// NO.19-013 | 04/2019

DISCUSSION PAPER

// MARTIN LARCH, ALESSANDRO CUGNASCA, DIEDERIK KUMPS, AND ELOÏSE ORSEAU

Fiscal Policy and the Assessment of Output Gaps in Real Time: an Exercise in Risk Management

ZEW

Fiscal policy and the assessment of output gaps in real time: an exercise in risk management

Martin Larch
Secretariat of the European Fiscal Board,
European Commission

Alessandro Cugnasca
Secretariat of the European Fiscal Board,
European Commission

Diederik Kumps
Vrije Universiteit Brussel

Eloïse Orseau
Secretariat of the European Fiscal Board,
European Commission

Abstract

Fiscal policymakers are expected to conduct countercyclical policies to mitigate cyclical fluctuations of output, but the assessment of cyclical conditions in real time is subject to considerable uncertainty. They face two types of risk: (i) launching discretionary measures to support or dampen aggregate demand when no measures are required (type I error), or (ii) not launching any stabilising measures when this is warranted by cyclical conditions (type II error). A rational policymaker could manage these risks by correcting real-time estimates for past errors, notably the apparent tendency to underestimate good times when they occur. In practice, however, fiscal policy has been largely pro-cyclical or a-cyclical at best. Using statistical decision theory, we calculate thresholds for real-time output gap estimates beyond which governments could launch stabilisation measures, so as to reduce the risk of running pro-cyclical policies. We consider different preferences for avoiding type I or type II errors, and for addressing upside and downside growth risks. We show that the tendency to run pro-cyclical fiscal policy and the ensuing deficit bias can reflect two factors: a preference for activism that is, attaching a lower cost to type I errors, combined with an inclination to be gloomy about cyclical conditions.

Keywords: fiscal stabilisation, pro-cyclical fiscal policy, risk management, real-time output gap estimates.
JEL classification: E62, E63, H68

Acknowledgements: We are grateful to Peter Claeys, Christophe Kamps and Werner Roeger for helpful comments.

1. Introduction

Fiscal policy decisions crucially depend on the assessment of the economic cycle. In line with the stabilisation function of fiscal policy, governments are expected to prop up or dampen demand when there are signs of slack or overheating in the economy. However, determining the state of the business cycle in real time is an inherently difficult exercise for two reasons. First, such an assessment requires accurate forecasts about forthcoming economic developments. Second, determining the position of the economy along the cycle requires knowing the level of potential output, which is unobservable. Consequently, conventional measures of the output gap are surrounded by a significant degree of uncertainty. Rather than taking at face value point estimates available in real time, fiscal policymakers could carry out a risk assessment taking into account past errors.

This paper deals with the challenges related to performing such a risk assessment in real time, and the trade-off it involves. In particular, we illustrate the decision of fiscal policymakers as they attempt to balance two types of errors. The first error is associated with the incorrect belief that the economy is far from its potential, which leads the government to use actively fiscal policy for stabilisation purposes although it is not justified by actual economic conditions (type I error). Conversely, the second error is associated with the incorrect assessment that the economy is near its potential when it is in fact falling short of it or exceeding it; this assessment would lead the government to adopt a neutral fiscal stance while a counter-cyclical stance would be more appropriate (type II error). We employ statistical decision theory to describe the optimal real-time decision which minimises the expected loss associated with these two types of error.

Using real-time output gap estimates for 28 EU countries between 2003 and 2017, we find a tendency to underestimate economic good times in real time, which in hindsight is one of the drivers of pro-cyclical fiscal policies. The tendency to be too pessimistic about the cycle turns out to be more marked for the production function approach used for EU fiscal surveillance. A lower bias is observed for forecasts based on the agnostic Hodrick-Prescott (HP) filter. We also show how a rational fiscal policymaker could avert the risk of pro-cyclical policies by exploiting past information. We argue that, on top of genuine uncertainty, pro-cyclical policies observed in the past can be presented as the result of policy makers (i) not being concerned about the costs of activism, i.e. intervening when there is no need, and (ii) having a greater aversion to being too optimistic than pessimistic. While such a behaviour or preference may be politically understandable in the short term, it leads to an accumulation of debt over the long term with all its negative implications.

The remainder of this paper is as follows. Section 2 summarises the issues raised in the literature on fiscal policy and stabilisation. Section 3 illustrates how timely information and measurement errors in real-time estimates of the output gap matter when assessing the cyclical behaviour of fiscal policy. Section 4 presents the data and identifies a number of stylised facts. Section 5 conducts an empirical analysis on output gap forecast errors and indicates for what values of the output gap the government should consider using fiscal policy to stabilise the economy, depending on its preferences over the risks involved.

2. Fiscal policy and the business cycle

Traditionally, one of the three main objectives of fiscal policy is to stabilise the economy along its potential output (Musgrave (1959)). When economic activity falls short of its potential, the government should undertake an expansionary fiscal stance to support real demand; conversely, the government should compress demand and build fiscal buffers when output is above potential. The economic argument for doing so is that, from an economic perspective, there are welfare losses associated to both episodes of downturn and overheating.

In practice, numerous studies have observed that countries often pursue pro-cyclical policies. Gavin and Perotti (1997) first noted that fiscal policy in Latin American countries tends to be pro-cyclical; Talvi and Vegh (2005) and Kaminski, Reinhart and Vegh (2005) noted that pro-cyclical fiscal policies are typical of many developing countries. For developed countries, Lane (2003) shows varying degrees of pro-cyclicality, with countries with more volatile output and dispersed political power more likely to run pro-cyclical policies. Maravalle and Claeys (2012) arrive at a similar result by adding a fiscal rule to a standard RBC model that allows public spending to follow the cycle. Finally, OECD (2003) shows that developed countries tend to have a counter-cyclical fiscal stance during downturns and a pro-cyclical stance during upturns. In short, a substantial empirical literature shows quite convincingly that the actual fiscal policy implemented by governments may not be optimal. In particular, there seems to be a common tendency towards a deficit bias during upturns, when the government budget constraint is less binding, hence a pro-cyclical policy during good times (Beetsma and Giuliodori (2010)).

Many of the early studies that analyse the cyclicality of policy decisions make use of ex-post data. Orphanides (2001) and Orphanides and van Norden (2002) were the first to claim that unrealistic assumptions about the timeliness of data availability may lead to incorrect conclusions about policymakers' behaviour. Orphanides (2003) provides an analytical framework to assess the level of noise present in data available in real-time. The framework provides evidence that when the noise is taken into account, policy actions are better in stabilising the economy. Extending this analysis to fiscal policy and looking at OECD countries, Cimadomo (2012) shows that, while fiscal policy appears to be pro-cyclical when evaluated ex-post, the fiscal stance appears counter-cyclical when assessed on the basis of real-time data which is available to the government when decisions are made. Golinelli and Momigliano (2006) also find evidence that the policies of euro countries largely react in a counter-cyclical way when evaluated in real-time. Gollinelli and Momigliano (2009) survey the recent empirical literature concerning the cyclicality of fiscal policies in the euro area, and they find that the results are heavily affected by the data vintage used in the analysis of the fiscal policy reactions. Hughes Hallett et al. (2007) show that real-time estimates of the cyclically-adjusted budget balance are subject to significant revisions ex-post, and that this lack of accuracy may explain why some fiscal slippages go unnoticed in real time.

These results suggest that a predominant factor in determining a suboptimal fiscal policy in advanced economies lies in informational problems. Lack of timely information is due to the significant lags associated to policymaking, which are particularly acute in the case of fiscal policy. First of all, there is a lag in the availability of data: GDP figures, for instance, are only available on a quarterly basis and they are subject to significant revisions. A second source of lag is caused by the budgeting process: the government must prepare a budget law, or an update to it, which then needs to go through parliament. Third, there is an implementation lag: for tax measures this depends on the date when the new tax laws apply, while for expenditure measures this depends on the time it takes to effectively disburse the money. Fourth, there is a transmission lag, namely the time it takes for fiscal impulses to propagate throughout the economy and affect the decisions of households and firms.

As a way of example, the substantial nature of these policy lags can be roughly quantified for the euro area, where fiscal policies are closely coordinated under the Stability and Growth Pact. The draft budgets of euro area countries for a given year *t* have to be prepared by 15 October of year *t-1*. This implies that the latest available information on economic conditions which is factored in by the government refers to the third quarter of year *t-1*. The realised level of economic activity for year *t* is observed only ex-post, at the end of the first quarter of year *t+1*. The overall information lag for policymakers can therefore be roughly quantified around one year and a half, which implies the possibility of significant forecast errors. Policymakers are therefore left to take decisions under a substantial degree of uncertainty, and how to deal with such uncertainty is not straightforward. For instance, with reference to monetary policy, Brainard's principle suggests that policymaker should behave conservatively in the face of uncertainty (see Brainard 1997), but more recent results suggest that an aggressive response to uncertainty may be optimal under some circumstances (see Söderström 2002).

An additional element of uncertainty regards the timing and effectiveness of fiscal policy in stabilising the economy. On the one hand, neoclassical models suggest that fiscal multipliers are rather small, especially as households internalise the government's budget constraint and smooth their consumption by accessing credit markets (Baxter and King (1993)). On the other hand, Keynesian models predict that price rigidities and liquidity constraints lead to a positive response of private consumption to an increase in government spending, giving rise to sizeable fiscal multipliers (Galí, López-Salido and Vallés (2007)). A number of recent studies confirm that the impact of fiscal policy on output is state dependent: Auerbach and Gordonichenko (2017) show that government spending shocks have a negligible impact during expansions, but a sizeable one during recessions when frictions impair the functioning of e.g. credit markets. While the size of fiscal multipliers does not affect per se the discussion on the pro-cyclicality of fiscal policy, the composition of fiscal policy does, as the effect of different fiscal measures on the economy may materialise at different times. A fiscal stimulus may thus be counter-cyclical at the time it is decided, but by the time its effect on output becomes noticeable, it may turn out to be pro-cyclical.

Beyond pure uncertainty, the use of information and fiscal slippages may also reflect strategic motives. An extensive economic literature suggests that discretionary fiscal policy suffers from a deficit bias. Calmfors and Wren-Lewis (2011) identify a number of reasons to explain this bias. First, there are information asymmetries on the part of voters, which could be exploited by the government to boost its chances of re-election election – for instance, governments may have an incentive to embellish the economic outlook to distort voters' perceptions of the state of the economy (Jonung and Larch (2006), Frankel and Schreger (2013)). Second, electoral competition may cause governments to not fully internalise the cost of issuing debt, because these costs may be borne by the opposition if the government is not re-elected. This burden is then passed on to future generations, which are saddled with higher levels of debt and possibly lower levels of capital. Finally, common-pool theory suggests that policy makers often fail to internalise the overall cost of debt on the budget when policy actions only target small groups.

In this paper, we consider the case of a policymaker which does not engage in this kind of strategic behaviour. He or She genuinely wishes to pursue a counter-cyclical policy, but is stymied by a lack of adequate information in real-time. Taking into account past forecast errors on the output gap, the policymaker takes fiscal decisions based on its preferences over two factors: (i) the trade-off between taking incorrect decisions and failing to act, and (ii) the degree of aversion to downward growth surprises.

3. Real-time fiscal policy as a risk management exercise

Assuming that a policymaker wishes to pursue a counter-cyclical fiscal stance, this section discusses the informational problem faced by the government. Policymakers have to base their decision on a real-time assessment of the state of the economy, which is inevitably prone to error. Fiscal policy decisions need to balance the risks associated with two types of errors: the first error consists in implementing policies believed to be counter-cyclical while the economy is actually near its potential (type I error); the second error consists in adopting a neutral fiscal stance when the economy is far from its potential, while this would call for stabilisation policies (type II error).

We assume that the economy can be characterised by three different states. When output is close to its potential, the economy is said to be in '*normal times*'; when output is significantly below or above potential, the economy will be in '*bad times*' or in '*good times*', respectively. In line with the existing literature, we consider the output gap as an overall indicator of the economic cycle. Therefore, denoting as ω_t the state of the economy in year t, and assuming that output is close to potential when the distance between the two is less than half a percent of potential GDP[1], the values of ω_t will be as follows:

$$(1) \quad \omega_t = \begin{cases} 'bad\ times' & if \quad OG_t < -0.5\% \\ 'normal\ times' & if \quad -0.5\% < OG_t < +0.5\% \\ 'good\ times' & if \quad OG_t > +0.5\% \end{cases}$$

The decision of the government consists in setting the fiscal stance, i.e. the discretionary change of the budget balance, for year t. In broad qualitative terms, we consider that the fiscal stance can be of three types: an improvement in the budget balance, which represents a fiscal consolidation; a deterioration in the budget balance, which corresponds to a fiscal stimulus; and an unchanged budgetary position, i.e. a neutral fiscal stance. In this problem we will not discuss the size of the appropriate fiscal stance, but merely whether the stance is expansionary, restrictive or neutral. Assuming that policymakers intend to pursue a counter-cyclical fiscal stance, the government's reaction function is characterised as follows:

$$(2) \qquad r(\omega_t) = \begin{cases} 'stimulus' & if \quad \omega_t = 'bad\ times' \\ 'neutral' & if \quad \omega_t = 'normal\ times' \\ 'consolidation' & if \quad \omega_t = 'good\ times' \end{cases}$$

[1] An interval of 1% of GDP, centred on zero, aims at capturing the uncertainty about when the economy is at its potential. It is in line with the length of the confidence interval of output gap estimates under both the production function method and the HP filter.

The problem faced by the government is that the true state of the economy for the upcoming fiscal year t, ω_t, is unknown when budgetary decisions need to be taken in year $t-1$. Determining the true state of the economy requires both estimating the level of potential output, which is unobservable, and measuring economic growth in the following year, which is still unknown. The only information available to the government in $t-1$ is a real-time assessment of the cycle, ω_t^R. We assume that ω_t^R is determined on the basis of the real-time estimate of the output gap, OG_t^R, which is based on an estimate of the level of potential output and a forecast of the level of GDP in the following year. The real-time assessment of the cycle is therefore as follows:

$$(3) \quad \omega_t^R = \begin{cases} \text{'bad times'} & if \quad OG_t^R < \tau_1 \\ \text{'normal times'} & if \quad \tau_1 \leq OG_t^R \leq \tau_2 \\ \text{'good times'} & if \quad OG_t^R > \tau_2 \end{cases}$$

where τ_1 and τ_2 identify the thresholds that the government uses to determine the state of the economy in real time, taking into account errors in the real-time output gap. The government will set the fiscal stance on the basis of its belief on the state of the economy according to the following real-time decision function:

$$(4) \qquad d(\omega_t^R) = \begin{cases} \text{'stimulus'} & if \quad \omega_t^R = \text{'bad times'} \\ \text{'neutral'} & if \quad \omega_t^R = \text{'normal times'} \\ \text{'consolidation'} & if \quad \omega_t^R = \text{'good times'} \end{cases}$$

Due to the errors in real-time estimates of the output gap, the real-time decision $d(\omega_t^R)$ may be different from the desired reaction $r(\omega_t)$. Whenever this happens, the government suffers a loss $L(d(\omega_t^R), r(\omega_t))$. The government aims to find the real-time decision function that minimises the loss, i.e. the pair of thresholds (τ_1, τ_2) that minimises the difference between the real-time assessment of the cycle, ω_t^R, and the true state of the cycle, ω_t. In hindsight, taking the latest available estimate of the output gap as a proxy for the true state of the economy, the government can infer from past observations the conditional probability $P(\omega_t^R|\omega_t)$ and the prior probability $\pi(\omega_t)$, and retrieve the optimal real-time decision function.

For a given state of the economy ω_t, the expected loss (i.e. the risk) associated with a particular decision function d is:

$$(5) \qquad R(d, \omega_t) = E\left[L\Big(d(\omega_t^R), r(\omega_t)\Big)\right] = \sum_{\forall OG^R} L\Big(d(\omega_t^R), r(\omega_t)\Big) P(\omega_t^R|\omega_t)$$

The optimal decision function is the one with the lowest expected risk across the various states ω_t:

$$\begin{aligned} (6) \qquad d^* &= \arg\min_d E[R(d, \omega_t)] = \arg\min_d \sum_{\forall OG} R(d, \omega_t)\, \pi(\omega_t) \\ &= \arg\min_d \sum_{\forall \omega_t} \sum_{\forall \omega_t^R} L\Big(d(\omega_t^R), r(\omega_t)\Big) P(\omega_t^R|\omega_t) \pi(\omega_t) \end{aligned}$$

Table 1 outlines the possible situations that can materialise.

<table>
<caption>Table 1: Possible outcomes</caption>
<tr><td colspan="3"></td><td colspan="3">Real-time decision of the government $d(\omega_t^R)$</td></tr>
<tr><td colspan="3"></td><td>Stimulus</td><td>Neutral</td><td>Consolidation</td></tr>
<tr><td colspan="3"></td><td>$OG_t^R < \tau_1$</td><td>$\tau_1 \leq OG_t^R \leq \tau_2$</td><td>$OG_t^R > \tau_2$</td></tr>
<tr><td rowspan="3">Reaction desired ex-post $r(\omega_t)$</td><td>Stimulus</td><td>$OG_t < -0.5\%$</td><td>Correct action</td><td>Incorrect inaction (type II error)</td><td>Incorrect action (type I error)</td></tr>
<tr><td>Neutral</td><td>$-0.5\% \leq OG_t \leq 0.5\%$</td><td>Incorrect action (type I error)</td><td>Correct inaction</td><td>Incorrect action (type I error)</td></tr>
<tr><td>Consolidation</td><td>$OG_t > 0.5\%$</td><td>Incorrect action (type I error)</td><td>Incorrect inaction (type II error)</td><td>Correct action</td></tr>
</table>

4. Data

In this paper, we use output gap estimates for 28 countries in the European Union between 2003 and 2017 (Table 2). We consider two measures of the output gap as estimated by the European Commission. The first one compares actual GDP to potential GDP, while the other compares it to trend GDP. In the first approach, the European Commission estimates potential output using a production function approach, a method which was endorsed by the ECOFIN Council in 2002 (Havik et al. (2014)). This approach consists in estimating first the potential levels of labour, capital and total factor productivity, and then combining these results via a Cobb-Douglas production function to derive the corresponding level of potential output. In the second approach, by contrast, the Commission derives the output gap from trend GDP as calculated using an HP filter with a smoothing coefficient of 100.

Table 2: Sample of output gap estimates

Austria	2003-2017	Ireland	2003-2017
Belgium	2005-2017	Italy	2003-2017
Bulgaria	2008-2017	Lithuania	2005-2017
Cyprus	2005-2017	Luxembourg	2005-2017
Czech Republic	2005-2017	Latvia	2005-2017
Germany	2003-2017	Malta	2005-2017
Denmark	2003-2017	The Netherlands	2003-2017
Estonia	2005-2017	Poland	2005-2017
Greece	2003-2017	Portugal	2003-2017
Spain	2003-2017	Romania	2008-2017
Finland	2003-2017	Sweden	2003-2017
France	2003-2017	Slovenia	2005-2017
Croatia	2013-2017	Slovakia	2005-2017
Hungary	2005-2017	United Kingdom	2003-2017

To measure of the real-time state of the economy ω_t^R in a given year *t*, we consider output gap estimates from the Commission's autumn forecast of year *t-1*. This estimate is usually published in November and proxies the information available to the government at the time when the budget was drafted. To measure the true state of the economy ω_t in year t, we consider output gap estimates which were released by the Commission in its spring 2018 forecast, as it includes the latest available information.

We use European Commission forecasts because they provide four important advantages. First, the methodology is the same for all Member States, allowing us to pool together the estimates of the different countries. Second, due to the important role of output gap estimates in EU fiscal surveillance, the methodology employed by the European Commission to generate these estimates is specifically tailored for their policy use. For this reason, Commission estimates of the output gap tend to be less susceptible to ex-post revisions than estimates from other institutions. This implies that the type I and type II errors that we assess based on this dataset will be less prominent compared to what would appear using alternative sources, such as national Ministries. Third, Commission forecasts are performed independently from national governments, and therefore arguably do not suffer from the type of strategic bias which is often observed in government forecasts (Jonung and Larch, 2006; Frankel and Schreger, 2013; Fioramanti et al., 2016). Finally, the production of Commission forecasts is linked to the EU economic policy surveillance cycle, and therefore the release of the autumn forecast is synchronised with the preparation of budget laws in EU Member States; this makes it a good proxy of the information available to governments at that time[2]. Table 3 provides summary statistics for the chosen sample.

Table 3: Summary statistics for the output gap by vintage and measure

Output gap measure		Obs.	Mean	Std. dev.	Min	Max
Real-time	PF	378	-1.42	2.10	-14.36	3.44
	HP	380	-0.91	2.00	-12.07	5.89
Ex-post	PF	420	-0.44	3.52	-15.01	14.01
	HP	420	0.11	4.06	-12.79	20.31

Note: European Commission estimates using the production function (PF) approach or the HP filter (HP).

5. Empirical analysis

This section aims to determine whether the real-time estimates of the output gap are biased, and to characterise how the government should set its fiscal stance in real time depending on available information about the output gap and a balance of risks.

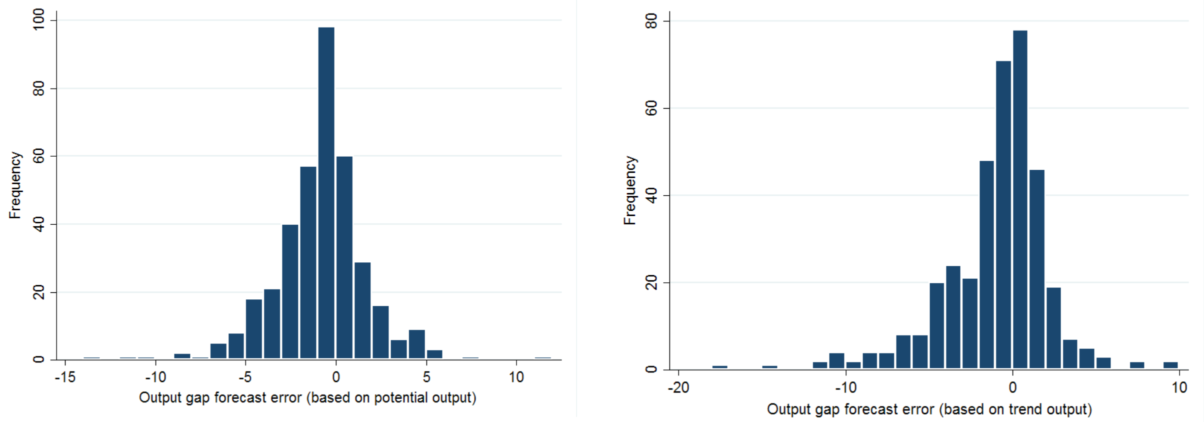
5.1 Forecast bias in real-time estimates of the output gap

Real-time estimates of the output gap are subject to two sources of uncertainty: the uncertainty associated with forecasts of GDP growth, and the model uncertainty underlying the estimates of potential GDP. The latter is particularly significant, because potential output is unobservable, and its estimated value can be significantly revised even several years into the future. Moreover, conventional methodologies to estimate potential output may be distorted by cyclical factors (see Coibion et al. 2017).

[2] A change of accounting standards from ESA95 to ESA2010 affects the estimate of output levels across time, but this has a proportional impact on potential output: the effect on the estimate of the output gap is therefore negligible. The impact of changes in the methodology to calculate potential output is discussed in footnote 4.

Over the time horizon considered, both the real-time output gap estimate based on the production function methodology and the one based on the HP filter display significant forecast errors, and the average forecast error is negative (Figure 1). This would suggest that real-time estimates of the output gap tend to overstate the size of economic downturns and to understate booms. Policymakers who take real-time output gaps at face value would therefore be prone to significant policy errors: they would fail to build up adequate fiscal buffers during good times and they would tend to provide excessive support to the economy during bad times. In line with the findings discussed in Section 2, this suggests that government policies may be too pro-cyclical during good times. In this case, however, this behaviour would not be the result of poor incentives for policymakers giving rise to a deficit bias, but it would rather follow from an informational problem, where policymakers fail to take into account the risks of making decisions based on real-time data.

Figure 1: Distribution of output gap forecast errors based on potential output and trend output



Note: Forecast errors refers to the difference between the Commission autumn forecast in year t-1 for year t and the ex-post estimate of the same year t from the Commission 2017 autumn forecast, for EU countries between 2003 and 2017.
Source: European Commission

One possible cause for the pessimistic bias in real-time estimates of the output gap may lie in the methodologies commonly employed to estimate potential output. In broad terms, the concept of potential output refers to the level of economic activity which is sustainable over the medium term and consistent with full employment. From an empirical perspective, this concept of economic sustainability is frequently associated with the idea that potential output is the level of activity which leads to stable prices, or to non-accelerating wage costs. Price and cost developments therefore play a key role in identifying potential output, for instance via the NAWRU, thereby remedying the problem of its non-observability. However, as recent experience has shown, the accumulation of large financial imbalances may lead to an unsustainable trajectory for output which does not necessarily result in inflationary pressure. Borio et al. (2017) shows that conventional methods for the estimation of potential output may fail to capture cyclical swings in economic activity which are due to the financial cycle. During a build-up of financial imbalance, a real-time assessment of the cycle may therefore point to a near-zero output gap even though the economy is operating above capacity. At the same time, in the immediate aftermath of a financial correction, the output gap may point to an overly pessimistic view of the cycle under the assumption that the pre-crisis peak represented the 'true' level of potential output to which the economy needs to converge. This incorrect assessment of the underlying level of potential output would lead to a negative bias in output gap estimates in real-time.

Following Theil (1966), we test the existence of a forecast bias in real-time output gap estimates by running the following regression:

$$(7) \qquad (OG_t^r - OG_t) = \alpha + \varepsilon_t$$

We then test the null hypothesis that $\alpha = 0$. Table 4 presents the results for the full sample and for a variety of sub-samples.

Table 4: Output gap forecast bias

	Output gap measure			
	Production function approach		HP filter	
Sample	**Average bias**	**Observations**	**Average bias**	**Observations**
Full sample	-0.80***	378	-0.94***	380
Pre-crisis years (2003-2008)	-2.74***	130	-3.26***	132
Crisis years (2009-2017)	0.22*	248	0.29**	248
Years with positive output gap	-2.49***	157	-2.86***	158
Years with negative output gap	0.40***	221	0.42***	222
All years excluding recessions	-1.36***	308	-1.28***	310
Years of recession	1.66***	70	0.54	70
Years with negative output gap but no recession	-0.28**	161	0.06	162
Crisis years (2009-2017) excluding recessions	-0.43***	189	-0.01	189

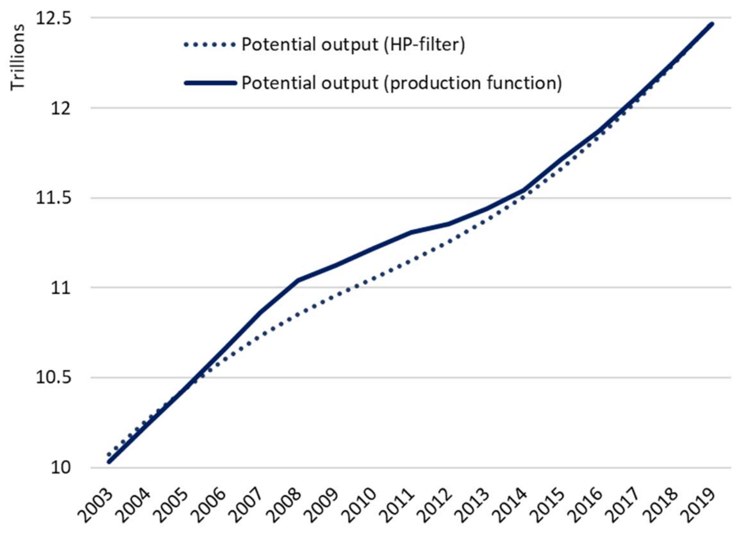
Note: ***Significant at 1% ; ** Significant at 5% ; * Significant at 10%.

In the full sample, both the output gap based on the production function methodology and the one based on the HP filter display a sizeable and statistically significant negative bias. With few exceptions, all countries display a negative average forecast error for the real-time output gap, both with the production function methodology and the HP filter. [3] Hence the bias is an issue for both individual countries and the aggregate, including in particular the euro area. The behaviour of the two series is however different over the business cycle. During years of recession, the production function method displays a positive and significant forecast bias. This is not particularly surprising, since recessions are usually difficult to predict: in this case, the error is therefore largely due to growth forecasts, not to estimates of potential GDP. In these periods, the HP-filter estimates also display a positive error on average, but it is not statistically significant. Outside recession years, the output gap based on the production function method shows a negative and significant bias, both when the output gap is positive and when it is negative, although in the latter case the bias is much smaller. This suggests that the production function methodology has a general tendency to be too pessimistic, and that this problem is particularly severe during upturns. By contrast, with the HP-filter approach, we only find a negative bias when the output gap is positive. When the output gap is negative, outside of recession years, there appears to be no forecast error.

[3] When the production function method is considered, Greece, Croatia and Romania are the only countries where the average forecast error is positive, but not statistically significant. When the HP-filter is considered, Croatia, Malta and Poland are the only countries where the average forecast error is positive, but not statistically significant.

Overall, these findings confirm that conventional measures of the output gap are too cautious during good economic times, by failing to capture episodes of credit booms and overheating in real time, such as during the years up to the 2007 financial crisis. Conversely, an 'optimistic bias' emerges during bad economic times, which is however entirely driven by recession years. During phases of economic recovery, when the economy is not in recession but the output gap is still negative, the HP filter however tends to be more symmetric, while the production function approach remains too pessimistic[4]. This last result may stem from the fact that potential output estimates from the HP filter tend to be more pro-cyclical than those from the production function method. Since the Great Recession was characterised by a permanent negative shock to output, the HP filter was better suited to capture a downward revision in potential output. Indeed, looking at aggregate data for the European Union, the HP-filtered potential output began to immediately decline after 2006, relative to pre-crisis trend; the production function method, on the other hand, continued to suggest that potential growth was broadly in line with the pre-crisis trend still in 2008 (see Figure 2).

Figure 2: Potential output estimates using the production function method and the HP filter



Source: European Commission, based on ex-post data.

5.2 *Optimal fiscal stance for the government*

In this section, we look at how the different properties of the two real-time measures of the output gap impact the risk-management problem of the government. We derive the optimal real-time decision function of the government on the basis of a qualitative loss function, which simply considers whether the decision to implement either a neutral or a counter-cyclical fiscal stance is

[4] The Commission methodology for calculating potential output was updated in 2014: for earlier years, the forecast error considered in this paper therefore compares output gap estimates under two slightly different methodologies. This update of methodology had however a negligible impact on the output gap estimates of most countries, with the exception of Spain, Croatia, Cyprus and Portugal (see European Commission 2014). When these countries are excluded from the tests in Table 4, the findings are broadly unchanged: a negative bias of -0.83*** emerges under the full sample, a bias of -2.5*** emerges under the sample with only positive output gaps and a bias of -0.25** emerges in the sample with only negative output gaps but excluding recessions.

broadly correct, in light of ex-post information about the cycle. We consider that the government suffers a loss equal to ℓ every time the decision taken is incorrect. We further assume that the loss is double, 2ℓ, whenever the government confuses an expansion with a downturn, or vice versa. We then consider that the government attaches a weight of $\theta \in [0,1]$ to an incorrect action, which would occur whenever the government decides to implement a counter-cyclical fiscal stance when a neutral stance would have been appropriate (type I error). The government attaches a weight of $(1-\theta)$ to incorrect inaction, which would occur when the government maintains a neutral stance when a counter-cyclical stance would have been appropriate (type II error). Finally, we consider that the government attaches a weight of $\gamma \in [0,1]$ to the possibility of a downside risk in its real-time assessment, and a weight of $(1-\gamma)$ to the possibility of an upside risk in the real-time assessment. Normalising $\ell = 1$, we can characterise the loss of the government as follows:

$$L\left(d(OG_t^R), r(OG_t)\right) = \begin{cases} 0 & if\ d = r \\ (1-\theta)\gamma & if\ d = 'neutral'\ and\ r = 'stimulus' \\ (1-\theta)(1-\gamma) & if\ d = 'neutral'\ and\ r = 'consolidation' \\ \theta(1-\gamma) & if\ d = 'stimulus'\ and\ r = 'neutral' \\ \theta\gamma & if\ d = '\ consolidation'\ and\ r = \ 'neutral' \\ 2\theta\gamma & if\ d = 'consolidation'\ and\ r = 'stimulus' \\ 2\theta(1-\gamma) & if\ d = 'stimulus'\ and\ r = 'consolidation' \end{cases}$$

The loss function can be also represented as a matrix (Table 5).

Table 5: The loss function of the government

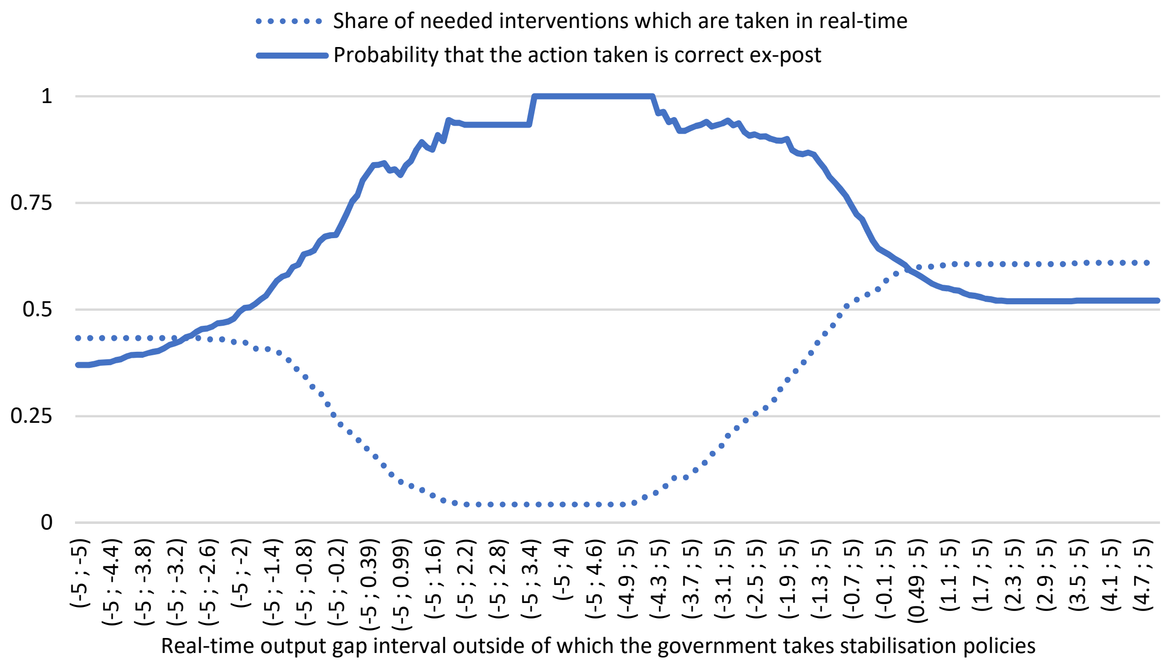
			Real-time decision of the government		
			Stimulus	Neutral	Consolidation
			$OG_t^R < \tau_1$	$\tau_1 \leq OG_t^R \leq \tau_2$	$OG_t^R > \tau_2$
Reaction desired ex-post	Stimulus	$OG_t < -0.5\%$	0	$(1-\theta)\gamma$	$2\theta\gamma$
	Neutral	$-0.5\% \leq OG_t \leq 0.5\%$	$\theta(1-\gamma)$	0	$\theta\gamma$
	Consolidation	$OG_t > 0.5\%$	$2\theta(1-\gamma)$	$(1-\theta)(1-\gamma)$	0

Figure 3 illustrates the policy trade-off that the policymaker faces when deciding on whether undertaking stabilisation policies, based on an observed level of the real-time output gap. A policymaker may behave cautiously, and therefore decide to stabilise the economy only after observing very large values for the output gap in real-time (i.e. choosing a pair of thresholds τ_1 and τ_2 that are far apart). In this case, it is more likely that the stabilisation policies taken will be correct ex-post, but at the same time such behaviour would result in a level of stabilisation that is much lower than what the policymaker desires. The opposite would happen to an activist policymaker (i.e. one who chooses a pair of thresholds τ_1 and τ_2 that are close): in this case, it is more likely that the stabilisation needs of the economy are identified, but at the same time it is less likely that specific policy interventions will be correct ex-post. Both extremes, excess caution or excess activism, would result in a degree of economic stabilisation which is lower than what the policymaker desires based on its reaction function.

Among all the possible decision functions as described in equation (4), the policymaker needs to take the one which minimises the loss, and which is closest to the desired reaction function in equation (2). Since the government's decision is a function of the assumed state of the economy, which in turn is determined based on the real-time estimate of the output gap, the choice of the government is ultimately to determine the optimal pair (τ_1, τ_2) which constitutes the real-time thresholds for policy intervention.

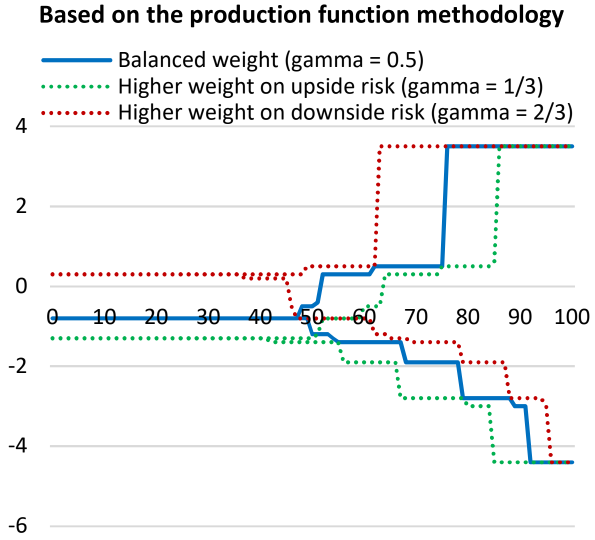
Figure 4 shows the optimal real-time thresholds (τ_1, τ_2) calculated for output gap estimates based on the production function methodology (left panel) or on the HP filter (right panel). In both cases, we consider three possible weights γ that the government may attach to downside risks, indicated by three different colours. The thresholds (τ_1, τ_2) are a function of the weight θ attached to type I errors.

Figure 3: Policy trade-off faced by the government when choosing the optimal pair of real-time output gap estimates above (or below) which to implement a fiscal consolidation (or a fiscal stimulus).



Note: This chart considers a government that wishes to implement countercyclical fiscal policies when the output gap is outside the interval comprised between -0.5% and +0.5% of GDP. The x-axis shows the pair of real-time output gap estimates above (or below) which the government actually decides to intervene in real-time. The solid blue line indicates how many stabilisation interventions are correct ex-post, out of all the stabilisation interventions which are taken in real-time. Alternatively, the solid line shows the probability that an extreme level of the real-time output gap (i.e. a level which is outside the interval indicated on the x-axis) is also extreme ex-post (i.e. is outside the interval between -0.5% and +0.5% of GDP). The dotted blue line shows how many stabilisation interventions are taken in real-time, out of all the stabilisation interventions which are needed ex-post. Alternatively, the dotted line shows how many real-time output gaps appear extreme in real time (i.e. outside of the interval indicated on the x-axis) as a share of all the output gaps which are considered extreme ex-post (i.e. which are outside the interval between -0.5% and +0.5% of GDP).

Figure 4: Loss-minimising thresholds of real-time output gap estimates for considering fiscal stabilisation



Note: On the y-axis, this figure shows the upper and lower thresholds for real-time estimates of the output gap outside which the government will consider implementing countercyclical fiscal policies. The thresholds are calculated for output gap estimates based on the production function methodology (left panel) and on the HP filter (right panel). They are a function of the weight θ attached to type I errors (shown on the x-axis in percent). The three colours indicate three possible weights γ that the government may attach to downside risks, i.e. the risk that the economy will turn out to be worse than expected.

Towards the left of each graph, the government attributes a lower weight to type I errors than to type II errors, that is, it does not want to miss a chance to stabilise the economy, even if this implies a risk of unnecessary interventions. In these cases, the two thresholds τ_1 and τ_2 are equal to each other: the government will always consider intervening, unless the output gap has this particular value. For any output gap above this threshold, the government will consider adopting a restrictive fiscal stance, and for any output gap below the threshold, it will consider implementing a fiscal expansion.

Moving gradually towards the right side of each graph, the weight attributed to type I errors increases and the government becomes less interventionist. The lines representing τ_1 (below) and τ_2 (above) diverge. For real-time output gaps below τ_1, the government will choose an expansionary fiscal stance; for output gaps above τ_2, it will consolidate; and, in between, it will adopt a neutral fiscal stance. At the right end of the graphs, the government above all wants to avoid wrong interventions and prefers to keep a neutral fiscal stance even for very large negative or positive values of the output gap.

When the output gap is based on the production function approach, the threshold which triggers fiscal stimulus for an interventionist government is well below zero. This is consistent with our finding that this method systematically results in a negative bias for output gap estimates in real time. A rational policymaker should take this information into account and expect that a small negative output gap in real time may well lead, in hindsight, to the conclusion that the economy was at potential or in good times. By contrast, when the HP filter is considered, the threshold for which an interventionist government undertakes fiscal stimulus is close to zero: this reflects the lower bias in HP-filtered output gaps.

Under both measures of the output gap, Figure 4 indicates that the thresholds for optimal policy interventions begin to widen only when the weight attributed to type I errors becomes significant, i.e. for very cautious policy makers. Furthermore, the upper threshold for active policy is less smooth under both measures of the output gap, because positive values for the real-time output gap tend to be rarer than negative ones.

The thresholds also depend on the cost that the government attributes to downside risks, i.e. the risk that the economic situation turns out worse than expected. The blue lines in Figure 3 assume that the government attaches equal importance to downside and upside risks. In the case of the production function approach, if the government is more concerned about downside risks (red lines), it will be more tempted to take small negative values of real-time estimates at face value and decide to support the economy. Conversely, if the government is more concerned about positive growth surprises (green lines), it will require an even more negative output gap to support the economy. When using the HP filter, the ordering of the red, blue and green lines is the same, but with smaller differences s because the bias in the real-time estimate is more limited. In particular, a government that is concerned of being too optimistic and wishes to avoid negative growth surprises (red lines) would undertake a fiscal stimulus based on roughly the same output gap as a government with balanced expectations about the state of the economy (blue lines).

These results explain how governments basing their decisions on real-time output gaps estimates may end up implementing pro-cyclical fiscal policies. In real time, providing fiscal stimulus to the economy when the output gap is slightly negative may seem to be the right decision. With hindsight, however, this is likely to be a wrong choice as the economic situation is likely to have been underestimated. One reason why policymakers may still make this decision is that, even if they are aware of the pessimistic bias of real-time output gap estimates, because they have a preference for mitigating recessions rather than for stabilising the economy in a symmetric manner. This asymmetric behaviour may then reflect strategic reasons, such as not upsetting voters with tax hikes and lower public spending in good economic times.

From an economic policy perspective our findings raise the question of why voters do not penalise an activist behaviour coupled with inattention toward economic booms. Among the many alternative explanations provided in the literature (see for instance Drazen, 2000) we would like to highlight one in particular namely the asymmetry of information. Voters may simply not have sufficient information to judge the motives and performance of policy makers which stresses the importance of having independent fiscal institutions to enhance transparency and, in turn, the accountability of policy makers.

6. Conclusions

This paper assumes that fiscal policymakers seeking to maximise social welfare will consider running counter-cyclical fiscal policies when the economy is in bad or good times, using the output gap as an indicator of the cyclical situation. However, the output gap is particularly challenging to measure in real time as it relies both on forecasts and non-observables, and in hindsight real-time estimates often turn out to differ from the 'true' output gap. Uncertainty around cyclical conditions in real time gives rise to two types of errors. On the one hand, governments may wrongly believe that the economy is in a downturn and needs fiscal stimulus – or, conversely, that it is overheating and calls for fiscal retrenchment – while in reality the economy is close to its potential. We describe as type I error the decision to incorrectly undertake counter-cyclical fiscal policies when a neutral fiscal stance would rather be warranted. Conversely, governments may believe there is no slack in the economy and that there is no need to intervene, while the economy is actually in a downturn, or overheating, and would benefit from fiscal stabilisation. We label the failure to provide counter-cyclical fiscal support or restraint as type II error.

To reduce the costs associated with uncertainty, fiscal policymakers can take into account past forecast errors when considering fiscal stabilisation measures. Based on observations in EU countries between 2003 and 2017, we show that the estimates based on the production function approach, used for fiscal surveillance in the EU, tend to be too pessimistic throughout the cycle. Rational fiscal policymakers should correct for this bias to avoid pro-cyclical policies. In particular, they should consider stimulating the economy only when they see a significantly negative output gap in real time, while they should take a small negative real-time output gap as a sign that the 'true' output gap is not necessarily negative but rather likely to be close to zero or even positive. The time may then be ripe for building up fiscal buffers rather than spending them.

We also analyse real-time output gap estimates based on the HP filter. We find that they also tend to underestimate good times, which is consistent with earlier findings that conventional measures of the output gap fail to capture episodes of overheating induced by credit booms. However, during episodes of downturns, with the exception of outright recessions, the HP filter tend to behave differently from the production function method. While the production function approach still displays a negative bias in real time during downturns, the HP filter does not. This greater symmetry in the HP filter may be explained by its tendency to be more pro-cyclical, thus better capturing the impact of permanent growth shocks. By being more stable, potential output estimates derived from the production function method may, on the other hand, tend to overestimate the size of economic downturns in response to large and persistent recessions.

The government's decision depends on the relative weight it attributes to the risks of making type I and type II errors. A government that does not want to miss a chance to stabilise the economy will only adopt a neutral fiscal stance for a very narrow range of output gaps, even if this implies a risk of unnecessary or pro-cyclical interventions outside this range. On the other hand, a government seeking to avoid wrong interventions will maintain a neutral fiscal stance unless the output gap takes very large negative or positive values.

Finally, we underline the consequences of asymmetric preferences with respect to mitigating downside and upside growth risks. Past research observing that fiscal policies tend to be pro-cyclical ex-post, but not in real time, seems to suggest that governments simply do not correctly take into account the risks and biases involved in real-time assessments of the state of the economy. An alternative explanation that could rationalise such a behaviour would assume that governments have a stronger aversion to downside risks to the growth outlook than to upside risks. This would prompt policymakers to ignore or possibly explain the pessimistic bias of real time output gap estimates.

References

Auerbach, Alan J. & Yuriy Gorodnichenko, 2012. *'Measuring the Output Responses to Fiscal Policy,'* American Economic Journal: Economic Policy, American Economic Association, vol. 4(2), pages 1–27, May.

Auerbach, Alan J. & Yuriy Gorodnichenko, 2017. *'Fiscal Stimulus and Fiscal Sustainability,'* NBER Working Paper Series n° 23789, September.

Baxter, Marianne & Robert G. King, 1993. '*Fiscal Policy in General Equilibrium*,' American Economic Review, American Economic Association, vol. 83(3), pages 315–334, June.

Beetsma, R. & Massimo Giuliodori, 2010. '*Fiscal adjustment to cyclical developments in the OECD: an empirical analysis based on real-time data,'* Oxford Economic Papers, Oxford University Press, vol. 62(3), pages 419-441, July.

Borio, Claudio & Piti Disyatat & Mikael Juselius, 2015. '*Rethinking potential output: Embedding information about the financial cycle*,' Oxford Economic Papers, vol. 69(3), pages 655–677, July.

Brainard, William, 1967. '*Uncertainty and the effectiveness of policy*,' American Economic Review, 57, pp 411-425.

Cimadomo, Jacopo, 2012. '*Fiscal Policy in Real Time*,' Scandinavian Journal of Economics, Wiley Blackwell, vol. 114(2), pages 440–465, June.

Calmfors, Lars & Simon Wren-Lewis, 2011. '*What should fiscal councils do?*,' Economic Policy, vol. 26(68), pages 649–695, October.

Coibion, Olivier & Yuriy Gorodnichenko & Mauricio Ulate, 2017. '*The Cyclical Sensitivity in Estimates of Potential Output*,' NBER Working Papers 23580, National Bureau of Economic Research, Inc.

Drazen, A. (2000) Political Economy in Macroeconomics, Princeton University Press, Princeton.

European Commission, 2014. *'European Economic Forecast, Spring 2014,'* European Economy 3|2014.

Fioramanti, Marco & Laura González Cabanillas & Bjorn Roelstraete & Salvador Adrian Ferrandis Vallterra, 2016. *'European Commission's Forecasts Accuracy Revisited: Statistical Properties and Possible Causes of Forecast Errors,'* European Economy – Discussion Papers 27, March.

Frankel, Jeffrey & Jesse Schreger, 2013. '*Over-optimistic official forecasts and fiscal rules in the eurozone*,' Review of World Economics, vol. 149(2), pages 247–272, June.

Galí, Jordi & J. David López-Salido & Javier Vallés, 2007. '*Understanding the Effects of Government Spending on Consumption*,' Journal of the European Economic Association, MIT Press, vol. 5(1), pages 227–270, March.

Gavin, Michael & Roberto Perotti, 1997. '*Fiscal Policy in Latin America*,' NBER Chapters, in: NBER Macroeconomics Annual 1997, vol. 12, pages 11–72 National Bureau of Economic Research, Inc.

Golinelli, Roberto & Sandro Momigliano, 2006. *'Real-time determinants of fiscal policies in the euro area,'* Journal of Policy Modeling, vol. 28, pages 943–964, August.

Golinelli, Roberto & Sandro Momigliano, 2009. *'The Cyclical Reaction of Fiscal Policies in the Euro Area: The Role of Modelling Choices and Data Vintages,'* Fiscal Studies, vol. 30(1), pages 39–72, March.

Havik, Karel & Kieran Mc Morrow & Fabrice Orlandi & Christophe Planas & Rafal Raciborski & Werner Roeger & Alessandro Rossi & Anna Thum-Thysen & Valerie Vandermeulen, 2014. '*The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps*,' European Economy - Economic Papers 2008 - 2015 535, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Hughes Hallet, Andrew & Rasmus Kattai & John Lewis (2007), *'Early Warning or Just Wise after the Event? The Problem of Using Cyclically Adjusted Budget Deficits for Fiscal Surveillance'*, CEPR Discussion Paper No. DP6213.

Jonung, Lars & Martin Larch, 2006. '*Improving fiscal policy in the EU: the case for independent forecasts*,' Economic Policy, vol. 21(47), pages 491–534, July.

Kaminsky, Graciela L. & Carmen M. Reinhart & Carlos A. Végh, 2005. '*When It Rains, It Pours: Procyclical Capital Flows and Macroeconomic Policies*,' NBER Chapters, in: NBER Macroeconomics Annual 2004, Volume 19, pages 11–82 National Bureau of Economic Research, Inc.

Lane, Philip R., 2003. '*The cyclical behaviour of fiscal policy: evidence from the OECD*,' Journal of Public Economics, Elsevier, vol. 87(12), pages 2661–2675, December.

Maravalle, Alessandro & Peter Claeys, 2012. *'Boom-bust cycles and procyclical fiscal policy in a small open economy,'* Journal of Policy Modelling, vol. 34(5), pages 735–754, September.

Musgrave, Richard A., 1959. '*The Theory of Public Finance: A Study in Public Economy*,' McGraw Hill, New York.

OECD, 2003, Economic Outlook, No. 74 (December).

Orphanides, Athanasios, 2001. '*Monetary Policy Rules Based on Real-Time Data*,' American Economic Review, American Economic Association, vol. 91(4), pages 964–985, September.

Orphanides, Athanasios & Simon van Norden, 2002. '*The Unreliability of Output-Gap Estimates in Real Time," The Review of Economics and Statistics,*' MIT Press, vol. 84(4), pages 569-583, November.

Soderstrom, Ulf, 2002. '*Monetary Policy with Uncertain Parameters*,' Scandinavian Journal of Economics, Wiley Blackwell, vol. 104(1), pages 125-145.

Talvi, Ernesto & Vegh, Carlos A., 2005. '*Tax base variability and procyclical fiscal policy in developing countries*,' Journal of Development Economics, Elsevier, vol. 78(1), pages 156–190, October.

Theil, H., (1966), '*Applied Economic Forecasting*', North-Holland Publishing, Amsterdam.

IMPRINT

ZEW – Leibniz-Zentrum für Europäische Wirtschaftsforschung GmbH Mannheim

ZEW – Leibniz Centre for European Economic Research

L 7,1 · 68161 Mannheim · Germany
Phone +49 621 1235-01
info@zew.de · zew.de