

## A SURVEY-BASED MEASURE OF OUTPUT GAP FOR PORTUGAL

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### Abstract

*Given the importance of output gap estimations, particularly in the context of budgetary surveillance, policy setting and economic monitoring, a new measure of output gap for Portugal is developed. The methodology is grounded in Szörfi (2015) framework, which is based on qualitative data. It integrates information about manufacturing, services and construction sectors, providing a representative measure of total economy slack. The survey-based estimates revealed robust stability properties when considering revisions in the projections of the main international institutions, namely the OCDE, the IMF and the EC. Both in real-time and nearly real-time estimations, the survey-based approach performed better than these organizations. It also performed well in 1, 2 and 3 year lagged estimations.*

**Key-Words:** Output gap, slack, survey data

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### 1. Introduction

In the European Central Bank (ECB) Monthly Bulletin of April 2014 (Box 5), output gap estimates from the main international institutions were compared with survey based indicators, such as the balance of responses regarding “demand limiting production”. By June 2015, Box 6 of ECB’s Economic Bulletin contemplated a new method to compute slack that resorts to survey data concerning, once again, answers on demand limiting production. Two months later, Szörfi prepared “A survey-based measure of slack” for the Directorate General for Economic and Financial Affairs (DG ECFIN) workshop about the “Assessment on the real-time reliability of different output gap calculation methods”. Using the methodology developed by Szörfi (2015), this article presents a new measure of output gap for the Portuguese economy.

*“The output gap is an economic measure of the difference between the actual output of an economy and its potential output. Potential output is the maximum amount of goods and services an economy can turn out when it is most efficient—that is, at full capacity. Often, potential output is referred to as the production capacity of the economy.”* (IMF, 2013)

Output gap is positive when actual output is higher than potential output. This happens when demand is high and in order to meet demand, the economy works above its most efficient capacity. In contrast, a negative output gap relates with weak demand, where there is no need to produce at full capacity.

Measuring output gap is important because it gauges the extent of inflationary pressures in the economy by displaying the dynamics of demand against supply. When output gap is positive, higher demand is expected to put upward pressure on prices. If output falls below potential, due to low demand, inflation is projected to fall. Hence, a reliable measure of output gap is relevant for the conduct of monetary policy. In the context of inflation rate targeting, if the economy is operating above equilibrium, central banks may set higher interest rates in order to cooldown economic activity and control

inflationary pressures. In reverse, if output gap is negative, the economy is underperforming and monetary authorities may set lower interest rates with the purpose of stimulating demand and limiting disinflationary developments. Moreover, for some monetary authorities' mandate, full employment (or non-unemployment gap) is an officially important target. The difference between the actual unemployment rate and the unemployment rate consistent with a constant rate of inflation (NAIRU) are usually defined as the unemployment gap. The output gap is closely related with the unemployment gap, since if the economy is producing close to full capacity then most of the labour force is probably being used in the production process<sup>2</sup>.

Output gap estimations are also relevant for authorities' fiscal stance. In the context of disinflationary drifts and unemployment rates above the NAIRU (reflexes of a negative output gap), authorities may set expansionary fiscal policies, by increasing government spending or by lowering taxes. In the case of an overheating economy, contractionary fiscal policy may be implemented to shrink demand and consequently limit inflation. If authorities are capable of setting actual unemployment rate to equal the NAIRU, actual output should be rather close to potential output. Output gap is relevant to infer on conceivably suitable fiscal policies and it also makes it possible to identify the component of budget balances that is the result of short-term influences. Thus, estimates of slack are also important to understand the influence of cyclical factors on the budget balance. A deterioration of the balance that is the result of a negative peak in economic activity is likely to soften as economic activity picks up. Consequently it may not be appropriate to see it as a weakening of the budget position (while the inverse also applies). Analysing the structural component of the budget balance gives a better picture of the underlying trend of public finances. Thus, accounting for robust estimates of output gap

<sup>2</sup> Most international institutions (OECD, IMF or EC) use a Cobb-Douglas production function based approach to compute potential output. According to this setting the difference between actual and potential output depends on the gap in labour inputs, capital stock and technological progress (TFP). Therefore, full employment does not necessarily imply a null output gap. Even so, unemployment gap and output gap should be closely associated.

leads to more accurate assessments about the degree of fiscal consolidation implemented. Overall, this study is pertinent for monetary and fiscal policy setting, for economic monitoring and budgetary surveillance.

The main purpose of this study is to adjust Szorfi's (2015) framework and apply it to Portugal. The methodology uses high frequency inputs, since it applies qualitative data that is available on a quarterly basis and is presented at the end of the corresponding quarter. This offers two main advantages: it is possible to compute output gap estimates quarterly (1) and with a very short time lag (2).

Several analyses were developed to assess stability and robustness properties of the estimations of slack. To better gauge the usefulness of survey based indicators, its outcome is compared with results from main international organisations procedures and with a simple Hodrick-Prescott (HP) filter approach. Based on the tests shown in this article, the reliability and consistency of the presented methodology is validated. Overall, this approach appeared to be the most consistent while also providing stable measures of slack. It performs better both in real-time and nearly real-time estimations<sup>3</sup>. Moreover, it presented the lowest 1 and 2 year-ahead revisions, whereas only EC's projections have lower revisions in a 3 year horizon. In addition, survey-based estimates of slack seem to be in accordance with recent developments of the Portuguese economy.

## 2. Literature Review

The ideas embedded in the output gap concept can be dated at least since *the general theory of employment, interest and money*, presented by Keynes in 1936, in which the author developed hypothesis about the relationship between unemployment and the rate of change in wages (Kuh, 1966). Nonetheless, it was only in 1958 that this relation was empirically investigated by Philips, when analyzing the link between unemployment dynamics and the rate of wage growth for the United

<sup>3</sup> Please refer to the methodology section.

Kingdom between 1861 and 1957. He concluded that it was negative and highly nonlinear, since the change in wages depended both on the level of unemployment and on the rate change of unemployment.

However Philips noted the possibility that inflation may have an impact in the studied relation, particularly in periods of rapid rise in prices. In this context, the rate of change of wages would grow even if this was not a result of labor market dynamics. The interaction between those variables was later demonstrated by Solow and Samuelson (1960), using Philips framework, hence the authors named the link "*Philips curve*", which reflects a nonlinear function, with a negative slope, that relates inflation with unemployment.

Paish (1962) made a more generalized approach by linking inflation with capacity utilization instead of unemployment. The use of capacity utilization can already be seen as a proxy for output gap. Nonetheless, it was Okun (1962) who introduced the concept of GNP gap, which was described as the difference between potential and actual GNP<sup>4</sup>. The author presented GNP gap as a measure of unused productive capacity (namely unused labor), since he described it as the maximum production that could be achieved without generating inflationary pressures. Okun presented the first model with the ability to calculate potential output, which subtended what became known as the Okun's Law. The connection between the rate of output growth and the unemployment rate was used to estimate potential output, given labor slack:

$$P = A[1 + B(U - U^*)] = A[1 + 0.032(U - 4)] \quad (2.1)$$

*P*: Potential output

*A*: Actual output

*U*: Unemployment rate

*U\**: Unemployment rate consistent with full employment

*B*: Coefficient

The unemployment rate associated with full employment was defined at 4%. The relation between

<sup>4</sup> The issue with "GNP gap" notion is that it includes net income payments from abroad, while these flows do not affect potential domestic supply.

unemployment gap and output gap was quantified at 3.2%, and results from the weighted average of 3 employed methods. Okun (1971) pointed that during the fifties and sixties, this level of unemployment was generally accepted as a target for full unemployment, accompanied by an inflation rate of 2% to 3%. Okun's law became important amid the fiscal policy setting in the following years.

Okun's framework was employed in many studies during the seventies and the eighties (Gordon, 1972; Hamada and Kurosaka, 1984; Gordon and Clark, 1984; Nguyen and Siriwardana, 1988). Nonetheless, the literature reconsidering Okun's law was also lengthy<sup>5</sup> (Friedman and Watcher, 1974; Smith, 1975; Tatom, 1978; Knoester, 1986). Economists like Friedman (1966, 1967, 1968) and Phelps (1967, 1968) questioned the stability of the relation between unemployment and inflation (i.e Philips curve).

In Friedman's view<sup>6</sup>, the rate of wage growth would be stable but only at one rate of unemployment ("*the natural rate*"), which would depend on structural factors. Following Friedman-Phelps hypothesis, Lucas (1972a, 1972b) studied the existence of "*the natural rate*" and found, for the U.S, a negative correlation between inflation and unemployment. However, the author argued, despite the difficulties in judging the natural rate hypothesis on empirical grounds, this could be achieved through a simultaneous equations model. The argument implied that the relation between inflation and unemployment had to be studied while accounting for the policy influence, which can be seen as a proxy for short-term dynamics. Assessment could be made by evaluating the behavior of the Philips curve under different policies. This way, the author was able to

<sup>5</sup> Moreover, there are still contemporary studies testing Okun's law (Silvapulle *et al.*, 2004; Villaverde and Maza, 2009; Knotek, 2011; Ball *et al.*, 2013). There's also a string of literature studying the existence of asymmetry in Okun's law (Harris and Silverstone, 2001; Silvapulle *et al.*, 2004; Holmes and Silverstone, 2006).

<sup>6</sup> "What matters for unemployment, we argued, was not wages in dollars or pounds or Kronol but real wages – What wages would buy in goods and services. Low employment, would, indeed, mean pressure for a higher real wage- but real wages could be higher even if nominal wages were lower, provided that prices were still lower." Friedman (1977).

include in his framework the natural rate of unemployment<sup>7</sup> hypothesis (long term) and the empirically verified negative correlation between inflation and unemployment (short term).

Perloff and Watcher (1978) presented an article estimating the output gap, while employing a production function (PF) non-accelerating inflation approach. Despite PF methods had already been applied, the authors scrutinize the framework. They used diverse methods to estimate “the natural rate of unemployment” and tried various PF structures. It was based on their methodology that the International Monetary Fund (IMF), and later the Organisation for Economic Co-operation and Development (OECD), made their first articles on output gap measurement (IMF, 1987; 1990; OECD, 1990).

In fact, production function approaches became the most commonly used framework by international institutions. European Commission (2014) uses a Cobb-Douglas production function, in which total factor productivity (TFP) trend, the non-accelerating wage rate of unemployment (NAWRU) and the capital stock need to be estimated. The main advantage of this method, which is European Commission’s (EC) justification for its application, have to do with the possibility of recognizing the economic factors driving the results, given these models are grounded on economic theory, which is useful for policy setting. Moreover, there is the chance to make forecasts, given assumptions about the evolution of structural factors, such as institutions or technological progress.

However, these models tend to be revised quite frequently, and their revisions can be of considerable magnitude, particularly around turning points<sup>8</sup>, which may be the periods where more precise information is needed. Zsolt (2015) enhanced that even in soothing periods, the revisions of EC’s output gap estimates, in the year after the assessed year, were between 0.5 and

<sup>7</sup> The natural rate of unemployment represents the rate of unemployment consistent with a scenario where all shocks have peter out, such as the impact of policy measures.

<sup>8</sup> Partly because filtering techniques are applied. This may undermine its relevance on real-time assessments of economic stance.

1.0 percentage points (p.p.)<sup>9</sup>, which is quite large in the author’s view. In addition, Zsolt (2015) calls for an important element, when using EC’s or IMF’s approaches: the countries with the smallest volatility in their current account balances are usually the ones with lesser slack revisions, while the opposite also applies<sup>10</sup>.

*“This finding underlines that the methodologies of the EU and IMF are lacking information, which would be useful in estimating potential output at least for those countries that often have more variable current account balances.”*

According to Szörfi (2015) the main sources of uncertainty in these models are related to the data used, parameters employed in the model and the underlying structure. Koske and Pain (2008) argued that output gap revisions are mainly associated with actual data revisions and to a lesser extent, with methodological changes.

An alternative approach solely uses simple statistical filters, wherein Hodrick-Prescott (HP) filter is the most well-known method<sup>11</sup>. The process consists in identifying the trend of output (potential output). The difference between this trend and the actual output is defined as the output gap. This methodology has the advantages of being simple and transparent. Even so, the results provided by the filter are dependent on statistical choices, such as smoothing parameters. Likewise, in these models, there is no contemplation of economic theory behind the results. Their end point estimations are also usually biased and sensitive to the inclusion of new data. Despite using a production-function setting, EC applies an HP filter to the trend in the participation rate and the labour force gap. Furthermore, until 2010,

<sup>9</sup> Based on the 2001-2015 editions of EC’s spring economic forecast.

<sup>10</sup> Another of Zsolt (2015) statements is that EC output gap setting is highly NAWRU dependent, and while the underlying relation could hold for large closed economies it may be scarce for small open economies. While not stated by the author, the size and openness of an economy may influence the volatility of current account balances and consequently the magnitude of slack revisions, hence these characteristics could be taken in consideration in future researches.

<sup>11</sup> Beveridge-Nelson decomposition, unobserved components models and the band-pass filter are examples of others univariate techniques.

EC used an HP filter to smooth total factor productivity time-series, which was measured as the component of output not explained by labour or capital factors<sup>12</sup>. Nowadays, to smooth TFP, EC applies an unobserved components model, using a Kalman filter, while considering in the process the link between TFP cycle and capacity utilization rate<sup>13</sup>. The Kalman filter, when compared with HP filter approach, has the advantage that the extraction of the trend and cycle components are not being estimated based on statistical assumptions about the smoothness of the trend. Instead the division is based in the data content and incorporates the relationship amongst the variables.

The usage of survey information is commonly restricted to the capacity utilisation rate data. Nevertheless, it only incorporates information about the manufacturing sector<sup>14</sup>. Still, survey data has the advantage of being released within short intervals, its revisions being rather infrequent, and usually being better at recognizing turning points. Given these benefits, Szörfi (2015) solely used survey data on “demand limiting production”, which is available for the manufacturing, construction and services sector. With that objective, a bivariate unobserved components model was employed, through a Kalman filter procedure. Christensen (2015) presented the Danish Ministry of Finance (DMoF) approach, which has also applied a non-production function based model, including reduced form economic relationships and capacity utilization rate data from surveys. Revisions of real-time estimates using Christensen (2015) approach for Denmark were slighter than those from OECD’s and EC’s production function estimates<sup>15</sup>. However, the DMoF setting only includes

capacity utilization in manufacturing, therefore only accounts for slack in this sector. As recalled in ECB’s economic bulletin of November 2011, more pronounced reviews of the output gap assessments for some countries in the run-up to the crises period may be related with specific overheating sectors, like construction or the financial sector, hence, including sectorial data may be appropriate. The survey-based measure of slack proposed by Szörfi (2015) produces revisions of real-time estimates smaller than those resulting from OECD, IMF, EC and HP filter approaches, when applied to the Euro Area, enhancing the yield of this framework. It should be noted that the reliability of real-time estimates is crucial for policy-makers. If output gap is inversely derived, fiscal and budgetary policies, considering the information underlined in the estimates, will be pro-cyclically, which is opposed to the objective of estimating output gaps. Besides, output gap assessment defines if a deficit is understood as cyclical or structural<sup>16</sup>. EC (2014) reported:

*“...Given that the estimates are used for budgetary surveillance purposes, it is important to produce unbiased estimates of the past and future evolution of potential growth by seeking to avoid both false optimism and unjustified pessimism.”*

Szörfi (2015) recalled the autumn 2007 forecast when EC presented a negative euro area output gap in 2006 and 2007 (-0.6% and -0.2%, respectively), while at the 2015 Spring forecast, estimates of the output gaps for these years became positive (1.6% and 2.8%, respectively)<sup>17</sup>. Aramendia and Raciborski (2015)

<sup>12</sup> This component is usually known as the Solow residual, given the method derived to measure productivity was presented by the economist Robert Solow in 1957, even if that was not the main purpose of Solow’s work. The author was trying to explain the long run drivers of GDP growth.

<sup>13</sup> It is relevant to notice the developments made during the last years by the EC regarding output gap estimates. EC presented improvements in the applied method in 2002, 2006, 2010 and 2014.

<sup>14</sup> For Portugal, data regarding capacity utilisation in the services sector became available since the third quarter of 2011.

<sup>15</sup> Danish Ministry of Finance highlights their results are methodology sensitive. Still, despite the re-estimation of their model every year, minor adjustments were made. Still one must

notice, as the authors enhanced, DMoF have more knowledge of the Danish economy, hence, are able to present a more adjusted model.

<sup>16</sup> The last methodological revision introduced by EC (2014) is mainly related with improvements in the NAWRU (Non-accelerating wage rate of unemployment) calculation procedure. However, it was enhanced by Gechert *et al.* (2015) that the new NAWRU estimations are still very determined by actual unemployment. Thus, output gap measure may not be reliable when used to assess structural deficit. In fact, the NAWRU displayed a strong rigidity to modifications in structural elements.

<sup>17</sup> In the report made in 2014 about the output gap new calculation design, EC expressed that when looking at medium and long term forecasts for output gap estimates, potential output should not be seen in a static manner. Forecasts are

reminded the negative real-time estimates of the output gap for Ireland between 2007 and 2010, and stated:

*“...revised estimates showed that output gaps had been underestimated in real-time and confirmed that Ireland had been growing well above potential and the underlying fiscal position was less sound than assumed.”*

Nevertheless, it is important to highlight that even if output gap estimates are stable, that does not necessarily mean they are reliable. If an HP filter with lambda either equal to 16 or 1600 is employed to calculate output gap, it is noticeable that HP-16 has substantial smaller real-time estimate revisions. However, at the same time, it is highly pro-cyclical given it closely follows actual Gross Domestic Product (GDP), hence has low utility for policy purposes. A useful measure of output gap should be able to provide accurate calculations of real-time estimates and look reliable in retrospective.

### 3. Methodology

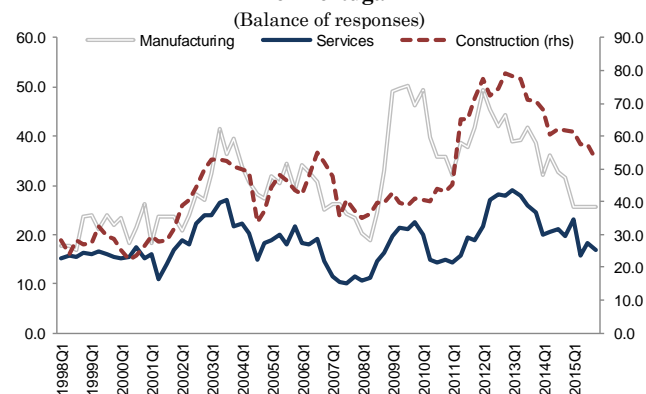
The methodological procedure is based on the Szörfi (2015) survey-based measure approach. Firstly, a survey indicator for the whole economy needs to be constructed. Answers on capacity utilization are commonly used in the literature and in various output gap estimation settings. Since 2010, EC uses this information to measure the Total Factor Productivity gap (TFP), while Christensen (2015) applies it to estimate the unemployment gap. Nonetheless it is not possible to build a survey-based measure that incorporates total economy slack while using capacity utilization data, since it is not applicable in construction surveys and information on services sector is only available from 2011 onwards. Besides, services sector value added accounts for more than 70% of total economy value

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made in the context of a panoply of assumptions. Additionally EC stated: *“...all the available methods have pros and cons and none can unequivocally be declared better than the alternatives in all cases. Consequently, what matters is to have a method adapted to the problem under analysis, with well defined limits and, in international comparisons, one that deals identically with all countries.”*

added in Portugal. One alternative, as suggested by Szörfi (2015), corresponds to the use of the balance of responses signaling demand as a factor limiting production. In the case of the Euro Area this information is available since 1985 for construction and manufacturing sectors, and from the third quarter of 2003 for services. In the case of Portugal, information on manufacturing, services and construction is available from the first quarter of 1995 and both the second quarter of 2001 and 2008, respectively. To address data availability constraints, the correlation between the balance of responses on demand limiting production and answers to others survey questions are computed, for both services and construction sectors. The question with higher absolute correlation in construction relates with *“building activity development over the past 3 months”* while in services sector the most suitable question is about the *“evolution of demand over the past 3 months”*. These series are then used to backcast data on demand limiting production, until the first quarter of 1995 and the third quarter of 1997, for construction and services, respectively<sup>18</sup>.

**Graph 1 – Insufficient demand limiting production per sector for Portugal**



Source: European Commission, authors' own calculations.

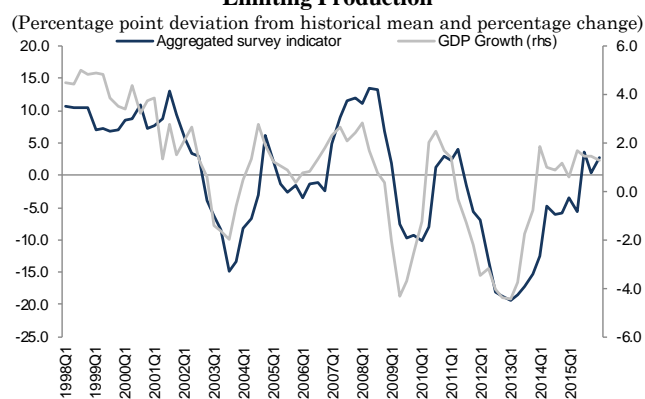
The aggregated survey indicator is assembled in a three-step procedure. Firstly, the balance of responses on the inquiry for each sector are standardized and then rescaled in order to match the volatility of the correspondent sector value added. This ensures that the

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<sup>18</sup> Those series need to be transformed since they are negatively correlated with assessments on demand limiting production. The correlations are -60,4% and -70,4%, for construction and services, respectively.

survey indicator is not influenced by more volatile answers on specific sectors. The second step consists in calculating the weighted average of the answers for the three sectors. Each sector weight equals the correspondent value added share in the total economy<sup>19</sup>. In a final stage, the aggregated survey indicator is computed as the deviation from its own historical mean in percentage points.

**Graph 2 – Survey-based indicator of slack – Demand Limiting Production**



Source: European Commission, authors' own calculations.

To produce output gap estimations, the following bivariate unobserved components model is employed:

$$y_t = \bar{y}_t + \hat{y}_t \quad (3.1)$$

$$d\bar{y}_t = d\bar{y}_{t-1} + \varepsilon_t \quad (\text{Measurement equation}) \quad (3.2)$$

$$\hat{y}_t = \beta DLP_t + \mu_t \quad (\text{Transition equation}) \quad (3.3)$$

Where  $y_t$  is actual output,  $\bar{y}_t$  corresponds to potential GDP and  $\hat{y}_t$  relates to output gap.  $DLP_t$  is the aggregated survey-based indicator. In equation (3.1) actual output equals potential output plus the output gap. Potential output is structured as a random walk in first differences in equation (3.2). In equation (3.3) output gap is assessed as a function of the survey-based indicator. The model is computed with Kalman-filter procedure.

<sup>19</sup> Gross value added, prices of 2010.

Moreover, expanding window estimations are employed to obtain real-time<sup>20</sup> estimations of output gap. The univariate approach based on HP-filter<sup>21</sup> setting is also applied and used as benchmark when assessing the performance of the survey-based measure. Specifically, to evaluate the attributes of the survey-based procedure an examination of both the consistency and stability properties is made. To do that some definitions need to be clarified:

- 2015 estimations are defined as the assessments of slack made using all data available until 2015.
- Real-time estimates are regarded as the ones made with information available only until the end of each year. Therefore, the real-time estimate for year  $t$  uses only data available in year  $t$ .
- Nearly real-time calculations (or 1 year lagged estimates) refer to the ones made 1 year after the year that is being assessed. In other words, those are estimations of output gap made in  $t+1$  for the year  $t$ . This is particularly relevant to compare the survey based measure of slack with the ones from international institutions, since they had to rely on provisional data to compute their real-time estimates.
- The 2 year lagged estimates relate to projections of slack made 2 years after the year being assessed, which would correspond to estimates made in  $t+2$  for the year  $t$ .
- The 3 year lagged estimates refer to year  $t$  and were made in  $t+3$ .

To compare stability properties of the output gap estimates, 2 kinds of revisions are computed:

- Real-time revisions are defined as the absolute value of the difference between 2015 estimations and real-time calculations.
- Nearly real-time revisions equal the absolute value of the difference between 2015 estimations and nearly real-time estimates.

<sup>20</sup> Although abstracting from data revisions, namely with the new ESA 2010, which is a recognized caveat.

<sup>21</sup> Lambda is set to equal 1600.

The consistency of the different procedures is evaluated against 3 sorts of revisions:

- 1 year-ahead revisions refer to the absolute value of the difference between nearly real-time estimates and real-time calculations.
- 2 year-ahead revisions correspond to the absolute value of the difference between the 2 year lagged estimates and the real-time estimations.
- 3 year-ahead revisions denote the absolute value of the difference between 3 year lagged calculations and real-time estimates.

#### 4. Results

Estimation results are presented in Table 1. At first hand one can conclude that the survey-based indicator is statistically significant at 99% confidence level as well as the magnitude of the coefficients is due to the fact that GDP is measured in levels. It is important to highlight the irrelevance of including dummies that account for breaks in the series (when the backward estimations end). Indeed, when one or both dummies are added, based on the coefficients obtained and other statistical measures, such as the Akaike, Schwarz or Hannan-Quinn criterions, the results do not change meaningfully.

**Table 1 – Estimation results**

Sample: 1997Q3 2015Q4		
	Coefficient	Prob.
$\beta$	74.572	0.000
$\bar{y}_t$	42446.940	0.000
$\hat{y}_t$	200.427	0.679
Akaike info criterion		16.109
Schwarz criterion		16.171
Hannan-Quinn criter.		16.134

Source: European Commission, authors' own calculations.

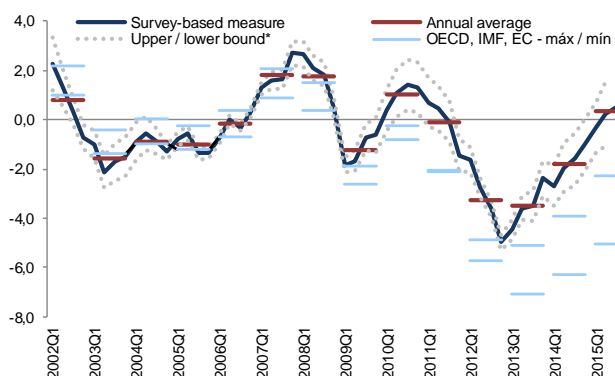
According to the annualised survey-based measure of slack, in 2015, output gap for Portugal corresponds to 0.3%. The years in which the gap was more negative were 2012 and 2013 (3.2% and 3.5%, respectively). The Portuguese economy overheated the most in 2007 and

2008, with output gap reaching 1.8%. In a quarterly perspective, slack was -4.2% in the second quarter of 2013. In contrast it reached 2.3% in the second and third quarter 2008. Since 2011, the second quarter of 2015 was the first in which the output gap registered a positive value (0.2%).

HP-filter estimations suggest that, in 2015, the Portuguese economy had already closed the gap, given output gap is estimated to be 1.5%, the same as in 2007 and 2008. However, this can be associated with the already mentioned end-point problem of HP-filter estimations.

According to the survey-based estimates, potential output in 2015 stood at EUR 170,547 million, having declined 0.7% (-0.8% in 2014). EC's projections suggest that the Portuguese economy at the most efficient capacity would produce an output worth EUR 175,631 million. Its estimates also hint a decrease in the potential output in 2015, but of a lesser magnitude (-0.1% which compares with -0.5% in the previous year).

**Graph 3 – Survey-based measure of output gap**  
(Percentage points)



Source: European Commission, authors' own calculations.

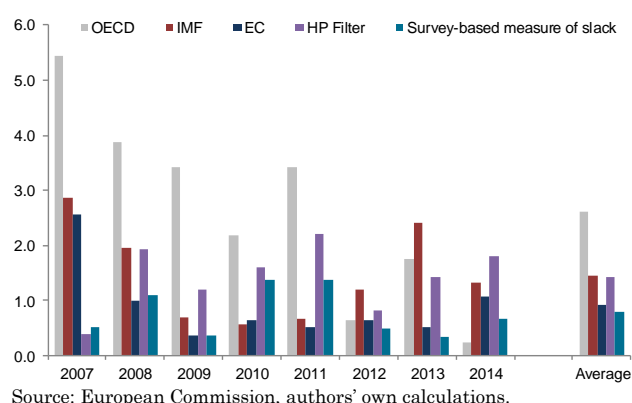
\*90% confidence level interval based on real-time revisions.

Graph 4 indicates that in the period between 2007 and 2014, revisions to real-time estimations of output gap are particularly high when using OECD's method (average revisions equal to 2.6 p.p.). IMF's and HP-filter's revisions are both of 1.5 p.p., and EC achieves revisions of 0.9 p.p.. Overall, the survey-based measure performs better, with average revisions of 0.8 p.p.. Nonetheless, IMF's and EC's real-time estimations



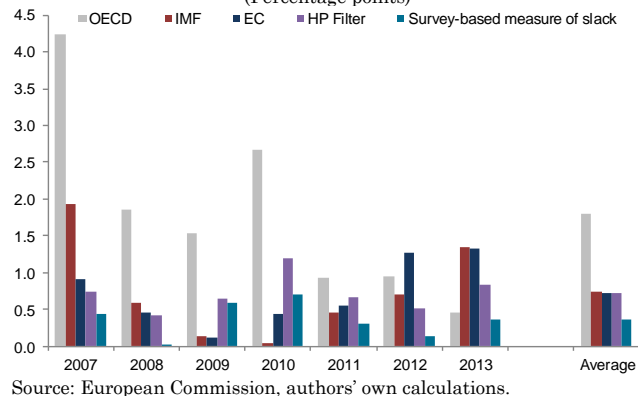
suffered smaller revisions in 2010 and 2011. The reason why the survey-based approach performed better was mainly due to the ability to give more accurate estimations of slack in 2007, maintaining consistency in the years that followed. This hints that the procedure used may be especially useful in detecting turning points.

**Graph 4 – Real-time revisions of estimates**  
(Percentage points)



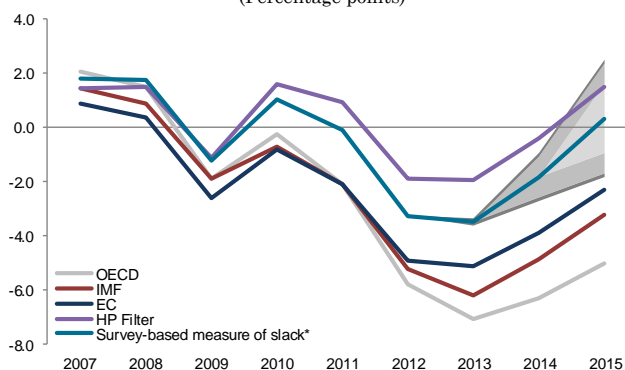
The analysis is reproduced to focus on revisions of nearly real-time estimates. As expected, all procedures perform better in nearly real-time estimations. OECD continues to present the highest absolute revisions to its estimates (1.8 p.p.), whereas the IMF, EC and HP filter settings had revisions around 0.7 p.p.. The survey-based method continues to have the lowest adjustments (0.3 p.p.).

**Graph 5 – Revisions to nearly real-time estimates**  
(Percentage points)



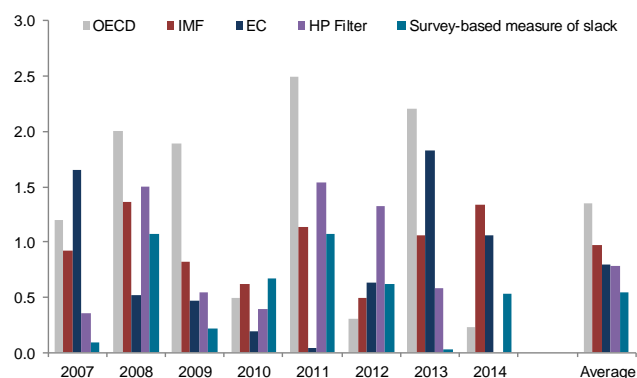
When considering the projections from all 5 methodologies it is possible to point that, overall, they all express similar developments. Nevertheless, projections for the more recent years have increasing differences in the magnitude of slack. Still, according to the already presented revision properties, it is more likely that OCDE's, IMF's and EC's estimations converge to the projections of the survey-based approach. It is relevant to consider that, overall, the organisation whose estimations are more reviewed are OCDE's, followed by the IMF's and then EC's. When looking at graph 8, it is noticeable that OECD's estimations are the farthest way from survey-based projections, followed by the IMF and then EC. Moreover, in general, the survey-based estimations are in line with what is known to have happened in the Portuguese economy in the last years.

**Graph 6 – Estimates of output gap in 2015**  
(Percentage points)



To assess stability attributes of the various estimates, a comparison of 1, 2 and 3 year-ahead revisions is made. In the year after the year being assessed revisions are, on average, smaller when using the survey-based method (0.5 p.p.). Amendments to EC's and HP filter's estimates are on average of 0.8 p.p., while those of the IMF and OECD tend to be of a higher magnitude (1.0 p.p. and 1.4 p.p. respectively).

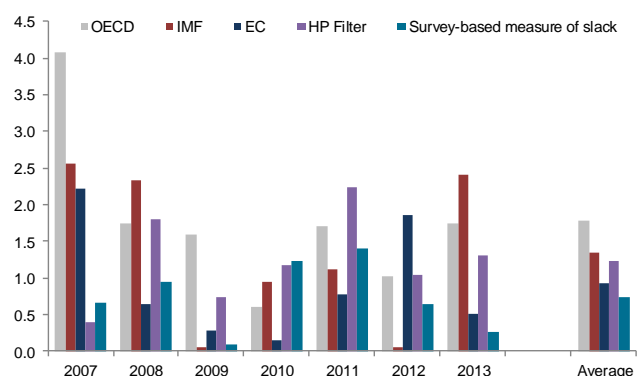
**Graph 7 – 1 year-ahead revisions**  
(Percentage points)



Source: European Commission, authors' own calculations.

In 2 year-ahead revisions the scenario is also similar, despite EC's estimates surpassing, in terms of stability, the HP filter procedure. It is important to enhance that the survey-based procedure is the best regarding 2 year revisions horizon (0.7 p.p.). Nonetheless, the increase in the adjustments from 1 year to 2 year-ahead revisions, is the lowest for the EC's approach whose amendments increase 0.1 p.p. (from 0.8 p.p. to 0.9 p.p.) which compares with 0.2 p.p. for the survey-based measure.

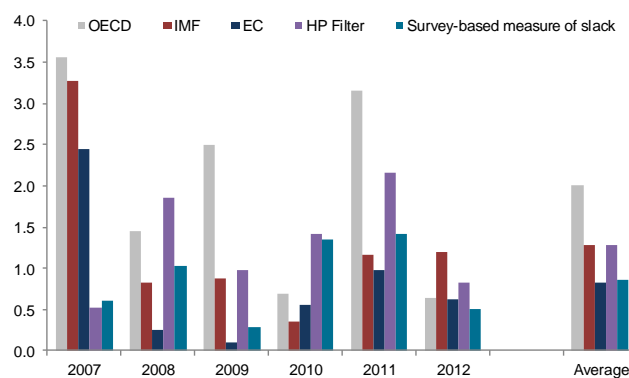
**Graph 8 – 2 year-ahead revisions**  
(Percentage points)



Source: European Commission, authors' own calculations.

When considering 3 year-ahead revisions, in general there is a stabilization of the projections of output gap. The adjustments to OECD's estimations are worth 2.0 p.p. on average, IMF's and HP filter's 1.3 p.p., EC's 0.8 p.p. while the revisions to survey-based projections reach 0.9 p.p..

**Graph 9 - 3 year-ahead revisions**  
(Percentage points)



Source: European Commission, authors' own calculations.

Overall, the methodology under discussion seems to present robust stability properties when compared with estimates from other institutions, which are on their own, based on different indicators and technical assumptions. Still, it should be mentioned that there is also a relevant role for economic judgement when reading through the different available estimates. Therefore, the debate surrounding output gap measurement as well as the appropriateness of its real-time use in the context of policy making will surely be a constant in the following years providing a lively academic discussion.

## 5. Conclusion

This article presents some background on how the output gap concept developed over the previous century. It was possible to shed some light on how the main procedures to estimate slack have been evolving as well as the challenges that researchers face.

Output gap is a theoretical concept and an unobserved concept that has been used in practice for diverse policy purposes, which highlights its usefulness for policymakers. However, the relevance and benefit of its use depend on the ability to estimate it accurately with a reasonable time lag.

Survey-based methods as well as purely statistical techniques, such as the HP filter procedure, cannot be seen as directly sourced in economic theory. When

contemplating both stability and consistency properties of these methods, the HP filter does not look to have many advantages, besides its simplicity, as the former offers significantly more robust estimates. Regarding the estimates of the OECD, IMF and EC, the article presents a number of analysis concerning revisions in different time horizons. Overall, EC's approach looks to perform better than the IMF's, which could perhaps be linked with both its methodology and possible informational advantages in its forecasts regarding data provisions underlying the Economic and Monetary Union (EMU), e.g. the European Semester. In general terms, it could be useful to consider EC estimates and the survey-based methodology complementarily. While EC procedure has the advantage of being grounded in economic theory, the survey-based approach can be used to make quarterly estimations at the end of the corresponding quarter (that is, with no time lag) and still have robust revision properties. Considering the uncertainties surrounding the level of the output gap, one should bear in mind the similarities between changes in the output gap, as estimated by different institutions. As such, attention should be given to the level changes of the survey-based measure of slack and not specifically to its level, which is what is of relevance regarding budgetary surveillance and economic monitoring. Although no guarantee can be given about the absence of revisions in any methodology, our work provides for a useful tool for the timely assessment of economic activity.

Per last, as already highlighted, there are at the same time, different dynamics in the various sectors of an economy which need to be accounted for. Therefore, it may be beneficial to consider additional sector specific data, especially from sectors that play an important role in the economy. Given the developments in the Portuguese financial system in the last few years, a survey-based measure that incorporates not only information about the manufacturing, construction and services sectors, but also data related with the financial system could yield incremental value.

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