.06	0.01
1988	0.04	0.29	-0.22	-0.01	0.04	0.02
1989	0.07	0.29	-0.17	-0.01	0.02	0.01
1990	0.05	0.32	-0.12	-0.01	0.02	0.01
1991	0.03	0.31	-0.03	-0.05	0.03	0.01
1992	0.02	0.34	-0.02	-0.01	0.05	0.01
1993	0.03	0.35	-0.06	-0.01	0.05	0.01
1994	0.02	0.34	-0.10	-0.01	0.05	0.01
1995	0.03	0.34	-0.14	-0.01	0.05	0.01
1996	0.03	0.33	-0.18	-0.01	0.05	0.01
1997	0.03	0.30	-0.23	-0.01	0.05	0.02
1998	0.03	0.30	-0.27	-0.01	0.05	0.02
1999	0.03	0.31	-0.31	-0.01	0.05	0.02
2000	0.03	0.28	-0.36	-0.01	0.05	0.02
2001	0.03	0.27	-0.41	-0.01	0.05	0.02
2002	0.04	0.28	-0.45	-0.01	0.05	0.02
2003	0.04	0.31	-0.50	-0.01	0.05	0.02
2004	0.05	0.36	-0.54	-0.01	0.05	0.02

Legend of tables

The sample relates to 1980-2007 period and 19 countries, for a sum total of 475 observations.

The dependent variable is always , the natural log of the unemployment rate, where $i = 1, \ldots, N$ stands for the country, and $t = 1, \ldots, T$ stands for a given year.

Among the independent variables, *v* is the natural log of vacancy rate, *inf* the natural log of the inflow rate, *glob* the natural log of the globalisation index, *tp* the technological progress, *k* the capital deepening index, *tfp* the total factor productivity, *nrw* the unemployment benefits index, *epl* the employment protection legislation index, *co* the bargaining coordination index, *ud* the union density index, *t* the total tax wedge.

In the model we have included yearly and country dummies and linear and quadratic trends, not shown in the interest of parsimony. The p-values belong to the z-statistics (akin to t-ratios) for the regression coefficients.

In Tables A.1 and A.4, *R-squared* is the coefficient of determination, *Breusch-Pagan test* is the test of residual contemporaneous correlation independence, *Durbin Watson statistic* is the test statistic of first-order autocorrelation in the residuals, *Hausman test* tests the exogeneity of regressors and *RESET test* stands for Ramsey's Regression Error Specification Test.

In Table A.2, A.3, A.5 and A.6, *AB(1) and AB(2)* are the Arellano–Bond test for first and second order serial correlation (distributed as a normal), *Sargan* and *Hansen tests* are tests of overidentifying restrictions that detect the exogeneity of the instruments as a group, and *D-i-H Test* is the Difference-in-Hansen tests of exogeneity of instrument subsets.

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