Portugal: Trends, cycles, and instability in output and unemployment over 2008–2012

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Abstract
This article presents a trend-cycle decomposition of Portuguese Gross Domestic Product and unemployment over 2008–2012. Results show that product and labour markets were primarily marked by low frequency movements in the trend component, and less so by cyclical factors. Economic policy should therefore not neglect the structural properties of these markets, resting solely centered around standard business cycle objectives. Okun's law—the negative correlation between the output and unemployment gaps—remained empirically relevant, but not without noteworthy trend instability. All results are based on a semi-structural model with rational expectations, tailored for a small economy integrated in a credible monetary union. (JEL: C51, E32, F45)

Introduction

Portugal experienced an unstable 2008–2012 period, marked in 2011 by the request for international financial assistance, agreed with the European Union (EU), and the International Monetary Fund (IMF).

Gross Domestic Product (GDP) fell around 10% over 2008–2012, while unemployment soared, reaching 16.7% of the labour force. Behind such dramatic events are, among other reasons, (i) spillover effects from the international financial crisis, which intensified in the second half of 2008; (ii) co-movements in sovereign risk hikes across vulnerable euro area countries (Ireland, Greece, Cyprus, Italy, Spain); (iii) the need to reduce macroeconomic imbalances; and (iv) sudden stops in credit flows, which intensified financial fragmentation.

The sharp deterioration in product and labour market conditions, possibly interacting with financial factors and high credit spreads, calls for a model-based assessment of such developments: What drove such events? Was it

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a cyclical downturn, motivated by large and persistent negative demand shocks, partially imported, or the result of deeper structural problems? What was the relative importance of these disturbances? How to monitor and assess such events analytically? How did standard textbook's macro-modelling strategies behave under such extreme events? In particular, what happened to Okun's law (the negative correlation between output and unemployment gaps)?

This article discusses, on the one hand, the relative importance of several disturbances using a semi-structural model with rational expectations. On the other hand, it evaluates Okun's law robustness throughout the 2008–2012 period. The discussion takes into account the results of a multivariate filter named herein, for ease of reference, "*Model Q*." Key theoretical references are Carabenciov *et al.* (2013) and European System of Central Banks (2016). The current version is tailored for a small economy integrated in the credible monetary union, where the risk-free nominal interest rate is set by the monetary authority of the model—in this case the European Central Bank (ECB). It includes several innovations relative to standard approaches, namely identical long-run restrictions in both the small economy and the rest of the monetary union (identical long-run growth rates in the trend component of output; unemployment rate levels; and real interest rates). The model lacks microfoundations, although each behavioural equation is a fairly standard textbook's equation with an economic interpretation (Berg *et al.* 2006), namely a policy equation defining official interest rates' responses, an inflation equation, an output equation and a version of Okuns' law. All shocks are stochastic and orthogonal. Some are labelled demand, supply and monetary policy shocks. For simplicity, those affecting trend components are grouped under the designation of "non-cyclical disturbances." *Model Q* embeds unobserved components and is estimated with Bayesian techniques.

The main result suggests that Portuguese product and labour markets were mainly hit by low frequency developments in trends, and less so by cyclical factors. The economy was nevertheless hit by other adverse shocks, notably the two exogenous recessive periods in the euro area, and abnormal sovereign risk hikes. This outcome complements the results reported by Castro *et al.* (2014). The increase in the trend component of the unemployment rate confirms the results obtained by Centeno *et al.* (2009), although current estimates are more volatile and depict a steeper outcome.

Model Q substantiates a decrease in the level of the trend component of Portuguese output, over 2008–2012, in line with other methodologies. Okun's law remained empirically relevant, however, not without noteworthy trend instability—evaluated by (pseudo) real time estimates. It should be emphasized that the current version of the model is silent about all economic forces driving trends. They are simply given by highly flexible stochastic processes.

This article has the following structure: section 2 sketches the model focusing solely on the main equations for Portugal. Model-based decompositions of output and unemployment rates are reported in Section 3. The instability of Okun's law is evaluated in Section 4. Section 5 concludes, puts forward tentative policy implications, and possible ways to extend the model.

A two-country model for a small euro area economy

Model Q considers two regions: a small euro area economy—in this case Portugal—and the rest of the monetary union. The model mixes stringent and rigid ingredients with relatively flexible elements, although the small economy is effectively "tying its hands" with the rest of the union (an expression from Giavazzi and Pagano (1988)). A central ingredient is the assumption of a credible monetary union. This restriction implies that the nominal exchange rate is a credible institutional feature, expected to remain fixed, and that the ECB sets nominal interest rates in line with a fully credible long-run inflation target, set herein at 2.0%. Short- and medium-run inflation expectations may deviate from target, depicting high persistence, but not long-run expectations, when all shocks' impact have dissipated.

The ECB mandate in *Model Q* is translated into a policy function that only reacts to developments in euro area aggregates, an assumption that can also be found in micro-founded general equilibrium models, *e.g.* PESSOA (Almeida *et al.* 2013). The trend component of the real interest rate, which may deviate from a fixed long-run benchmark, is also determined solely by euro area data, and assumed identical in both regions.

Among the flexible elements, a special focus should be placed on all trend components of product and labour markets. In addition, short and medium-run real interest rates in the two regions may differ substantially, and persistently, due to region-specific inflation expectations, while price differentials may have long-lasting effects on real exchange rates. Nominal interest rates can drift apart due to an exogenous risk premium.

Behavioural and a-theoretical equations for Portugal

This section briefly presents the core set up for Portugal.[1] With the exception of nominal interest rates, all other variables have functional forms expressed in "gaps," *i.e.* in deviations from unobserved trends (identified with a "~"). Euro area aggregates are identified with a "$*$."

1. A comprehensive assessment of the model, including all estimation results, can be found in Maria (2016).

Okun's law associates herein unemployment gaps at quarter t, namely $u_{gap,t} = u_t - \tilde{u}_t$, to its own lead and lagged values, and to the output gap, $y_{gap,t-1} = y_{t-1} - \tilde{y}_{t-1}$. More precisely,

$$(1 + \alpha_1\alpha_2)u_{gap,t} = \alpha_1 u_{gap,t-1} + \alpha_2 u_{gap,t+1} - \alpha_3 y_{gap,t-1} + \varepsilon_{u_{gap},t}, \quad (1)$$

where u_t is the Portuguese unemployment rate, y_t is actual GDP data, and $\varepsilon_{u_{gap},t}$ is an idiosyncratic disturbance. The trend component of unemployment embodies a fixed term, u, shared by both Portugal and the euro area; $\tilde{u}_t = \rho_u u + (1-\rho_u)\tilde{u}_{t-1} + \tilde{u}_{g,t}$, where $\tilde{u}_{g,t}$ is an autoregressive process with its own disturbance $\varepsilon_{\tilde{u},t}$. The presence of lagged values captures labour market frictions, while lead values introduces more flexibility in the model by allowing for expectations to also play a role.[2]

The inflation equation of *Model Q* associates current price changes to lagged and expected inflation, the output gap, and to changes in the real exchange rate. More precisely,

$$\begin{aligned}(1 + \lambda_1\lambda_2)(\pi_t - \pi) = \lambda_1(\pi 4_{t-1} - \pi) + \lambda_2(\pi 4_{t+4} - \pi) + \\ + \lambda_3 y_{gap,t-1} + \lambda_4 \pi 4_{q,t-1} - \varepsilon_{\pi,t}, \quad (2)\end{aligned}$$

where $\pi = 2.0\%$ is the long-run inflation anchor. Variables $\pi 4_t$ and $\pi 4_{q,t}$ measure year-on-year changes in consumer prices and in the real exchange rate, respectively (an increase in $\pi 4_{q,t}$ represents a real depreciation). Disturbance term $\varepsilon_{\pi,t}$ is labelled "supply shock." The associated negative sign ensures that a positive supply shock is consistent with downward inflation pressures, as in Carabenciov *et al.* (2013).

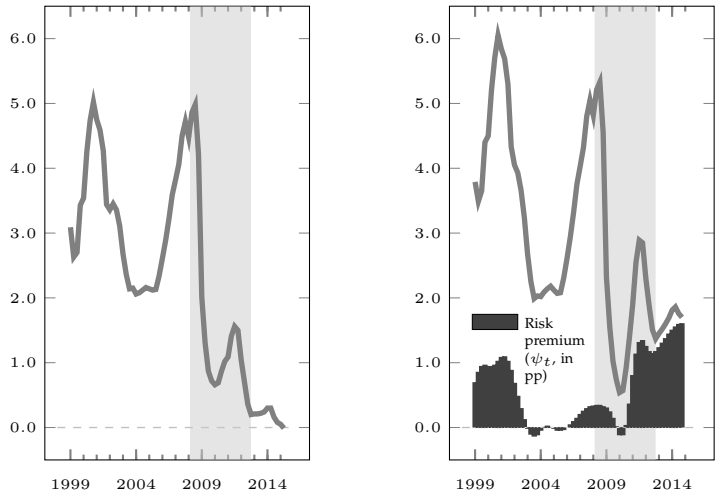
The output equation includes the real interest rate gap, $r_{gap,t} = r_t - \tilde{r}^*_t$, the foreign output gap, $y^*_{gap,t-1}$, and the real exchange rate gap, $q_{gap,t} = q_t - \tilde{q}_t$. More precisely,

$$\begin{aligned}(1 + \beta_1\beta_2)y_{gap,t} = \beta_1 y_{gap,t-1} + \beta_2 y_{gap,t+1} - \beta_3 r_{gap,t-1} + \\ + \beta_4 y^*_{gap,t-1} + \beta_5 q_{gap,t-1} + \varepsilon_{y_{gap},t}, \quad (3)\end{aligned}$$

where $\varepsilon_{y_{gap},t}$ is a disturbance term henceforth labelled "domestic shock."

It should be noted that $i_t = i^*_t + \psi_t$ and i^*_t are nominal interest rates (the latter set by the ECB), where $\psi_t = \rho_i\psi_{t-1} + \varepsilon_{i,t}$ is an exogenous risk premium, $0 < \rho_i < 1$ and $\varepsilon_{i,t}$ is a i.i.d risk premium shock. The evolution of these exogenous variables over 1999Q1 and 2015Q2 are depicted in Figure 1. In addition, $r_t = i_t - \pi_{t+1}$ is the real interest rate; $\pi_{t+1} = 4(p_{t+1} - p_t)$ measures expected inflation conditional on information up to period t; $q_t = p^*_t - p_t$ is the real exchange rate, computed with Harmonized Indices of Consumer

2. A general equilibrium model where the unemployment-inflation relationship considers current, lagged, and future unemployment can be found in Ravenna and Walsh (2008).



(A) Euro area (B) Portugal

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FIGURE 1: Nominal interest rates (%)

Source: Banco de Portugal, Eurostat and own calculations.

Notes: Interest rates of the euro area i_t^* are given by ECB's official interest rates. In the Portuguese case they are given by $i_t = i_t^* + \psi_t$, where ψ_t is an exogenous risk premium computed as in Castro *et al.* (2014). The shaded area identifies the 2007Q4-2012Q4 period.

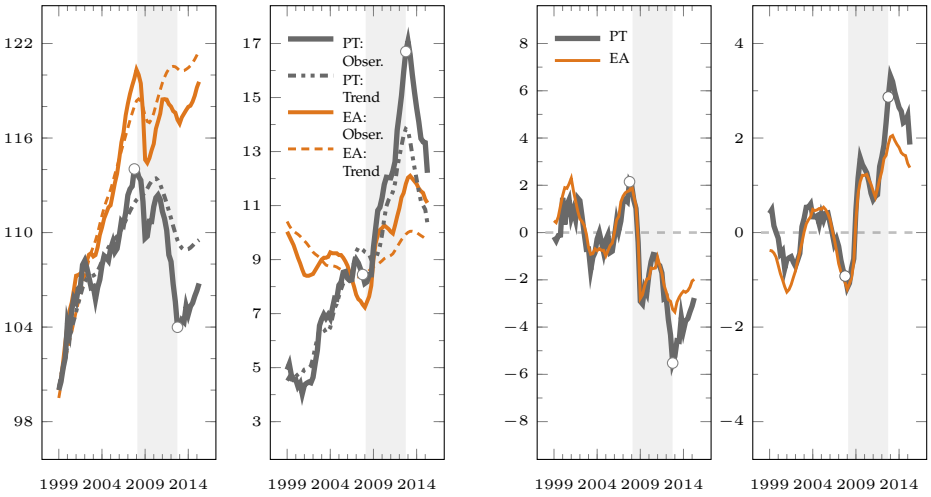
Prices for the euro area and Portugal, respectively. The real exchange rate gap $q_{gap,t}$ follows an autoregressive processes with disturbance term $\varepsilon_{q_{gap},t}$, and the trend component $\tilde{q}_t$ is modelled as a random walk with disturbance $\varepsilon_{\tilde{q},t}$. As in Carabenciov *et al.* (2013), the trend component of the real interest rate is assumed to evolve around a fixed benchmark r, namely $\tilde{r}_t^* = \rho_{\tilde{r}}^* \, r + (1 - \rho_{\tilde{r}}^*) \, \tilde{r}_{t-1}^* + \varepsilon_{\tilde{r},t}^*$. The trend component of output includes a long-run fixed term, y_g, shared by both Portugal and the euro area, $\tilde{y}_t = \tilde{y}_{t-1} + y_g + \tilde{y}_{g,t}$, where $\tilde{y}_{g,t}$ is an autoregressive process with disturbance $\varepsilon_{\tilde{y},t}$.

Finaly, the interest rate equation is given by

$$i_t^* = \gamma_1 i_{t-1}^* + (1-\gamma_1)\left[(\tilde{r}_t^* + \pi 4_{t+4}^*) + \gamma_2(\pi 4_{t+4}^* - \pi) + \gamma_3 y_{gap,t-1}^*\right] + \varepsilon_{i^*,t}. \quad (4)$$

This equation clarifies that the ECB sets nominal interest rates i_t^* by only reacting to developments in euro area aggregates. Changes in i_t^*, however, have a direct impact on Portuguese nominal and real interest rates.

The estimation period of *Model Q* ends in 2015Q2. Ideally, the information set should begin after the inception of the euro. However, given that 1999Q1-2015Q2 is relatively short and plagued by an unprecedented economic crisis, the information set was extended backwards until 1995Q1, which allows for 82 observations over 1995Q1-2015Q2. Results for 1995Q1-1998Q4 are ignored.



(A) GDP (B) Unemployment (C) Ouput gap (D) Unempl. gap

FIGURE 2: Observed variables and trends

Source: Banco de Portugal, Eurostat and own calculations.

Notes: Output is in logs and normalized to GDP=100 in 1999Q1. Unemployment is in percentage of the labour force. Output gaps are in percentage, and unemployment gaps in percentage points (pp). Portugal and the euro area are identified with PT and EA, respectively. The shaded area identifies the 2007Q4-2012Q4 period.

Trends and cycles

Figure 2 depicts actual and trend components of output and unemployment rates in Portugal, as well as the implied output and unemployment gaps.

Results suggest that actual output was above trend by 2007Q4, around 2%, but rapidly moved below trend as the international financial crisis gained momentum. Actual and trend levels came closer around 2011, but only briefly. This period is marked by the beginning of a persistent downward movement in both actual and trend components of output. The model flexibility can thus easily accommodate a positive long-run growth rate that is common to both regions—estimated to be around 1.8%—,with domestic unobserved short-run rates that are persistently negative. The downward movement came to an halt by 2013, and thus outside the period under analysis.

The trend component of the Portuguese unemployment rate is marked by a sharp upward movement almost over the entire sample period. It only recedes outside the period under analysis. Its behaviour is in general consistent with the view that the Portuguese labour market was not only fundamentally unprepared to cope with the crisis, featuring a worrisome institutional architecture before the crisis (Centeno *et al.* 2009). Trend levels are

highly volatile, namely in comparison with the results reported by Centeno *et al.* (2009). This difference is not a surprise since the current version of *Model Q* embodies no *ex ante* restriction on the volatility behind developments in trend components, in contrast with Centeno *et al.*. The estimated volatility is only respecting an a-theoretical law of motion that, among other effects, does not have associated economic factors nor isolates undesirable impacts.[3]

In comparison with the euro area, there are signs of similarities, and signs of sharp differences. Both output and unemployment gaps reveal high synchronicity. The linear correlation coefficients between output gaps (Figure 2c) or unemployment gaps (Figure 2d) over 1999Q1-2015Q2 are close to 0.9. The Portuguese data is more volatile: the standard deviation of the unemployment and output gaps stand at 1.9 and 1.2, respectively, which compares with 1.7 and 1.0 in the euro area. The results are consistent with the view that the crisis left visible marks in both regions, although the differences are quite impressive by 2012Q4. The larger output gap in the euro area was close to 3% in absolute terms, while the Portuguese was close to 5%. Developments in trend levels in the two regions show sharper differences, although the assumed structure from which they are estimated is identical. In product markets, the first euro area recession coincides with an abrupt reduction in the trend component that does not occur in Portugal. During 2012—the second recessive period in the euro area—the euro area showed a relatively minor decrease in trend levels, while Portugal maintained a persistent decline. The differences between the two regions are also visible in the trend component of the unemployment rate, which depicts an initial downward trend in the euro area, before the crisis inception, in contrast with the Portuguese case. During 2008Q1-2012Q4, the increase registered in the euro area is much smaller than in Portugal.

Historical decompositions over 2008–2012

Table 1 quantifies the contributions of each shock to output between 2007Q4 and 2012Q4. It disaggregates actual data between domestic factors and other factors, the latter including the contribution of monetary policy shocks (ε_i^*). The sum of all contributions equals actual data. Domestic shocks include demand (stemming from $\varepsilon_{y_{gap}}$), supply (ε_π), non-cyclical (which aggregate $\varepsilon_{\tilde{u}}$, $\varepsilon_{\tilde{y}}$ and $\varepsilon_{\tilde{q}}$), and risk premium shocks (ε_i). Shocks linked to foreign factors feature a similar structure. The contributions associated with $\varepsilon_{q_{gap},t}$ and $\varepsilon_{u_{gap},t}$ are included in "Other factors: Rest".

3. It fully ignores, for instance, the series break in Labour Force Survey statistics that took place in 2011. In this year, a period when trend component estimates increase sharply, Statistics Portugal introduced a new data collection scheme (associated to the use of telephone interviews; questionnaire changes; and new field work supervision technologies).

	Portugal: Output			Euro Area: Output		
	2007Q4	2012Q4	Δ	2007Q4	2012Q4	Δ
Actual data	30.2	20.1	-10.1	28.6	26.0	-2.6
Domestic factors						
Demand ($\varepsilon_{y_{gap}}$)	0.7	-1.5	-2.2	0.0	0.0	0.0
Supply (ε_{π})	0.0	0.3	0.2	0.0	0.0	0.0
Non-Cyclical	-4.8	-16.5	-11.6	0.0	0.0	0.0
Labour market ($\varepsilon_{\tilde{u}}$)	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Output market ($\varepsilon_{\tilde{y}}$)	*-4.8*	*-16.5*	*-11.6*	*0.0*	*0.0*	*0.0*
Rest	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Risk premium (ε_{i})	-0.3	-1.2	-0.9	0.0	0.0	0.0
Other factors						
Foreign factors	1.7	-3.0	-4.7	6.4	-5.2	-11.6
Demand ($\varepsilon^{*}_{y_{gap}}$)	*1.7*	*-2.7*	*-4.4*	*1.8*	*-3.2*	*-5.0*
Supply (ε^{*}_{π})	*0.0*	*-0.4*	*-0.4*	*0.0*	*-0.1*	*0.0*
Non-Cyclical	*0.0*	*0.1*	*0.1*	*4.7*	*-1.9*	*-6.6*
Rest	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Monetary Policy (ε^{*}_{i})	0.0	-0.1	-0.1	0.0	0.0	0.0
Rest	32.9	42.1	9.3	22.1	31.1	9.0

TABLE 1. Decomposition of output over 2007Q4-2012Q4

Source: Own calculations.

Notes: Actual data is in logs and differ from the observed by a constant. The sum of all contributions equals actual data. Real exchange rate shocks $\varepsilon_{\tilde{q}}$ are included in "Non-cyclical: Rest", whereas $\varepsilon_{q_{gap},t}$ are in "Other factors: Rest". The component "Other factors: Rest" also includes the growth rate y_g.

Over the period 2008–2012, the most significant domestic shock driving the fall in output is the non-cyclical shock. The contribution reached -11.6 pp. Among the remaining domestic shocks, demand played a more important role than supply shocks, although the nominal side of the economy recorded significant changes.[4] Domestic demand shocks accounted for -2.2 pp. Finally, the increase in sovereign risk premium is estimated to have subtracted output by 0.9 pp.

Results suggest that Portugal was also significantly affected by the two recessive periods in the euro area. Foreign factors amounted to -4.7 pp over 2008–2012. The importance of the negative foreign shocks is consistent with real impacts computed by Castro *et al.* (2014), following the sharp contraction in the Portuguese external demand. The negative contribution reported herein gained momentum during 2011 and lasted until late 2012.

The contribution of monetary policy shocks is virtually nil in both regions, while the aggregator "Other factors: Rest" reached 9.3 pp, influenced by the

4. In 2009, the reduction in inflation was largely unexpected in both regions. In addition, inflation expectations remained systematically below 2% over the last part of the sample period (see Maria (2016)).

	Portugal: Unemployment rate			Euro Area: Unemployment rate		
	2007Q4	2012Q4	Δ	2007Q4	2012Q4	Δ
Actual data	-1.5	6.7	8.3	-2.7	1.8	4.5
Domestic factors						
Demand ($\varepsilon_{y_{gap}}$)	0.0	0.3	0.3	0.0	0.0	0.0
Supply (ε_{π})	0.0	-0.2	-0.1	0.0	0.0	0.0
Non-Cyclical	2.3	6.2	3.9	0.0	0.0	0.0
Labour market ($\varepsilon_{\tilde{u}}$)	*2.3*	*6.2*	*3.9*	*0.0*	*0.0*	*0.0*
Output market ($\varepsilon_{\tilde{y}}$)	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Rest	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Risk (ε_i)	0.1	0.8	0.6	0.0	0.0	0.0
Other factors						
Foreign factors	-1.0	1.8	2.8	-3.8	0.8	4.6
Demand ($\varepsilon^*_{y_{gap}}$)	*-1.0*	*1.6*	*2.6*	*-1.0*	*1.8*	*2.8*
Supply (ε^*_{π})	*0.0*	*0.2*	*0.2*	*0.0*	*0.0*	*0.0*
Non-Cyclical	*0.0*	*0.0*	*0.0*	*-2.8*	*-1.1*	*1.7*
Rest	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*
Monetary Policy (ε^*_i)	0.0	0.0	0.0	0.0	0.0	0.0
Rest	-2.9	-2.2	0.7	1.2	1.0	-0.2

TABLE 2. Decomposition of the unemployment rate over 2007Q4-2012Q4

Source: Own calculations.

Notes: Actual data differ from the observed by a constant. Real exchange rate shocks $\varepsilon_{\tilde{q}}$ are included in "Non-cyclical: Rest", whereas $\varepsilon_{q_{gap},t}$ are in "Other factors: Rest". The component "Other factors: Rest" also includes the contribution of $\varepsilon_{u_{gap},t}$.

impact of the long-run growth rate y_g. Note also that the table's upper-right region of zeros respects the working hypothesis that Portuguese shocks have no effect on the euro area.

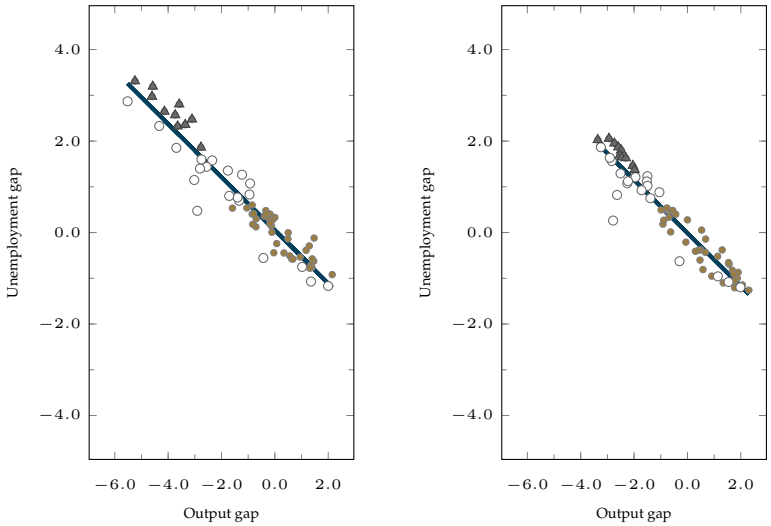
This paper fails to associate a large importance to real exchange rate shocks (included in the aggregate "Rest" of the domestic factors). Its virtually nil contribution may nevertheless suggest that the relative price of final consumption goods may not be a meaningful competitivenesses variable, and that further work is needed to create a more useful concept.

Table 2 reports the results for the unemployment rate. The outcome is qualitatively identical to that already disclosed for output, basically explained by the presence of an Okun's law. Over the period 2008–2012, the non-cyclical shock is the most significant shock driving the upward movement in the unemployment rate.

Okun's law over 2008–2012

This section evaluates the behaviour of Okun's law over 2008–2012, and assesses the stability of trend components.

Figures 3a and 3b depict static representations of unemployment and output gaps. These scatter plots reorganize Figures 2c and 2d, which are



(A) Portugal (B) Euro area

FIGURE 3: Okun's law

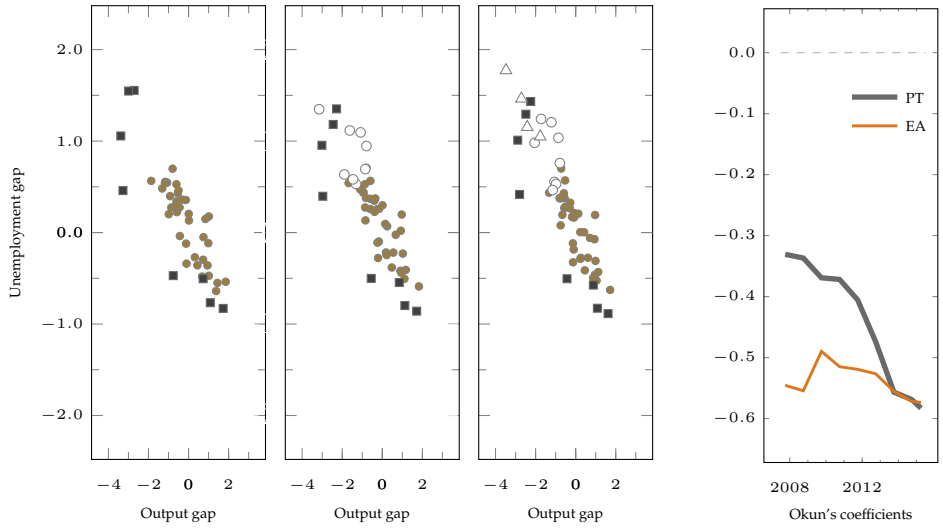
Source: Banco de Portugal, Eurostat and own calculations.

Notes: White dots cover the 2008Q1–2012Q4 period. Black triangles cover the 2013Q1-2015Q2 period.

functionally determined by the dynamic versions of Okun's law (defined in the Portuguese case by equation (1)).

Results suggest a relatively close relationship between unemployment and output gaps in both Portugal and the euro area. Over 2008–2012, the data points have basically moved from positive output gaps towards larger and larger negative output gaps in both regions (given by the white dots), with unemployment gaps depicting a mirror image. The subsequent period is evaluated by the model as a gradual movement backwards (the black triangles). These static relationships share another remarkable similarity: if the output gap increases by 1%, the unemployment gap decreases by 0.6 pp both in Portugal and in the euro area.

Figures 3a and 3b use all information up to 2015Q2, and therefore do not unveil how Okun's law changed as new data became available after 2008. Figure 4 fills this gap. Figure 4a, 4b and 4c depict recursive scatter plots where the end of each sample period is used as an identifier, namely 2009Q4, 2011Q4, and 2012Q4. Movements in the ordered pairs are identified with different symbols and colours. More precisely, squares, circles and triangles highlight how data coordinates changed as new information become available. The results reveal a close relationship between unemployment and output gaps, around a linear trend, but not without important revisions.



(A) 2009Q4 (B) 2011Q4 (C) 2012Q4 (D) 2008Q1–2015Q4

FIGURE 4: Instability of Okun's law in Portugal

Source: Banco de Portugal and own calculations.

Notes: Squares represent data points between 2008Q1 and 2009Q4; white circles between 2010Q1 and 2011Q4; and triangles between 2012Q1 and 2012Q4. Recursive estimates of Okun's coefficients cover the period 2007Q4-2015Q2.

Between 2009Q4 and 2012Q4, for instance, there is a considerable movement in data coordinates, with changes in the degree of clustering and in extreme values. Between 2009Q4 and 2012Q4, movements from positive output gaps towards larger and larger negative gaps also show instability signs, as depicted for instance by movements in the black squares.

Figure 4d plots "Okun's coefficients" using recursive estimates starting in 2007Q4. Each coefficient is defined as the negative derivative linking output and unemployment gaps. The estimates, derived from static representations of Okun's law, remained relatively stable in the euro area, around -0.55. In contrast, the Portuguese case is marked by a downward trend, suggesting a considerable movement in the static output-unemployment relationship. By the end of the sample, as expected by the results reported in Figures 3a and 3b, Portuguese and euro area coefficients coincide. This negative relationship depends among other factors on firms' decisions regarding how to adjust employment in response to temporary deviations in output, degree of job security, or social and legal constraints of firms' adjustment of employment (Blanchard 1997).

Given that observed data is invariant, the results imply that trend component estimates recorded important revisions. Uncertainties about the precise level of structural unemployment and the unemployment gap across euro area countries, using estimates from different sources (European Commission, Organisation for Economic Co-operation and Development, and IMF) are not a novelty in the empirical literature, and was highlighted for instance by European System of Central Banks (2012).

Conclusions and policy implications

This article shows that Portuguese output and unemployment over 2008–2012 are poorly assessed if unobserved trend developments are ignored. According to a semi-structural model with rational expectations, tailored for a small economy integrated in the credible monetary union—*Model Q*—, what happened in Portugal was not primarily a cyclical event, but a low frequency downward movement in the trend component of output, mirrored by an increase in the trend component of the unemployment rate.

Results confirm the desirability to achieve one of the main goals of the Economic and Financial Assistance Programme of 2011, established between the Portuguese authorities, the EU and the IMF: to remove structural impediments behind potential growth. Given that the model is silent about all economic forces driving trends, a possible way forward is to investigate causal relationships behind the estimated developments, and strengthen markets' linkages.

Results also show that the dramatic events over 2008–2012 were aggravated by the recession in the euro area, and by the higher Portuguese risk premia. Taken together, however, their importance does not outweigh all impacts coming from changes in trends. Economic policy should therefore not neglect the structural properties of these markets, resting solely centred around standard business cycle objectives.

Model Q embodies a relatively close relationship between unemployment and output gaps over all sample periods. However, there are signs of instability in trend components, making economic monitoring a difficult task.

Finally, additional ways to proceed include making the model geographically more comprehensive (*e.g.* more Member States), and structurally richer, with more information (capturing for instance financial frictions, alternative inflation measures, additional imported inflation impacts or more meaningful competitiveness variables). The analysis of the euro area is acknowledged to be incomplete. *Model Q* lacks the rest of the world economy, with prices and quantities playing their adjustment role. This is most probably an area of future work.

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