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Sluggish US employment recovery after the Great Recession: Cyclical or structural factors?

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ABSTRACT

This paper aims at investigating the causes of the observed departure of employment path from the GDP movements occurred in US in the late of 2008 onwards. Starting from a production function approach, and assuming that the TFP growth is explained by variables linked to the business cycle, we are able to formulate an extended version of Okun's law based on cyclical factors. Out-of-sample forecasting for the period 2008 onward shows that predicted US employment is on average 1.7% above the observed one, meaning that this gap cannot be attributed to identified cyclical factors.

1. Introduction

One of the macroeconomics "core ideas" that had been empirically confirmed before the recent crisis is Okun's law (Blinder, 1997). This simple rule-of-thumb suggested a relation between unemployment (or employment) and GDP (Okun, 1962). Economic predictors and policy makers frequently used this rule to assess the evolution of employment using GDP forecasts. From the late of 2008, however, the path of employment exhibits important departures from the GDP movements (Daly and Hobijn, 2010; Elsby et al., 2010; Bernanke, 2012). Fig. 1 shows the growth rates of US employment against GDP over the period 1970Q1–2013Q2. From 2008Q4 employment growth is below the regression line (i.e. employment is overpredicted) and continued on into the recovery period.

The empirical employment–GDP discrepancy raises an important question about the causes, as highlighted by Bernanke (2012): Is the low level of employment primarily the result of pronounced dip in cyclical factors (i.e. shift in aggregate demand and/or cyclical variables such as wages, prices, capacity utilization, etc.)? Or is instead the result of structural factors (i.e. mismatch between supply and demand for jobs caused by the presence of unskilled workforce, offshoring of manufacturing, low labor mobility, etc.)? Understanding the sources of this divergence raises important policy implications. If shifts in economic conditions predominate, then fiscal and monetary policies should be effective in supporting the employment recovery; if the causes are structural, then other policy measures are needed, such as programs to retrain workers or to promote their mobility towards areas where jobs exist.

This paper aims at investigating the causes of the employment–GDP empirical failure in the aftermath of the 2008's crisis going deeper into the characteristics of Okun's relation. We start from a classical log-levels version of the production function and evaluate the impact of GDP and TFP on employment. The idea is that through the well-known "capitalization effect" (i.e. technological progress favors employment by generating opportunities for profits) the TFP growth increases jobs creation, as demonstrated by Pissarides and Vallanti (2007) for US labor market.

We assume that the movement of TFP is captured by trade openness and the ratio of wages to machinery prices. In general, trade openness favors the circulation of ideas, knowledge and technologies, affecting in this way the TFP. Since openness may present non-monotonic (U-shaped) impact on growth (see Rivera-Batiz and Romer, 1991; Baldwin and Forslid, 1999), we introduce a quadratic term for openness into the regression as in Edwards (1998). The wages expressed in terms of machinery prices (i.e. the factors price ratio) affect the pace of mechanization and technical progress; when labor is more expensive than capital, there is an incentive to introduce a technological innovation (Acemoglu, 2003).

Since all the variables (i.e. employment, GDP, trade openness and wages to machinery prices ratio) are non-stationary in

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log-levels, we estimate a long-run relationship using the Dynamic OLS (DOLS) approach. The ECM version of this model is then compared to other specifications of Okun's law considered in the empirical literature. Our model performs better compared to alternative specifications of Okun's law in explaining the sluggish pattern of employment after the 2008. Since our model is based exclusively on variables linked to the business cycle, the misprediction of the employment (1.7% on average) may be attributable to structural factors.

The paper is organized as follows. Section 2 presents our model specification, Section 3 shows the estimation results and the comparison of our model with other alternative versions in terms of the employment explanation after 2008. Section 4 concludes.

2. Model specification

We start by considering the following production function:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} \tag{1}$$

where A is the stock of knowledge, Y is the output, K is the capital stock and L is the number of employers.

We assume that $A_t = A_0 e^{g_t}$, where A_0 is the initial Total Factor Productivity (TFP) and g_t is the growth rate of A. We can specify the evolution of A by making g a function of trade openness (*open*, the sum of imports and exports as a percentage of GDP) and wages to machinery prices ratio (*wm*, wages as a percentage of implicit price deflator for fixed investment in equipment and software):

$$g_t = \phi_1 open_t + \phi_t open_t^2 + \delta wm_t \tag{2}$$

where *open* is assumed to be nonlinear to capture non-monotonic (U-shaped) effects on growth (Edwards, 1998). In this regard, we expect that $\phi_1 < 0$ and $\phi_2 > 0$, so that the turnaround value corresponds to $|\phi_1/(2\phi_2)|$. Substituting (2) in (1) and taking the logs, we obtain:

$$y_t = a_0 + \phi_1 open_t + \phi_2 open_t^2 + \delta wm_t + \alpha k_t + \beta l_t. \tag{3}$$

Okun's law in terms of employment–output relation can be written as:

$$l_t = \varphi_0 + \varphi_1 y_t. \tag{4}$$

Substituting (3) in (4):

$$l_t = \varphi_0 + \varphi_1(a_0 + \phi_1 open_t + \phi_2 open_t^2 + \delta wm_t + \alpha k_t + \beta l_t). \tag{5}$$

If we assume that k is a linear function of y (i.e. $k_t = v_1 + v_2 y_t$) as supposed by the accelerator model, after some algebraic manipulations we obtain the following expression:

$$l_t = \theta + \omega_1 open_t + \omega_2 open_t^2 + \psi wm_t + \gamma y_t \tag{6}$$

where $\theta = \frac{[\varphi_0+\varphi_1(a_0+\alpha v_1)]}{(1-\varphi_1\beta)}$, $\omega_1 = \frac{\varphi_1\phi_1}{(1-\varphi_1\beta)}$, $\omega_2 = \frac{\varphi_1\phi_2}{(1-\varphi_1\beta)}$, $\psi = \frac{\varphi_1\delta}{(1-\varphi_1\beta)}$ and $\gamma = \frac{\varphi_1\alpha v_2}{(1-\varphi_1\beta)}$.

Eq. (6) represents the long run relation. The ECM form can be written as follows:

$$\begin{aligned}\Delta l_t = {} & -\lambda(l_{t-1} - (\theta + \omega_1 open_{t-1} + \omega_2 open_{t-1}^2 \\ & + \psi wm_{t-1} + \gamma y_{t-1})) + \sum_{k=1}^{n_1} m_k \Delta l_{t-k} \\ & + \sum_{k=0}^{n_2} p_k \Delta open_{t-k} + \sum_{k=0}^{n_3} q_k \Delta open_{t-k}^2 \\ & + \sum_{k=0}^{n_4} v_k \Delta wm_{t-k} + \sum_{k=0}^{n_5} z_k \Delta y_{t-k} + \varepsilon_t.\end{aligned} \tag{7}$$

3. Estimation results and model performance

To estimate the model in Eqs. (6)–(7), we use the data (covering the period 1970Q1–2013Q2) taken from Federal Reserve Economic Data (FRED). All data expressed in log-levels (*emp* and y)

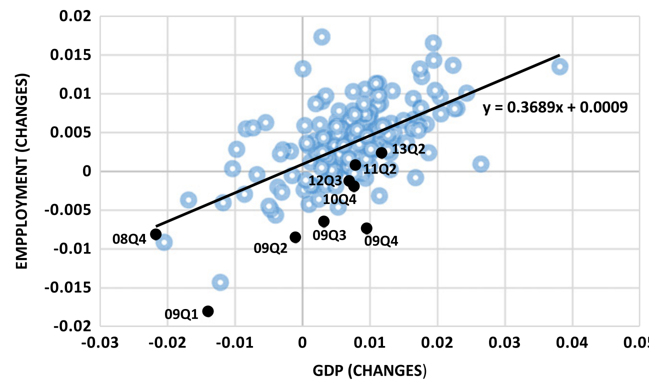

Fig. 1. Quarter on quarter growth rate of employment against GDP, 1970Q1–2013Q2. Black circles denote observations below the regression line in the aftermath of 2008's crisis.
Source: Author's calculation using FRED data.

and as a ratio (*open*, *open*^{2} and *wm*) are non-stationary over the period under investigation[1] and for this reason we study the presence of a long-run relation. We first estimate the long-run relationship of Eq. (6) using DOLS. This estimator deals with the problem of second-order asymptotic bias arising from serial correlation and endogeneity and is asymptotically efficient; in addition, DOLS performs better in finite samples compared to other asymptotically efficient estimators (Montalvo, 1995). Then, we estimate the ECM (Eq. (7)) with the long-run relation and we study the factor loading (λ) and the tests for correct specification.

Results are presented in Table 1. The long-run relation (Eq. (6)) exhibits statistically significant coefficients and the residuals cointegration test (ADF) confirms the existence of a long-run relationship. The nonlinear estimation of *open* produces a turnaround value of 0.244 (=3.11/[2(6.36)]); this nonlinear pattern is plotted in Fig. 2 (panel a). The ECM form (Eq. (7)) exhibits a factor loading (λ) negative and statistically significant; the diagnostic tests are satisfactorily confirming that the model is correctly specified. In Fig. 2 we also report a graphical representation of additional estimation results.

Having established the correct specification of our model, we perform an out-of-sample forecasting for the period of sluggish growth in employment (i.e. 2008Q2–2013Q2). The estimation is stopped in 2008Q1 and a forecast for the period until the end of sample is run. In Fig. 3 we compare our model (labeled as "*DOLS*") with different versions of Okun's law considered in the literature: Okun's classical regression in first difference (*OKUN*); dynamic version of Okun's law (*OKUN DYN*); Okun's law with GAP specification (*OKUN GAP*). Our model exhibits very accurate forecasts for employment over the period of sluggish employment growth, outperforming other models and showing a lower RMSE respect to these compared versions.

The extent of misprediction of our model is low. Employment is over-predicted by 1.7% (on average) over all the forecast period 2008Q2–2103Q2. One may conclude that this gap represents the extent part of employment that is reduced by structural factors, since our model is based only on business cycle factors. Given that this misprediction depends mainly on structural factors,[2] eliminating this employment shortfall will depend on the introduction of appropriate policy measures such as programs to retrain workers or to promote their mobility towards areas where jobs exist.

[1] The unit-root tests are available from authors upon request.

[2] The misprediction incorporates both structural factors and model uncertainty.

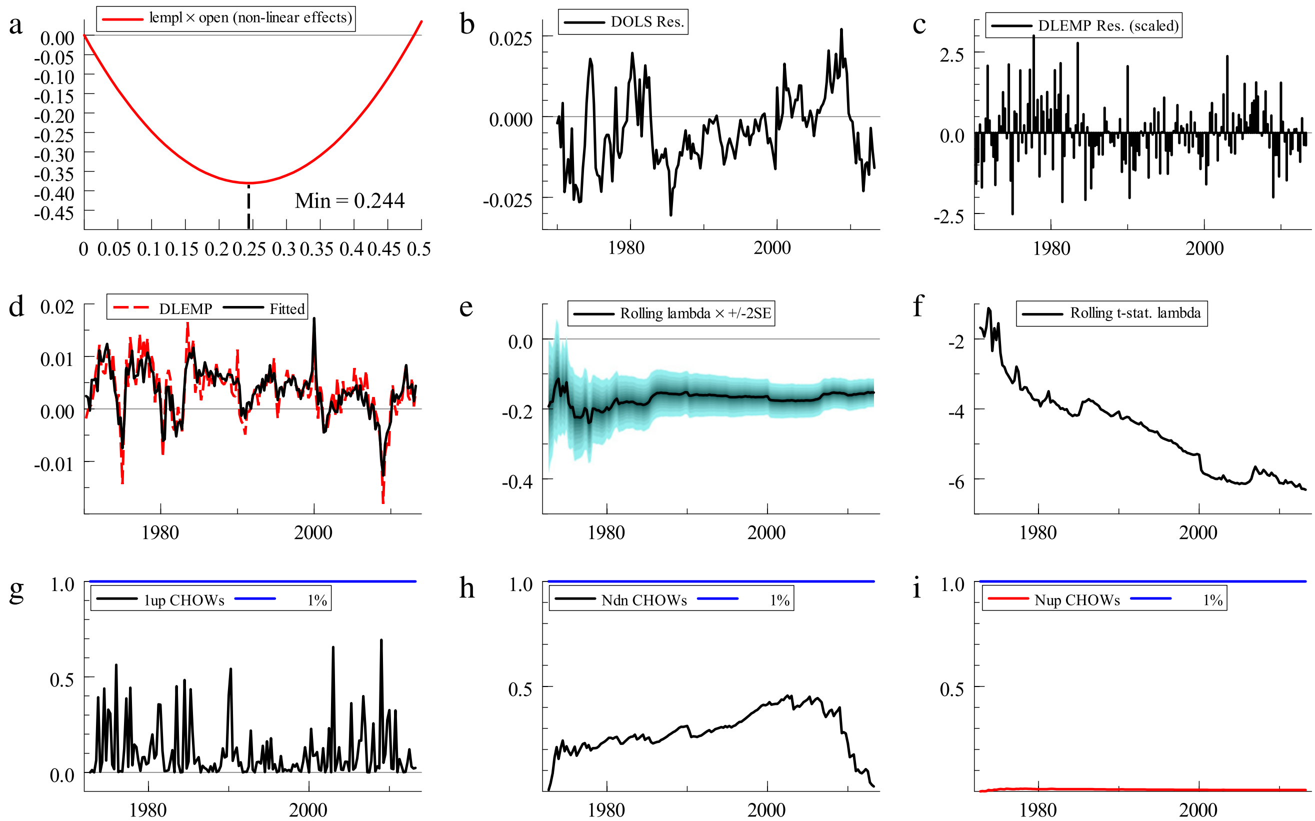

Fig. 2. Additional estimation results. Panel (a) = *empl* as a quadratic function of *open*; Panel (b) = cointegration relation residuals; Panel (c) = ECM residuals; Panel (d) = fitted versus historical values of Δemp; Panel (e) = rolling values of λ; Panel (f) = rolling t-statistics of λ; Panel (g) = 1-step Chow break point test; Panel (h) = recursive Chow break point test; Panel (i) = recursive Chow forecast test.

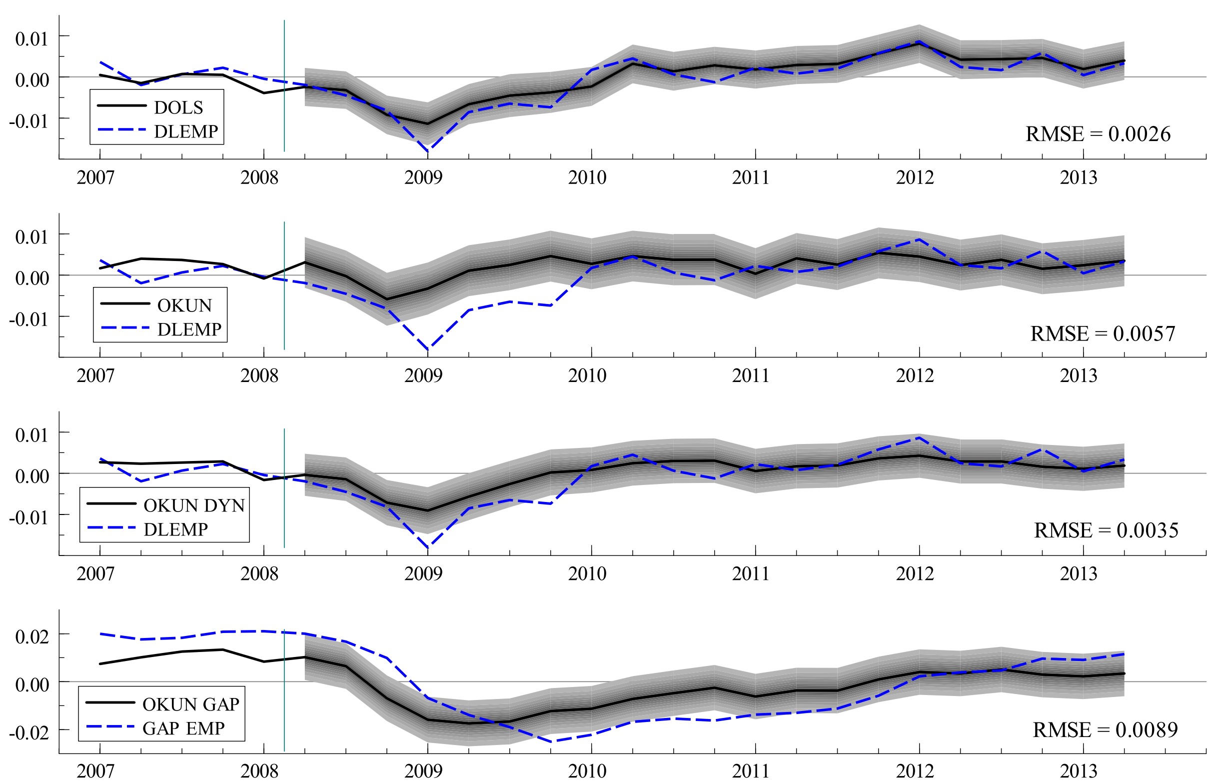

Fig. 3. Out-of-sample forecasting, 2008Q2–2013Q2. DLEMP = Δemp. Equation specifications: DOLS = Eq. (7) in the text; OKUN = $\Delta emp_t = \alpha + \beta \Delta y_t + \varepsilon_t$; OKUN DYN = $\Delta emp_t = \alpha + \sum_{i=1}^{k1} \gamma_i \Delta emp_{t-i} + \sum_{i=1}^{k2} \beta_i \Delta y_{t-i} + \varepsilon_t$; OKUN GAP = $(emp_t - emp_t^n) = \alpha + \beta(y_t - y_t^n) + \varepsilon_t$. The superscript n indicates the natural level of the variables obtained using the HP filter.

Table 1
DOLS estimates for employment, 1970Q1–2013Q2.

θ	4.005
	(0.190)
ω_1	−3.111
	(0.449)
ω_2	6.364
	(1.120)
ψ	−0.383
	(0.033)
γ	0.897
	(0.026)
λ	−0.153
	(0.024)
Res. ADF coint. test	−4.568*
R^2 adj. (ECM)	0.728
$\hat{\sigma}$	0.003
Diagnostic tests	
AR 1–5 test (p-value)	0.571
ARCH 1–4 test (p-value)	0.249
Norm. test (p-value)	0.156
Hetero-test (p-value)	0.070
Hetero-X test (p-value)	0.061
RESET test (p-value)	0.124

Notes: The number in parentheses is HAC standard errors with Bartlett kernel of bandwidth parameter 5. Leads and lags in DOLS estimate are selected according to the SIC criteria. *Res. ADF* is the residual-based cointegration test. λ is the factor loading of the ECM term. A spike dummy (2000Q1) is added in ECM (peak in US labor force). The numbers of lags n_1, n_2, n_3, n_4, n_5 in ECM are selected using *Autometrics* in PcGive and are not reported for brevity. Diagnostic tests: $AR\,1 - n$ is the Harvey test for nth order serial autocorrelation; *Norm* test is the Doornik–Hansen normality test; *ARCH* 1–4 is the Engle test for 4th order autoregressive conditional heteroskedasticity in the residuals; *Hetero* and *Hetero-X* are the White test for residual heteroskedasticity with and without cross products, respectively; RESET is the Ramsey test for functional form misspecification.

* Indicates significance at 5%.

4. Conclusions

We estimate an extended version of Okun's law starting from a classical production function. TFP is assumed to be explained by trade openness and wages to machinery prices ratio. Using the Dynamic OLS (DOLS) approach, the ECM version of our model is then compared to other specifications of Okun's law considered in the empirical literature. Our model performs better in explaining the sluggish pattern of employment after the 2008. Since our model is based exclusively on variables linked to the business cycle, the misprediction of the employment (1.7% on average) may be attributable to structural factors.

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