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The Beveridge Curve in the OECD Before and After the Crisis*

Sergio Destefanis and Giuseppe Mastromatteo

Abstract

This paper tests the existence of a Beveridge Curve across the economies of nine OECD countries from 1980 to 2011, investigating the impact of various kinds of structural factors (technological progress, globalisation, oil prices) and of the current recession on the Curve. Technological progress (R&D intensity) shifts the Curve outwards, producing evidence in support of the creative destruction effect. Globalisation and unfavourable oil price shocks also shift the Curve outwards, worsening the unemployment-vacancies trade-off. Structural relationships seem to be stable enough in the 2008-2011 period, suggesting that the current crisis mainly implied moves along the Curve.

Jel Classification: E24, J20, F60, O40

Keywords: Unemployment, vacancies, capitalisation effect, creative destruction, labour-market institutions.

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Introduction

In the literature concerning the Beveridge Curve, only a few contributions (Pissarides 1990; Aghion and Howitt 1994) have examined the role of technological progress as a significant shift factor for labour market performance. However, there is no unanimity about the sign of its impact. 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: thus, in terms of Beveridge Curve, the so-called capitalisation effect should increase the willingness of employers to open new positions and the matching efficiency, which shifts the curve inwards. On the contrary, Aghion and Howitt (1994) propose the creative-destruction effect (Schumpeterian models), whose underlying intuition is that growth has a reallocative aspect that the previous conventional model ignores: faster technological change is accompanied by faster obsolescence of skills and technologies, hence, more intense labour turnover and higher frictional unemployment. In terms of Beveridge Curve, a faster obsolescence should worsen matching efficiency, regardless of search intensity, which shifts the curve outwards.

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 expected to impact on the Beveridge Curve. Indeed, according to Nickell and Bell (1995) and Song and Webster (2003), the Beveridge Curve for unskilled workers should have shifted outwards in recent years, due to exportation of their jobs to the low-wage countries entailed by the process of globalisation. A corresponding outward shift in the aggregate Beveridge Curve should also follow.

The aim of this paper is to test the existence of a Beveridge Curve analysing the economies of nine OECD countries from 1980 to 2011, 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. Moreover in recent

years the Beveridge Curve has received little analytical attention. Yet the current crisis is widely believed to bring about long lasting changes in the world economy. Hence we provide a predictive exercise for the 2008-2011 period. We ask the following questions: does the Beveridge Curve shift outwards in that period? How are institutional factors (and hence policies) connected with this (eventual) shift?

The paper has the following structure. In Sections 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 (chiefly Nickell et *al*. 2003, but also Koeniger et *al.* 2007) providing further motivation to our study and some focus for the role of the current crisis in this context. In Section 4 we present the empirical specification and the data. The results are commented in Section 5, whereas Section 6 contains some concluding remarks.

1. Technological progress, globalisation and labour market matching

In the recent literature concerning labour market matching, a few contributions have stood out focusing on technological progress as one of the key factors in the evolution of unemployment. On the one hand, technological developments change the structure of the labour demand, which tends to be biased in favour of higher professional competences, especially if orientated towards growing sectors. On the other hand, more powerful means of communication make the flow of information faster and cheaper and, consequently, enhance the efficiency of the labour market (as well as of other kinds of markets).

Postel-Vinay (2002) aims at analysing the influence of the rate of technological change on the level of unemployment and, in particular, compares the short- and long-run effects of technological progress on employment. He starts from the statement (Mortensen and Pissarides 1998) that faster growth reduces the long-run unemployment rate through a capitalisation effect, or leads to a rise in long-run unemployment through a creative destruction effect (the so-called Schumpeterian models developed in Aghion and Howitt 1994), 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.

Suppose that the correct model is of Schumpeterian inspiration, that is there is total irreversibility and the economy leaves no space for any form of capitalisation effect. A speedup in growth eventually leads to a fall in long-run employment. Postel-Vinay's purpose is to find out whether, in that case, sustained technological change is detrimental to employment even in the short run. Critics of the Schumpeterian usually view come up with the argument 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. Short-run predictions may go in the opposite direction of long-run ones. Postel-Vinay adds that there is no a priori reason to think that the long-run effects should be the only ones to consider, or even that they should be in some sense more important than short-run effects.

Then, Postel-Vinay shows a simple model of job destruction, studies its steady state and comparative static properties, proceeds to a theoretical study of its dynamics, finally presents some numerical simulations of the model. Simulations 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. Yet, according to the model, the time it takes the unemployment rate to be back at its original level after a negative shock on productivity growth is well under the duration of a business cycle.

Pissarides and Vallanti (2007) aim at investigating the impact of total factor productivity (TFP) growth on unemployment, considering that theoretical predictions are ambiguous and depend on the extent to which new technologies is embodied in new jobs: therefore, they evaluate a model where creative destruction very much depends on the existence of this kind of embodied technological progress, and capitalisation effects are linked to disembodied technological progress along the lines of traditional growth models (disembodied progress is assumed to enhance the performance of extant and new jobs alike).

The analysis starts from the 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. The 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. Then, "creative destruction" appears to play no part in the steady-state unemployment dynamics of the countries in the sample and the Solow growth model augmented by an unemployment equation is an appropriate framework for the study of unemployment dynamics.

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 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: a) wages need to be insulated from labour market conditions, in particular the vacancy-unemployment ratio, and b) the firms need to discount the revenues from new jobs over an infinite horizon. Dynamically, if one posits that job destruction reacts faster than job creation to shocks, the impact effect of productivity growth on unemployment should be positive in the short run and eventually turn negative in the medium to long run.

A final interesting point of the analysis of Pissarides and Vallanti is that, in the empirical implementation of their model, they allow for capital accumulation as an extra factor capable of bringing about capitalisation an creative destruction effects. They expect the capital stock and TFP to have different effects on unemployment, mainly because the costs of adjustment in capital are different from the technology implementation lags. In the steady-state, capital stock per worker (as well as wages and employment) is an endogenous variable growing at the same rate of technological progress.

As international interdependence and integration grew significantly and more and at a furious pace in the last decades, the impact of globalisation on labour market matching and performance looks like another issue highly worthy of discussion. As shall be clear from the following account, however, this discussion has never been embodied in economic models similar to those examined in the previous section.

Higher unemployment and loss of jobs are quite commonly associated with globalisation, mainly due to the following arguments: a) multinationals have exported jobs from developed countries to developing countries through foreign investments and outward production in special economic zones; b) through trade liberalisation, governments have encouraged the replacement of domestically produced goods with goods produced abroad; c) the increased application of technology, especially in globally operating companies, can reduce the use of and dependence on labour (clearly this point overlaps with the role of technological progress highlighted in the previous section). Hence inter-government and inter-worker competition intensified to attempts at improving working conditions and benefits in industrial countries were weakened. Unemployment has been rising amongst low-skilled and relatively low-paid male workers, who traditionally found work in the manufacturing sectors that are most exposed to increased competition[1].

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, International Monetary Fund (IMF) and OECD[2] share the opinion that structural adjustment policies and globalisation, far from being the main sources of unemployment, can be used in a strategy for better growth and employment. A basic condition for this is that governments have their priorities right, and accept to complement the structural adjustment program by a major effort at reforming the state, including, in particular, reducing unproductive spending, collecting properly the taxes from those who can pay, and allocating them more efficiently to key social priorities.

At any rate, according to Nickell and Bell (1995) and Song and Webster (2003), the Beveridge Curve for unskilled workers should have shifted outwards in recent years, due to

exportation of their jobs to the low-wage countries entailed by the process of globalisation. A corresponding outward shift in the aggregate Beveridge Curve should also follow.

On the other hand, the impact of energy (especially oil) prices on the Beveridge Curve has received little, if any, attention in the literature. Yet energy prices are widely believed to be one of the *dominant factors* in the world economy (see e.g. Loungani 1986). Oil-price shocks are also believed to affect the capital-output ratio and the labour share in the OECD since 1970 (Bentolila and Saint-Paul 2003). By the same token, they could also influence the skill demand-mix and jobs matching. Besides, energy prices are also an important determinant of induced technological progress (Kumar 2008).

2. The empirical literature on OECD countries

In proceeding to set up a framework for empirical analysis where the effects of globalisation and technological progress are jointly measured and appraised, we draw inspiration chiefly from a paper by Nickell *et al.* (2003). They analyse 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, as well as shifts in the Beveridge Curves in twenty countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States). Their basic aim was to ascertain, using a very simple empirical model, if these shifts can be explained by changes in the labour market institutions expected to impact on equilibrium unemployment. Nickell *et al.* (see Table 1) include in their Beveridge Curve a set of institutional variables expected to influence equilibrium unemployment in the long run.

Table 1. *Institutional variables affecting the Beveridge Curve, Nickell et al. (2003)*

Unemployment benefit replacement ratio
Benefit duration index
Bargaining coordination index
Collective bargaining coverage
Union density
Employment protection legislation
Labour taxes
Owner occupation rate

What is 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].

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 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). As illustrated in Table 2, 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)*

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 then draw 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.

In more recent years the Beveridge Curve has received little analytical attention. Yet, the current crisis is widely believed to bring about long lasting changes in the world economy An outward shift of the curve can be interpreted as an indicator for an increased mismatch (a deterioration of human capital or of the search ability of the unemployed, a negative perception of the long-term unemployed on the part of potential employers, a higher availability of unemployment benefits, etc.). These are of course instances of hysteresis, but there may be other channels through which the crisis may have changed the skill demand-mix leading to an increased mismatch. There is the *discouraged worker effect*, that may pushed off

the market a quota of mainly marginal workers. On the other hand, low-skilled workers may have brought in the market by the *added worker effect*.

At any rate, Arpaia and Curci (2010) for European labour markets, Elsby *et al.* (2010) for the US labour market, both find that there have been *moves along* rather than *shifts of* the Beveridge curve.

3. The empirical specification

The basic model is the following Cobb-Douglas dynamic specification of the Beveridge Curve:

$$u_{it} = f(v_{it}, inf_{it}, glob_{it}, rd_{it}, k_{it}, tfp_{it}, oilp_{it}, Z_{it}, a_t, a_i, t_i, t_i^2) \qquad [1]$$

where $i = 1, \ldots, N$ stands for the country, and $t = 1, \ldots, T$ stands for the time period (year), u_{it} is unemployment rate, v_{it} the vacancy rate, inf_{it} the inflow rate, $glob_{it}$ the globalisation index, rd_{it} the index of R&D intensity, k_{it} the capital stock per worker, tfp_{it} a measure of total factor productivity, $oilp_{it}$, are real oil prices (deflated by consumer price indexes). All these variables are taken in natural logs[4]. Z_{it} is a vector of institutional variables which are expected to influence unemployment either because of their impact either on matching efficiency or on job creation, a_t and a_i are vectors of yearly and country dummies respectively; t_i and t_i^2 are country-idiosyncratic linear and quadratic time trends.

The inflow rate is measured by the ratio of inflow into unemployment to total employment. We used three distinct proxies for the globalisation index. The preferred one, the same used by Koeniger *et al.* (2007), is the ratio of total manufacturing imports from no-OECD countries to manufacturing value added (both variables at current prices). In order to explore the role of other dimensions of globalisation, we also used the KOF index of actual economic flows (allowing for external trade, capital flows and outsourcing) and the KOF overall index of globalisation (Dreher, 2006).

We follow Koeniger *et al.* (2007) also by taking an index of R&D intensity (the ratio of R&D expenditure over value added in the manufacturing sector, both variables at current prices) as

our preferred measure of technological progress. However, this measure is likely to emphasise the role of technology embodied in new jobs. Hence we also allow for other long-run variables: capital per worker (measured as the ratio of the capital stock of the business sector to total employment). This capital stock is also used, along with gross domestic output, employment and a smoothed share of labour, to construct a Tornqvist index of total factor productivity. TFP also works as a catch-all control (shades of the debate about the Solow residual).

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[5]; 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. We also attempted to include in our estimates of active labour market policies (ALMP) but they never worked. They were never significant and their coefficient was consistently positive.

More information about the data and their sources is provided in the Appendix.

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 regressors. We follow Pissarides and Vallanti (2007) in introducing two lags for unemployment, while other variables enter (1) with a current *and* a (first-order) lagged value.

We started our analysis with 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, for a 28-year

(1980-2007) and a 32-year period (1980-2011). There were some missing data, and hence we had an unbalanced panel. However, the OECD provides vacancy data only for nine countries (Australia, Austria, Finland, Germany, Norway, Portugal, Sweden, Switzerland, United Kingdom). It soon became apparent that estimates for this subset were much better behaved, and in the end decided to stick with them only. Still, missing data imply an unbalanced panel.

Important influences on our econometric approach were Judson and Owen (1999), Blundell *et al.* (2001), and Soto (2007). Judson and Owen (1999) provide a guide to appropriate techniques for panels of various dimensions. Their results, based on a Monte Carlo analysis, show that Kiviet's corrected Least Squares Dummy Variable estimator (LSDVC) is the best choice for any balanced panel, whereas for unbalanced panels: a) if T = 30, where T is the time dimension of the panel, LSDV performs just as well or better than the viable alternatives; b) when $T \leq 10$, Arellano and Bond's one-step Generalised Method of Moments estimator (AB GMM) is the best choice; c) when T = 20, AB GMM or Anderson and Hsiao estimator (AH) may be chosen.

Blundell *et al.* (2001), reviewing developments to improve on the relatively poor performance of the standard one-step difference GMM estimator for highly autoregressive panel series, provided Monte Carlo simulation comparison between one-step difference and a new estimator, denoted system GMM, that relies on relatively mild restrictions on the initial condition process, and made an application to a simple panel Cobb-Douglas production function for US data, showing that system GMM has substantial asymptotic efficiency gains, as it not only greatly improves the precision but also greatly reduces the finite sample bias.

Soto (2007) analysed through Monte Carlo simulations the properties of various GMM and other estimators when the number of individuals is small, as typical in country studies. He found that the system GMM estimator has a lower bias and higher efficiency than all the other estimators analysed, including the standard one-step difference GMM estimators.

We have an unbalanced panel with N = 9, and T = 28 or 32: thus, we have implemented LSDV and AB GMM (one-step difference and system) estimators. Moreover, we consider the useful advices provided by Roodman (2009a, 2009b) in order to make appropriate specification choices for AB GMM and correctly face up to the econometric problems which

may emerge, particularly autocorrelation and endogeneity. More specifically, Roodman suggests: a) to use orthogonal deviations, in order to maximise sample size; b) to put every regressor into the instrument matrix: if a regressor is strictly exogenous, it is inserted as a single column; if it is predetermined but not strictly exogenous (such as our regressors), lags 1 and deeper are used in GMM-style; if it is endogenous, lags 2 and deeper are used in GMM-style; c) to pay attention in evaluating the results of autocorrelation and endogeneity tests, as a small number of cross-country observations makes Arellano-Bond test for autocorrelation not very reliable and too many instruments weaken the power of Sargan and Hansen tests to detect overidentification[6].

4. The Econometric Results

Before discussing our results, we recapitulate in Table 3 the main predictions about the role of various factors 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 (ICFTU, Thorpe) **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).

	According to Pissarides and Vallanti, the Outward shift should dominate in the short run.
R&D Intensity	Outward shift, as we expect this indicator of technological progress to be largely related to technology embodied in new jobs (in the parlance of Pissarides and Vallanti), and hence to creative-destruction effects.
Capital accumulation	Outward shift (short run) and Inward shift (medium-long run): Pissarides and Vallanti (2007)
Oil prices	Outward shift: Nickell *et al.* (2003)

Our empirical evidence is reported in the Appendix. We sum up here the main results. First, let us examine the 1980-2007, that leave the current crisis out. Our estimation results confirm the existence of a Beveridge Curve for the countries considered. Much as in Nickell et al. (2003), the inflow rate matters. Furthermore we find a significant positive effect of current and lagged technological progress (especially through the index of R&D intensity), which tends to shift the curve outwards through the creative destruction effect. The first-order lagged coefficient of the globalisation index constructed along the lines of Koeniger et al. (2007) is always significant. Its positive sign means that it shifts the Curve outwards. On the other hand, the KOF indexes of globalisation (much as they should allow for capital flows and outsourcing) were never significant. Oil prices intervene in terms of rates of change, but a positive effect prevails. Capital accumulation is never significant and the TFP is, at best, much less significant than R&D intensity.

Among the institutional variables, union density and bargaining coordination are significant and have the expected impact on unemployment (yet union density has a transitory, rather than permanent, impact). EPL has the "wrong" sign, but, as already recalled, also Nickell et al. (2003) found this result. Unemployment benefit and, especially, the tax wedge are much less significant, although having the right sign.

Main Results: 1980-2007 (specification with Imp/VA)

	Baseline	No TFP	No K per w	No R&D		**Institutional Variables**
	-0.15***	-0.17***	-0.18***	-0.15***		EPL
	0.01*	0.01*	0.01*	0.01***		Unemployment benefit
	0.01	0.01**	0.01	0.01**		Tax Wedge (1st or. lag)
	-0.30***	-0.29***	-0.27***	-0.28***		Bargaining coordination
	0.02**	0.02**	0.02**	0.03***		Union density
	-0.02***	-0.02***	-0.02***	-0.03***		Union density (1st or. lag)

Main Results: 1980-2007 (baseline specification with different proxies of globalisation)

	Imp/VA	KOF (actual econ. flows)	KOF (overall)		**Structural Variables**
	0.20***	0.46	-0.70		Globalisation (1st or. lag)
	0.01***	0.01***	0.01***		R&D/VA
	1.12	1.05	1.63**		TFP
	-0.07	0.14	0.12		K per worker
	-0.04	-0.26	-0.18		K per worker (1st or. lag)
	0.50***	0.52***	0.42***		Real oil prices
	-0.19	-0.31**	-0.16		Real oil prices (1st or. lag)

Let us now turn to the current crisis and its impact on the Curve. We re-estimate the former model through 2008-2011 with no frills, and examine model stability. Then, we turn to an augmented model with country-specific (intercept) dummies, and an augmented model with country-specific (intercept) dummies plus a slope dummy for each institutional variable.

First, the 1980-2011 estimates with no frills. We get results that are very much consistent with the above ones.

Main Results: 1980-2011 (specification with imp/VA); no crisis dummies

	Baseline	No TFP	No K per w	No R&D		**Institutional Variables**
	-0.15***	-0.17***	-0.18***	-0.18***		EPL
	0.01***	0.01***	0.01**	0.01***		Unemployment benefit

	0.01	0.01**	0.01	0.01		Tax Wedge (1st or. lag)
	-0.25***	-0.24***	-0.21***	-0.31***		Bargaining coordination
	0.02**	0.01**	0.02**	0.03***		Union density
	-0.02***	-0.02***	-0.02***	-0.03***		Union density (1st or. lag)

Main Results: 1980-2011 – (baseline specification with different proxies of globalisation), no crisis dummies

	Imp/VA	KOF (actual econ. flows)	KOF (overall)		**Structural Variables**
	0.21***	0.29	-0.95		Globalisation (1st or. lag)
	0.01*	0.01*	0.01*		R&D/VA
	0.69	0.89	0.89*		TFP
	-0.30	-0.16	-0.18		K per worker
	0.20	0.04	0.12		K per worker (1st or. lag)
	0.50***	0.53***	0.39***		Real oil prices
	-0.21	-0.27**	-0.13		Real oil prices (1st or. lag)

The above found structural relationships seem to be stable enough in the 2008-2011 period (and formal stability tests, available upon request, validate this point). What about the crisis dummies?

Main Results: 1980-2011 (specification with imp/VA);with country-specific (intercept) dummies

	Baseline	No TFP	No K per w	No R&D		**Institutional Variables**
	-0.14***	-0.17***	-0.18***	-0.14***		EPL
	0.01**	0.01***	0.01**	0.01***		Unemployment benefit
	0.01	0.01*	0.01	0.01		Tax Wedge (1st or. lag)
	-0.29**	-0.28**	-0.27**	-0.29**		Bargaining coordination
	0.02***	0.02***	0.02**	0.03***		Union density
	-0.02***	-0.02***	-0.02***	-0.03***		Union density (1st or. lag)

Main Results: 1980-2011 – (baseline specification with different proxies of globalisation); with country-specific (intercept) dummies

	Imp/VA	KOF (actual econ. flows)	KOF (overall)		**Structural Variables**
	0.17***	0.30	-0.67		Globalisation (1st or. lag)
	0.01**	0.01***	0.01**		R&D/VA
	1.22	0.82	1.11*		TFP
	-0.30	-0.16	-0.18		K per worker
	0.24	0.04	0.12		K per worker (1st or. lag)
	0.41***	0.51***	0.39***		Real oil prices
	-0.16	-0.21**	-0.11		Real oil prices (1st or. lag)

Stability and the Crisis (1980-2011): The Dummies

	Intercept Dummy
Australia	0.07**
Austria	-0.13***
Finland	-0.13***
Germany	-0.17*
Norway	0.24***
Portugal	-0.04
Sweden	0.03
Switzerland	-0.12
UK	0.06

	Slope Dummy
Unemployment Benefit	-0.02
EPL	-2.67***
Tax Wedge	-0.03
Bargaining Coordination	0.06
Δ Union Density	-0.03

Again, we get results that are consistent with those for 1980-2007, and we must ask ourselves is the crisis really a structural change? The answer, pretty in line with the evidence from Arpaia and Curci (2010) and Elsby et al. (2010) suggests that there have been moves along

rather than shifts of the Beveridge curve. As for the country dummies, there would appear to exist some role for neo-corporatism (see the negative intercept dummies for Austria, Finland, Germany and Switzerland). Only Norway's Curve seems to shift decisively outwards in the crisis, and this certainly warrants further attention. One would also like to have more evidence (countries?) in order to appraise the robustness and meaning of the EPL-slope dummy shift.

5. Concluding Remarks

In this paper we considered the economies of nine OECD countries from 1980 to 2011 period in order to appraise the existence of a OECD Beveridge Curve and to investigate the impact of various kinds of structural factors (technological progress, globalisation, oil prices) and of the current recession on the Curve.

An OECD Beveridge trade-off is actually found. Current and lagged technological progress (especially through the index of R&D intensity) tends to shift the curve outwards through the creative destruction effect. Also the first-order lagged coefficient of the globalisation index constructed along the lines of Koeniger et al. (2007) is consistently positive and significant. On the other hand, the KOF indexes of globalisation (much as they should allow for capital flows and outsourcing) were never significant. Oil prices intervene in terms of rates of change, but a positive effect prevails. Hence both globalisation and unfavourable oil shocks shift the Curve outwards. Capital accumulation is never significant and the TFP is, at best, much less significant than R&D intensity. Yet the creative destruction effect also comes through with TFP.

Among the institutional variables, union density and bargaining coordination are significant and have the expected impact on unemployment (yet union density has a transitory, rather than permanent, impact). EPL has the "wrong" sign, but, as already recalled, also Nickell et al. (2003) found this result. Unemployment benefit and, especially, the tax wedge are much less significant, although having the right sign.

Our structural relationships seem to be stable enough in the 2008-2011 period. In line with the evidence from Arpaia and Curci (2010) and Elsby et al. (2010) this suggests that there have been moves along rather than shifts of the Beveridge curve. Some role seems to emerge for neo-corporatism, although more evidence (from other countries?) is certainly needed on this

point. Further research should also elucidate the paltry role we found for active labour market policies.

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Appendix

Table A.1 - *1980-2007 (specification with Imp/VA)*

	full	NO tfp	NO k	NO r&d_va
ur				
L1.	0.90***	0.90***	0.88***	0.97***
L2.	-0.36***	-0.35***	-0.33***	-0.39***
vr	-0.18***	-0.17***	-0.21***	-0.14***
inf	0.18***	0.17***	0.19***	0.20***
nrw	0.01*	0.01*	0.01*	0.01***
epl	-0.15***	-0.17***	-0.18***	-0.15***
Tx				
L1.	0.01	0.01**	0.01	0.01**
co				
--.	-0.30**	-0.29**	-0.27**	-0.28**
L1.	0.24**	0.25**	0.19	0.19
ud				
--.	0.02**	0.02**	0.02**	0.03***
L1.	-0.02***	-0.02***	-0.02***	-0.03***
imp_va				
--.	-0.14	-0.18	-0.08	-0.19
L1.	0.20***	0.20**	0.15**	0.21**
r&d_va				
--.	0.01***	0.01**	0.02***	
L1.	0.00	0.00	-0.00	
tfp				
--.	-0.09		-0.16	-0.84
L1.	1.12		1.14	1.69*
k				
--.	-0.07	-0.11		0.00
L1.	-0.04	0.02		-0.13
oilp				
--.	0.50***	0.43***	0.54***	0.47***
L1.	-0.18	-0.09	-0.19	-0.22

Table A.2 - *1980-2007 (specification with KOF index for actual economic flows)*

	full	NO tfp	NO k	NO r&d_va
ur				
L1.	0.88***	0.87***	0.90***	0.95***
L2.	-0.33***	-0.33***	-0.33***	-0.38***
vr	-0.18***	-0.17***	-0.18***	-0.14***
inf	0.18***	0.17***	0.19***	0.18***
nrw	0.01*	0.01	0.01**	0.01***
epl	-0.16***	-0.18***	-0.19***	-0.16***
Tx.				
L1.	0.01	0.01*	0.01	0.01*
co				
--.	-0.19	-0.19*	-0.23*	-0.19
L1.	0.15	0.16	0.14	0.11
ud				
--.	0.02**	0.02**	0.02**	0.03**
L1.	-0.02***	-0.02***	-0.02**	-0.02**
KOF-flows				
--.	-0.05	-0.18	-0.54	-0.08
L1.	0.46	0.32	0.26	0.21
r&d_va				
--.	0.01***	0.01***	0.02***	
L1.	-0.00	-0.00	-0.01	
tfp				
--.	-0.05		-0.33	-0.58
L1.	1.05		1.16	1.58
k				
--.	0.14	0.09		0.17
L1.	-0.26	-0.16		-0.30
oilp				
--.	0.52***	0.51***	0.57***	0.48***
L1.	-0.31***	-0.21**	-0.23**	-0.33***

Table A.3 - *1980-2007 (specification with KOF overall index)*

	full	NO tfp	NO k	NO r&d_va
ur				
L1.	0.86***	0.85***	0.85***	0.95***
L2.	-0.32***	-0.31***	-0.31***	-0.39***
vr	-0.16***	-0.17***	-0.17***	-0.13***
inf	0.19***	0.16***	0.20***	0.21***
nrw	0.01***	0.01**	0.01***	0.01***
epl	-0.19**	-0.20**	-0.21***	-0.19***
Tx				
L1.	0.01**	0.01**	0.01	0.01**
co				
--.	-0.28**	-0.24*	-0.32**	-0.25*
L1.	0.18	0.19	0.20	0.12
ud				
--.	0.02**	0.02*	0.02**	0.03***
L1.	-0.02***	-0.02***	-0.02**	-0.02***
KOF-overall				
--.	0.18	0.74	-0.03	0.14
L1.	-0.70	-0.82	-0.83	-0.91
r&d_va				
--.	0.01**	0.01***	0.02***	
L1.	0.00	0.00	0.00	
tfp				
--.	-0.59		-0.32	-0.84
L1.	1.63**		1.38	1.95**
k				
--.	0.12	0.19		0.16
L1.	-0.18	-0.25		-0.22
oilp				
--.	0.42***	0.41***	0.39***	0.38***
L1.	-0.16	-0.16	-0.11	-0.23

Table A.4 - *1980-2011 (specification with Imp/VA),No crisis-specific dummies*

	full	NO tfp	NO k	NO r&d_va
ur				
L1.	0.96***	0.94***	0.90***	0.97***
L2.	-0.37***	-0.36***	-0.32***	-0.38***
vr	-0.15***	-0.12***	-0.18***	-0.14***
inf	0.17***	0.15***	0.16***	0.15***
nrw	0.01**	0.01***	0.01**	0.01***
epl	-0.15***	-0.17***	-0.18***	-0.18***
Tx				
L1.	0.01	0.01**	0.01	0.01
co				
--.	-0.25**	-0.24*	-0.21**	-0.31**
L1.	0.19	0.21	0.14	0.21
ud				
--.	0.02***	0.01**	0.02***	0.03***
L1.	-0.02***	-0.02***	-0.02***	-0.03***
imp_va				
--.	-0.08	-0.12	-0.05	-0.13
L1.	0.21**	0.19*	0.17**	0.17***
r&d_va				
--.	0.01*	0.01	0.01	
L1.	-0.00	-0.00	-0.00	
tfp				
--.	0.35		-0.29	-0.46
L1.	0.69		1.22	1.51**
k				
--.	-0.05	-0.43		-0.19
L1.	0.11	0.45		0.24
oilp				
--.	0.50***	0.56**	0.57***	0.52***
L1.	-0.21	-0.12	-0.24	-0.23

Table A.5 - *1980-2011 (specification with KOF index for actual economic flows) No crisis-specific dummies*

	full	NO tfp	NO k	NO r&d_va
ur				
L1.	0.93***	0.93***	0.89***	0.96***
L2.	-0.38***	-0.36***	-0.34***	-0.39***
vr	-0.13***	-0.12***	-0.15***	-0.15***
inf	0.19***	0.17***	0.19***	0.18***
nrw	0.01*	0.01*	0.01***	0.01***
epl	-0.13***	-0.18***	-0.18***	-0.21***
Tx				
L1.	0.01	0.01*	0.01	0.01**
co				
--.	-0.23*	-0.25*	-0.22**	-0.26*
L1.	0.18	0.18	0.12	0.14
ud				
--.	0.01	0.01	0.02*	0.02*
L1.	-0.02*	-0.01***	-0.02**	-0.02*
KOF-flows				
--.	-0.15	-0.40	-0.66	-0.37
L1.	0.29	0.04	0.13	0.03
r&d_va				
--.	0.01*	0.01	0.01*	
L1.	-0.00	-0.00	-0.01	
tfp				
--.	0.89		-0.27	-0.37
L1.	0.18		1.02	1.15
k				
--.	0.01	0.41		0.10
L1.	-0.12	-0.40		-0.15
oilp				
--.	0.53***	0.63***	0.63***	0.52***
L1.	-0.27**	-0.06	-0.20**	-0.25**

Table A.6 - *1980-2011 (specification with KOF overall index)*
No crisis-specific dummies

	full	NO tfp	NO k	NO r&d_va
ur				
L1.	0.91***	0.90***	0.85***	0.92***
L2.	-0.36***	-0.35***	-0.33***	-0.37***
vr	-0.12***	-0.12***	-0.13***	-0.16***
inf	0.21***	0.15***	0.18***	0.19***
nrw	0.01	0.01	0.01	0.01*
epl	-0.21**	-0.16**	-0.19***	-0.25***
Tx				
L1.	0.01	0.01	0.01	0.01*
co				
--.	-0.33**	-0.27*	-0.26***	-0.25
L1.	0.18	0.21	0.15	0.10
ud				
--.	0.02**	0.01	0.02**	0.02**
L1.	-0.01*	-0.01	-0.02*	-0.02**
KOF-overall				
--.	-0.39	0.78	-0.33	0.22
L1.	-0.95	-0.96	-0.61	-1.02*
r&d_va				
--.	0.01**	0.01**	0.01**	
L1.	-0.00	0.00	-0.00	
tfp				
--.	0.11		-0.21	-0.29
L1.	0.89*		1.19*	1.12
k				
--.	0.06	0.60		0.18
L1.	-0.03	-0.63		-0.16
oilp				
--.	0.39***	0.48***	0.42***	0.40***
L1.	-0.13	-0.03	-0.06	-0.20

Table A.7 - *Full specification with Imp/VA, country-specific (intercept) dummies and standalone slope dummy for each institutional variable*

Model	zero	nrw	epl	tx	co	D.ud
cri_aus	0.07**	0.27	3.28***	0.92	-0.05	0.06**
cri_aut	-0.13***	0.10	5.89***	1.42	-0.36	-0.16***
cri_fin	-0.13**	0.26	6.01***	1.24	-0.42	-0.15***
cri_ger	-0.17*	0.26	5.72***	1.46	-0.41	-0.19**
cri_nor	0.24***	0.37*	2.38***	0.85	0.18*	0.23***
cri_por	-0.04	0.34	8.76***	1.13	-0.27	-0.05
cri_swe	0.03	0.36	5.91***	1.43	-0.15	-0.01
cri_swi	-0.12***	0.22	3.90***	0.56	-0.35	-0.13***
cri_uk	0.06	0.09	3.81***	1.09	-0.41	0.03
nrw		-0.01**				
cri_nrw		-0.02				
epl			-0.14***			
cri_epl			-2.67***			
tx				0.01		
cri_tx				-0.03		
co					-0.29**	
cri_co					0.06	
D.ud						0.02**
cri_D.ud						-0.03

Legend of tables A.1-A.7

The sample relates to 1980-2011 period and nine countries, for a sum total of 229 observations (197 observations up to 2007). The dependent variable is always the natural log of the unemployment rate.

Among the Z variables, *nrw* is the unemployment benefits indicator, *epl* the employment protection legislation indicator, *co* the bargaining coordination indicator, *ud* the union density indicator, *tx* the total tax wedge. The other variable labels have already been defined in the text.

In all models we have included yearly and country dummies and linear and quadratic trends, not shown in the interest of parsimony. Coefficient significances are denoted by stars: * means a p-value < .1; ** a p-value < .05; *** a p-value < .01. Diagnostics are always provided by the Arellano–Bond test for first, second and third order serial correlation (distributed as a normal), *Sargan* and *Hansen* tests of overidentifying restrictions that detect the exogeneity of the instruments as a group, and Difference-in-Hansen tests of exogeneity of instrument subsets. They are generally good (but for Sargan's test, which however is not as robust as the other two) and are available upon request.

Data Sources

The unemployment rates are derived from Nickell and Nunziata (2001), and updated through OECD Stat Extracts: they are based on OECD standardised rates and are an extension of those used in Layard *et al.* (1991).

The vacancy rates are taken from Nickell and Nunziata (2001) and updated with data from OECD Main Economic Indicators (2006). For Italy, vacancies data 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 series is mainly taken from Nickell and Nunziata (2001), and updated through OECD Stat Extracts. However, the data for Italy are derived from the ISTAT MARSS Database, and those for Switzerland from the OECD Database on Unemployment by Duration

In our preferred globalisation index, total manufacturing imports from non-OECD countries are drawn by the OECD STAN Bilateral Trade Database and International Trade by Commodity Statistics (2004), and value added by the OECD STAN Database for Industrial Analysis (2005). KOF indexes (the overall one, and the sub-index for actual economic flows) come from http://globalization.kof.ethz.ch.

Oil prices (for the West Texas Intermediate) are taken from the US Energy information Administration. They converted in each country's currency using exchange rates from OECD.Stat Extracts, and deflated by country-specific consumer price indexes from the same source.

R&D intensity uses data for R&D expenditure taken from the OECD Research and Development Expenditure in Industry Database (2005), and value added by the OECD STAN Database. The source of the private non-residential net capital stock (i.e. the capital stock of the business sector) is the OECD Analytical Database (2002), whereas gross domestic output and employment are drawn from OECD.Stat Extracts and the smoothed share of labour from

the OECD Unit Labour Costs Dataset (2009). Total factor productivity is calculated as a Tornqvist index.

Employment protection legislation series, basically following the OECD methodology, are from Allard (2005a). Unemployment benefits are from Allard (2005b), who uses OECD data to build an indicator combining the amount of the subsidy with their tax treatment, their duration and the conditions that must be met in order to collect them. The index of bargaining coordination is taken from OECD (2004). All these data are updated using information from the OECD Stat Extracts.

Union density is calculated using administrative and survey data from the OECD Labour Market Statistics Database.

Finally, the total tax wedge is drawn from OECD.Stat Extracts.

Notes

1 See, e.g., the report produced by the International Confederation of Free Trade Unions (ICFTU) at its 16th World Congress (1996), or Thorpe (1997).

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

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 Bevridge Curve empirical literature.

4 There is actually an exception to this. The index of R&D intensity turned out to be more significant if not logged. A linear specification for this variable was then adopted, and is included in our reported estimates.

5 See e.g. Nickell and Layard (1999) or Booth *et al.* (2000).

6 For this reason, we "collapse" the instrument set into a single column.