



Nominal and real interest rates in OECD countries, changes in sight after covid-19?

Claude Bismut¹ · Ismaël Ramajo²

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Abstract

In this article we seek to gain a better understanding of the decline in interest rates observed over the long term and we ask whether this trend is likely to stop or even reverse as a result of the covid crisis. For this, we introduce a model that combines an intertemporal framework and a price adjustment process. This model makes it possible to derive a testable relationship between observable macroeconomic variables. Tests carried out on a panel of 19 OECD countries confirm the influence of factors suggested by the theoretical model, in particular, the link between the fall in the interest rate and the economic slowdown. The covid episode is analyzed as a mixed shock of supply and demand. The exit from the covid crisis could be accompanied by a rebound, but rising real interest rates are not the most likely scenario.

Keywords Interest rate · Real interest rate · Risk premia · Macroeconomic policy · Potential growth · Stagnation · Covid-19 · Panel data

Résumé

Dans cet article on cherche à parvenir à une meilleure compréhension de la baisse des taux d'intérêt observée sur longue période et on se demande si cette tendance risque de s'interrompre voire de s'inverser à la suite de la crise du covid. Pour cela on introduit un modèle qui combine un cadre intertemporel et un processus d'ajustement des prix. Ce modèle permet de parvenir à une relation testable entre variables macroéconomiques observables. Les tests effectués sur un panel de 19 pays de l'OCDE confirment l'influence des facteurs suggérés par le modèle théorique, en particulier, le lien entre la baisse du taux d'intérêt et le ralentissement économique. L'épisode du covid est analysé comme un choc mixte d'offre et de demande. La sortie du covid

✉ Ismaël Ramajo
i.ramajo@hotmail.fr

Claude Bismut
claude.bismut@gmail.com

¹ CEE-M, Montpellier University, Montpellier, France

² DARES – MAE, Paris, France

pourrait s'accompagner d'un rebond mais la remontée des taux d'intérêt réels n'est pas le scénario le plus probable.

Mots clés Taux d'intérêt · taux d'intérêt réel · primes de risque · politique macroéconomique · croissance potentielle · stagnation · covid-19 · économétrie de panels

1 Introduction

Conventional macroeconomic theory falls short of explaining one of the major characteristics of the recent two decades: namely the declining trend of real interest rates to historical lows. Many papers including Blanchard et al. (2014), Summers (2014), Bernanke (2015), Bean et al. (2015), and others, have addressed the question: why are the interest rates so low? and, should we add, for how long?¹ an issue which is far from being totally clarified. The real interest rate had already put our discipline to a hard test in the eighties, as interest rate patterns were at the exact opposite.² Beyond different historical situations, understanding the real interest (not the least of our macro variables) seems to remain a challenge. The current covid shock adds further complexity, a crucial question being whether the low-rate trend will persist once the pandemic is over (Table 1).

Confronting conventional thinking with observed facts over a long period brings out two puzzles. First,³ the long-term decline in real interest rates has been associated with a slowdown in real activity. Conventional theory would rather suggest that a slowdown in activity would lead to a deceleration in the accumulation of savings and an increase in the interest rate (Fig. 1). What we see is a continuous increase in the saving rate, and the question is: what lies behind this trend. In addition, against all expectations, interest rates remained remarkably stable during the year 2020, despite the contradictory forces to which they were subjected, with an exploding public debt but also, an unusual swelling of savings.

A second puzzle is that, for many years, no evidence has been found that the upward trend of public debt has led, on average, to an increase in the real interest rate, while theoretical models predict an increase. One has to go back to the nineties to find such evidence (see Tanzi and Fanizza (1995)). However, recent literature (Ardagna et al. (2007); Baldacci and Kumar 2010 and others) have emphasized increasing default risks on sovereign bonds when government

¹ The persistence of low interest rates in relation with the secular stagnation hypothesis, is another issue that have been discussed by Blanchard et al. Rachel and Smith (2017) Rachel and Summers (2019) and many others.

² The title of a Ben Bernanke's article is: "Why are the interest rates so low?", posted on March the 30th 2015 on the author's page in the Brookings site. In 2014, Blanchard and co-authors published "A Prolonged Period of Low Real Interest Rates?", thirty years after "Perspectives on High World Real Interest Rates", Blanchard and Summers (1984) See also: Atkinson and Chouraqui (1985), and Bismut (1993).

³ This has been discussed in Bismut and Ramajo (2019)

Table 1 Econometric estimation of model (7) : best selected results

	Dependent variable Ten-year interest rate	Unweighted	Weighted
Time period	1960–2019	1960–2019	
Expected inflation	0.911*** (0.0302)	0.830*** (0.0309)	
Potential growth	1.570*** (0.0985)	2.110*** (0.114)	
Risk indicator	0.131*** (0.0110)	0.0160 (0.0268)	
Structural balance	-0.377*** (0.0351)	-0.301*** (0.0379)	
Constant	-0.0190*** (0.0030)	-0.002*** (0.000274)	
Nb of observations	731	73	
Number of countries	19	19	
R-squared	0.716	0.638	
Adjusted R-squared	0.707	0.627	

Standard errors between brackets

*** $p < 0.01$

are overindebted. We believe that, although there is some influence of public indebtedness on the rate of interest, the relationship is elusive and other factors operate at the same time in a different direction.⁴ For instance, Summers (2015a, b) argued that monetary policy would have been subject to an expansionary bias over a long period thus over-offsetting the influence of fiscal policy. Evidence is mixed on Summers' analysis. If the empirical relation between the interest rate and debt remains fragile, there is reasonable evidence of a relation between the risk as estimated by the rating agencies and the debt ratio (see Appendix 3 in Tables 3 and 41).

In Sect. of this paper, we introduce a dynamic framework which combines an intertemporal approach with a consistent treatment of inflation expectations. This alternative to the Keynesian propensity to consume is more consistent with the observed savings behavior. In Sect. 2, we specify and estimate an econometric relation on annual data for a panel of 19 OECD countries. The tests confirm the influence of the factors suggested by the model, in particular, the medium-term relation between interest rate and potential growth. The role of inflation expectations, the real exchange rate and the risk premia on public debt is also discussed and clarified. In Sect. 3 we try to understand why the interest rates stayed on the trend observed before the covid shock, despite a dramatic fall in real activity, and we discuss the prospect of the post covid-19.

⁴ See Haugh et al. (2009). for a detailed investigation.

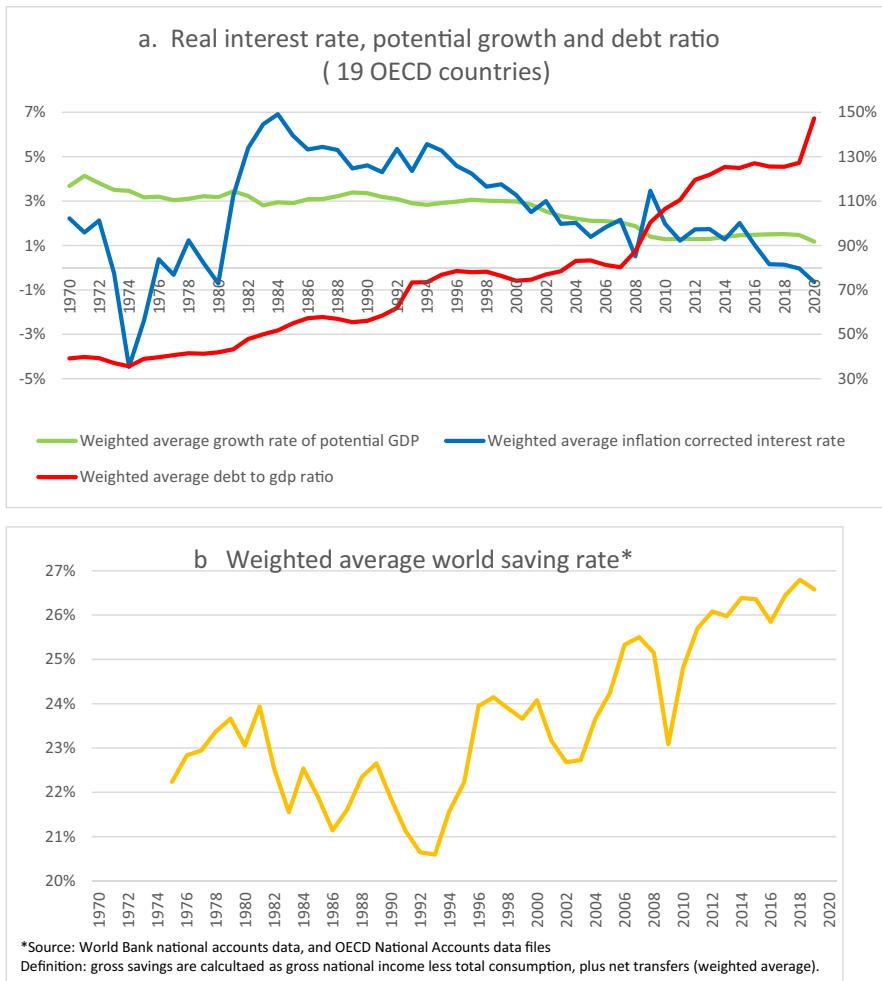


Fig. 1 Selected macroeconomic trends 1970–2020

2 The real rate of interest dynamics

In the present section, we adopt a dynamic approach of the interest rate, and we combine a relation between the real interest rate and potential output borrowed to optimal growth models, with a short-run dynamic model of inflation. This makes it possible to isolate a real component which includes the natural rate and other elements such as risk premia, and a nominal component or a Fisher effect. Then, we obtain a testable equation.

2.1 Optimal growth (intertemporal)

Conventional models (AS–AD, Appendix 1 in Table 2) though extended and completed, do not really explain the observed long-term developments in the interest rate for an obvious reason. There is no doubt that an increase in savings and/or a fall in investment would lead to a fall of the real interest rate, but those models predict that less real activity would lead to an increase in the real interest rate, because it would reduce (not increase) excess savings over investment. This effect is a straightforward implication of the specified saving and investment behaviors, and the question is: why do we have excess savings? In fact, the implications of those models lie on the propensity to consume (and to save) assumption. Naturally, we can imagine many exogenous reasons for an increase in excess saving, but these explanations would lie outside the model. What we are going to try now, is to re-specify the model in order to include some plausible endogenous mechanisms consistent with the empirical evidence.

Most of the alternatives to the Keynesian propensity-to-consume hypothesis rely on some sort of intertemporal approach to consumption behavior that is often assumed in growth models. As a result, besides technology, the interest rate mainly depends on the characteristics of the utility function such as time preference, elasticity of time substitution, and risk aversion. Previous contributions, including Laubach and Williams (2003) and Holston et al. (2017), have used the neoclassical growth model of a decentralized economy (Cass 1965) as the central block of the model in which that saving results from the choice of an optimal consumption flow over time. These models imply a relationship between the interest rate and the real GDP growth rate in the long run.

Another idea that has led to significant results, is to introduce the life cycle hypothesis into an overlapping generation model. This type of model also implies that the interest rate depends on productivity variables and utility function parameters, but by aggregating saving behaviors across a time varying distribution of heterogeneous savers it allows the consequence of demographic shocks to be investigated. Using a calibrated OLG model Andrea Papetti (2019) simulated the trajectory of the interest rate resulting from the demographic transition. Although particularly useful for political purposes, this model does not consider other major macroeconomic shocks such as the consequences of the public debt surge or more generally the perception of a riskier environment that can have a lasting effect on savings behavior. An econometric analysis including all the plausible mechanisms, although desirable, has proved intractable at this stage.⁵

Following Laubach and Williams (2003), we thus assumed that in the long run:

⁵ In discussing our paper, Werner Roeger and Joaquim Oliveira Martins have underlined the importance of demographic determinants, noticeably: the dependency ratio. We do not deny the role of these determinants which could be explicitly introduced in a more ambitious synthesis. Werner Roeger also suggested to replace potential output growth by two components TFP growth and employment growth in the equation to be estimated.

$$\hat{r}^* = \delta + \frac{1}{\sigma} \dot{y} + \dot{n}, \quad (1)$$

where \hat{r}^* is the optimal real interest rate, δ is the time preference, σ is the intertemporal elasticity of substitution, \dot{y} the rate of growth of real GDP, and \dot{n} the rate of growth of the population.

Flexible prices and perfect foresight are assumed in those optimal growth model, and therefore, the economy never depart from the classical regime. Full employment is achieved at any time and production is always equal to potential production. Money is neutral and the price level is determined by the equilibrium on the money market. However, in the real world the economy is affected by unpredictable shocks and do not clear instantaneously, and prices react to excess demand.

2.2 Supply side and short-term dynamics

Among the building blocks of short-run dynamic models, the paradigm of the natural unemployment rate certainly stands in pole position. We will start from this paradigm based on the assumption that there exists a short run inflation / unemployment trade-off, but only one rate of unemployment that stabilizes inflation and no trade-off in the long term: the so-called natural rate of unemployment.⁶ The idea is fairly simple: in a market economy, an unexpected real shock requires price corrections, and the equilibrium rate of unemployment is associated with a situation in which expected inflation errors are purely random, as rational expectations eliminate systematic errors. One important particular case is the NAIRU for which the rate of inflation follows a random walk. This means that at equilibrium, the (natural) rate of unemployment requires the rate of inflation to be stationary.

Here, we will assume that the deviation of the rate of growth of domestic producers' price \dot{p}_t from its expected value \tilde{p}_t , namely: the (domestic) inflation surprise, is an increasing (linear) function of the deviation of the (log) effective production y_t to its (log) potential level \bar{y}_t , namely, the output gap:

$$\dot{p}_t - \tilde{p}_t = \mu(y_t - \bar{y}_t), \text{ with } \mu > 0 \quad (2)$$

a relation known as the "Lucas supply curve". This relation implicitly implies the natural unemployment rate hypothesis (see Appendix 2). The implications of relation (2) are well known: the potential output is the only level of production consistent with stable inflation. This production level defined as the potential output is the one obtained at a level of employment which corresponds to the natural rate of unemployment.

In most economies, household consumption includes a sizable proportion of imports and that prices of imported goods enter as components of the CPI and other domestic demand price indices.⁷ Then, denoting by π_t the (log) real exchange rate

⁶ Despite serious criticisms this approach has been overwhelmingly used, because it makes it possible to define a theoretically consistent and empirically measurable notion of potential output.

⁷ See Bismut and Ramajo (2018)

and $\dot{\pi}_t$ its change over time, the growth of the CPI can be better approximated by $\dot{p}_t^c = \dot{p}_t + (1 - \lambda)\dot{\pi}_t$, where λ is the geometric weight of the domestic goods, and (2) should be replaced by:

$$\dot{p}_t^c - \tilde{p}_t^c = \mu(y_t - \bar{y}_t) + (1 - \lambda)(\dot{\pi}_t - \tilde{\pi}_t), \text{ with } \mu > 0 \text{ and } 0 < \lambda < 1 \quad (3)$$

where \tilde{p}_t^c denotes the expected rate of inflation and $\tilde{\pi}_t$ is the expected change of $\dot{\pi}_t$.

2.3 Real and natural interest rates

We will call real interest rate (or *ex ante* real interest rate) the nominal interest rate corrected from expected inflation:

$$\hat{r}_t = r_t - \tilde{p}_t^c \quad (4)$$

This variable is, conceptually, (one of) the true determinant(s) of investment and saving decisions and should not be substituted, neither by the nominal interest rate, nor by the so called “*ex post*” real interest rate, defined as the rate of interest less (effective) inflation.⁸ We assume that the real interest essentially reflects the optimal rate \hat{r}_t^* as implied by Eq. (1). However, other factors may affect the real interest rate, such as fiscal and policy instruments and risk premia on public debt. We collect those factors in one unique variable z_t and set:

$$\hat{r}_t = \hat{r}_t^* + z_t \quad (5)$$

It is important to note that expected inflation is unobservable, and thus the real interest rate too. However, it is possible to use the information on expected variables, implicitly contained in the Lucas supply curve hypothesis. Using (3) and (4) we can get:

$$r_t = \delta + \frac{1}{\sigma} \dot{y} + \dot{n} + \dot{p}_t - \mu(y_t - \bar{y}_t) + (1 - \lambda)\dot{\pi}_t + z_t \quad (6)$$

a relationship that relates nominal interest rates only to observable variables and that would be suitable for estimation.

The natural rate of interest is the risk-free rate of interest⁹ that would equalize saving and investment, if production is at potential (as defined by the production consistent with the natural rate of unemployment). This means setting $y_t = \bar{y}_t$, $\dot{\pi}_t = 0$. Some policy instruments variable may be included in z_t . They should be

⁸ The quote marks express our discomfort with this usual terminology. Strictly speaking the *ex-post* interest is the interest rate corrected by the inflation drift from the issuance to the maturity. It is often used for the more than one-year interest rate corrected by current inflation. We prefer using the term “Inflation corrected interest rate”.

⁹ Whether the risk-free condition should be included, as do Kings and Low (2014) in the definition of the natural rate, is a matter of debate.

taken at their full employment (or cyclically adjusted value) for estimating the natural rate of interest.¹⁰

At this point by introducing some short run dynamic features via the Lucas supply curve, we have now a better approach to expectations, with a true, although simplistic, expectation behavior which allows a distinction between expected and unexpected inflation. As a result, we also have a consistent and computable notion of the real interest rate.

3 Empirical application

Our objective is to achieve a better understanding of the evolution of worldwide interest rates. In restraining our investigation to the OECD countries, we inevitably miss an important side of the reality, in particular the role of the emerging countries. We believe that, at this stage, discussing about the natural interest rate in regions where the economy is characterized by substantial market imperfections is unwarranted.

On the contrary, it is important to take advantage of a diversity of country cases within the developed area and for this reason we used panel data econometrics. Most available empirical studies use time-series analysis applied to a single country (essentially the United States) and put the stress on the dynamic process. We adopted a more medium term and structural approach based on panel data which allows two possible interpretations. We are first concerned by testing a theoretical model and, in this perspective, the cross-country dimension helps test a general model. We are also interested in characterizing the development of the OECD area, and moreover global developments, and in this case a country's data should be weighted according to its size for testing a kind of aggregate model for the OECD area. We have conducted the analysis by testing systematically the unweighted (cross-country or international) and the weighted (aggregate or global) model.¹¹

Our estimation strategy is based on a single equation econometric model respectful to the theory, but it also reflects some eclecticism. The ten-year nominal interest rate appears as the dependent variable. It could be additively decomposed in an expected inflation component (the Fischer effect) and a real interest component. To establish the link with the theoretical model of Sect. 1, we assume that the real interest rate is equal to the natural rate plus a risk premium, and possibly a white noise, reflecting other determinants ignored in our simplified specification. The natural rate of interest depends on potential growth, and fiscal variables: the deficit and/or the debt ratios. We finally retained the structural balance sb . The risk premium rp

¹⁰ For production and the real exchange rate, $y_t = \bar{y}_t$ and $\dot{x}_t = 0$ natural stationary conditions. In principle, appropriate stationary conditions should be clarified for each element entering in z_t . For instance, a stable and low (negligible) risk premium sounds as a reasonable stationary condition. Note that the optimal growth model of paragraph II.1 above full employment is always achieved and therefore the (real) interest rate is always equal to the optimal interest rate and thus, it is justified to retain the same notation for the natural rate.

¹¹ See Appendix 4 in Table 5 the list of countries.

is proxied as a function of the rating indicator (Appendix 3 in Tables 3 and 4 and Ramajo (2013))

$$r = \beta_0 + \beta_1 \tilde{p}_t^c + \beta_2 \bar{y} + \beta_3 sb + \beta_4 rp + \varepsilon \quad (7)$$

Problems concerning the variables remain to be discussed before getting a testable equation.

The **expected rate of inflation** \tilde{p}_t^c is an unobserved variable, and it stands here as an attempt to capture the Fisher effect while not imposing the theoretical unit value. What we tried to do is to avoid the awkward use of replacing the true variable: expected inflation, by effective inflation. This is not only for obvious theoretical consistence—such a proxy would imply perfect foresight and thus no inflation surprise—but also for an empirical reason. In fact, there is a serious risk that this supposedly benign specification error would introduce a spurious correlation between the real rate of interest and some explanatory variables that have no reason to play a role, leading to biased estimates and misinterpretation, as we will see below.

As for expected inflation we finally decided to use the implicit estimates of the variable extracted from our own estimation of the Lucas supply curve (Bismut and Ramajo 2018). The idea is straightforward. The Lucas supply curve is a relation between the inflation surprise and the output gap, and more generally other unexpected shocks. We calculated the expected inflation as the difference between the observed inflation and the estimated unexpected inflation calculated from the Lucas supply curve.

$$\tilde{p}_t^c = p_t^c - \{\mu(y_t - \bar{y}_t) + (1 - \lambda)\pi_t\} \quad (8)$$

This method is not beyond criticisms, but the benefit is that, by construction, expected inflation is uncorrelated to the output gap and others unexpected shocks.¹² In this two-step strategy parameters the other parameters are estimated conditional to country specific μ 's.

As for the **natural real interest rate**, we found arguments to retain two main factors: the potential rate of growth and the government balance ratio. We used the OECD data for these two variables. The influence we would like to capture is not the automatic stabilizer effect but rather a permanent effect due to a possible Ricardian non neutrality. For this reason, we found appropriate to use the structural balance (Cyclically Adjusted Balance). One other reason of a possible influence of these variables is that they can be interpreted as indicators of sustainability.

The **risk premium** could be measured directly using a rating indicator or indirectly as a function of the debt ratio. We tested the two options. A crude indicator was derived from the Moody's rating and introduced as an explanatory variable on the regressions. We have also tried to introduce the debt ratio as a regressor although this raises problems as we will see further. A rough test of the relation between the

¹² Another option can be to use official survey establish by IMF or OECD. The method used here is introduced in Bismut and Ramajo (2018). Updated estimations reported in Appendix 6 in Table 9, include 2017 and to cover the 19 countries in the regression (2019).

risk indicator and the debt ratio was done by regressing the risk indicator on the debt ratio. The test confirms a significant but low correlation $R^2=0.26$. This is essentially due to the absence of perceived risks for a number of countries and years. The same test applied to the sub sample of countries that faced critical episodes (the GIPS) yields a much stronger correlation ($R^2=0.66$) (see Appendix 3 in Tables 3 and 4).

The econometric analysis based on Eq. (7) was conducted on a panel of 19 advanced economies, over 60 years. Each estimation was performed on unweighted and GDP weighted data. Table 4 in Appendix 3. below contains the main results obtained on unweighted and weighted data using panel econometric analysis with individual (country) fixed effects. We now discuss our main results based on our selected best equations.

A strong Fisher effect, as measured by the coefficient β_1 of the expected rate of inflation, is clearly confirmed. The estimated coefficient 0.9–0.8 is highly significant but significantly less than one). This result may come from a still oversimplified specification for anticipations. Tests of the same specification on subsamples indicate a full Fisher effect ($\beta_1=1$) when estimated on the recent period (Appendix 5 in Tables 6, 7 and 8). The coefficient obtained in the weighted estimation is somewhat lower, which means that the explanatory power of expected inflation rate may be larger in small countries.

The relation between potential growth and the natural rate of interest turns out to be particularly significant in our econometric investigation and comforts the results obtained on time-series by Laubach and Williams (2003), Hamilton et al (2016) and others. Coefficient β_2 is highly significant in all regressions and tends to be larger than one. Based on the theoretical interpretation, figures of approximately 1.5–2.0 sound quite plausible as it would correspond to an intertemporal elasticity of 0.5–0.7, values that are often retained in calibrations. This effect highly contributes to explain the declining trend in interest rate in OECD countries.

The cyclically adjusted fiscal balance has been retained among the plausible determinants of the rate of interest to make allowance for some Keynesian and/or non-Ricardian features. There is, actually, a clear statistical evidence of an effect of this variable on the real interest rate consistent with a number of empirical findings that has been published for more than four decades (see: Baldacci and Kumar 2010; Faini 2006; Haugh et al 2009; Tanzi and Fanizza 1995). The estimated coefficient β_3 is significantly negative, consistent with the theory, and equal to – 0.38 in the unweighted estimation and equal to – 0.3 in the weighted estimation, suggesting some sort of non-linearity. This means that a deterioration of the (structural) fiscal deficit would lead to an increase more important of the rate of interest for small countries (who hypothetically suffer from more fiscal difficulties). However, the theoretical interpretation is not easy. One important point to note is that during the last recession, soaring fiscal deficit did not raise the interest rate that much, although a negative effect is identified econometrically.

The risk factor was tested throughout the introduction of a rating-based measure, but here the evidence is mixed. The estimated coefficients β_4 are of the correct positive sign (an increasing risk leads to an increase in the interest rate), not significant in the weighted estimate because the ratings are high and invariant in the more weighted countries (in particular the United States). On the contrary the

coefficient is larger and significant for the unweighted estimation through which the risk indicator varies more (small countries). Furthermore, the risk indicator is poor, and factors explaining the risk are correlated with other variables, in particular fiscal variables. We believe that the fiscal balance partly captures a risk effect, and that the debt ratio is likely to be an even better indicator (see Corsetti et al. 2012). However, the introduction of the debt ratio brings a counterintuitive result, with an estimated coefficient stubbornly of the wrong sign. This reflects reverse causality: a low interest rate makes it easier to increase public debt. In fact, the interest rate and the debt ratio are jointly determined, and a single equation method of estimation can lead to simultaneity biases.¹³

To assess the robustness and the adequacy of the specifications derived from the theory we have tested alternatives specifications. One important point to check to that respect is the choice we have made to use the rate of expected inflation derived from the Lucas supply curve. For this purpose, we have tested a specification close to (7) but replacing the expected inflation rate by its determinants: the output gap and the real exchange rate. The coefficients have the expected signs but the gain in terms of R^2 is negligible. We have also tested a model including both expected and unexpected inflation (not reported here). Expected inflation remained always the most robust and significant variable but we found the inflation surprise sometimes significant. This suggests that predictive capacities of private agents might be underestimated. However, the major findings are not put into question, and we conclude that our estimated model is fairly robust.

Overall, the weighted estimations are close to the unweighted ones indicating that OECD countries are structurally similar. We note that the estimation coefficient of the potential growth is much larger in weighed than in unweighted estimations and we have not found any reason for explaining such a difference. The largest figures are not implausible, and we may simply say that the role of potential growth in explaining the decline of the interest rates in the OECD as a region is confirmed.

4 The covid-19 episode and after

The year 2020 is too specific to be treated in the same way as the others, but on the other hand it is not possible to say nothing about it. We have decided not to include it in our data sample for estimation, also because provisional statistics are subject to significant changes. On the other hand, it seemed interesting to us to seek to shed light on the recent period by using the work that we carried out on the real interest rate, asking ourselves what do we know? what we don't know, and maybe also, what do we need to know? We have tried to proceed using scenarios, to situate the macroeconomic policy problem of the exit from covid-19.

¹³ In a recent paper, Blanchard (2019) has argued that governments should take advantage of historically low interest rates to expand public expenditures in order to sustain faltering activity. Our results suggest that governments may have anticipated this explicit advice well before.

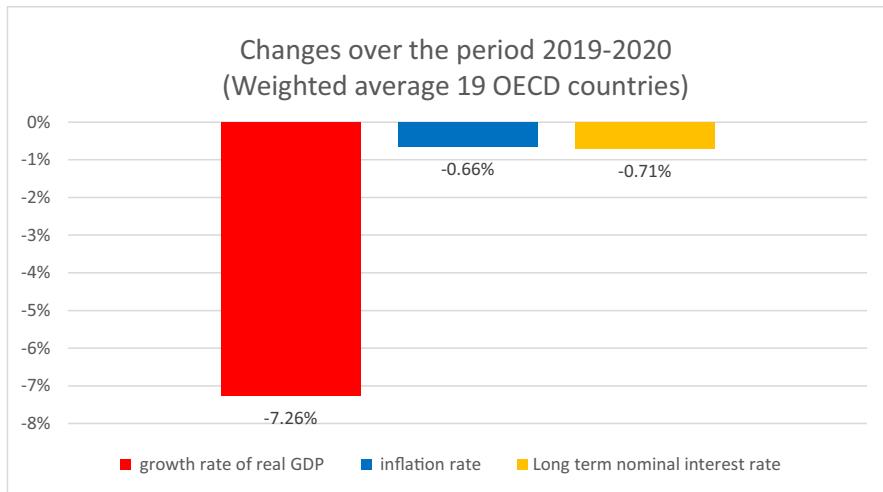


Fig. 2 Changes over the period 2019–2020. (Weighted average 19 OECD countries)

4.1 Covid shock and policy response

Unlike the previous one, the current crisis is not economic in origin, but has become so as a result of drastic measures that governments had to take to deal with a health problem, thus altering the normal functioning of the economy. Those measures were essentially a lockdown with the consequence of restricted consumption for households and limited activity for firms. At the same time, governments have taken measures to support households and businesses to prevent the most precarious individuals or businesses from falling into dramatic situations. These emergency measures are not questionable, despite windfall effects, because they prevent the weakest or the most precarious from being too badly hit. In particular, they reduce the unacceptable deterioration in the living and education conditions of children from the most disadvantaged families.

The covid shock can be macroeconomically analyzed as a mix of adverse supply and demand shocks. The conventional AS–AD framework predicts that the economy will move towards a new equilibrium with a drop in the level of production (no surprise) but the effect on the price level, as well as the effect on the interest rate are ambiguous (see Appendix 1 in Table 2). The calculation based on the 2020 and 2019 statistics (Fig. 2) is consistent with the theoretical multipliers. It turns out that the impact on inflation and the interest rate is very low but it is a coincidence, contradictory forces roughly balancing each other out.

In addition, contrary to conventional theory's prediction, the income supporting strategy has had limited stimulating effect since March 2020 and up to now simply because households have had no full access to the goods markets. This means that the adjustment works through an increase in the saving ratio (contrary to the “propensity to save” assumption) because part of households' savings is “forced”.

To a large extent, the macroeconomic situation since the beginning of 2020 could be viewed as an equilibrium with heavy quantitative rationing, where restricted

production is more or less in line with repressed demand. The absence of inflation does not reflect price rigidity as market forces are still working and prices react to excess demand in most goods markets. However, the usual analysis which retains the output gap as the key determinant of inflation, becomes less reliable together with potential output. No tensions on the interest rates come out, since abundant (partly forced) savings cover the needs of expansionary fiscal policy in all countries. Now, the question is: what is going to happen at the end of the pandemic, when the constraints will be removed?

Forecasters are split between two views of the end of the pandemic: those who anticipate a very strong rebound in economic activity, with a more or less long phase of strong growth, and those who see a difficult recovery, followed by a long period during which we will have to repay the consequences of the costly measures of the crisis. This natural division between the optimists and the pessimists comes in several variations, ranging from the euphoric dreamers, invoking a remake of the Roaring Twenties, to the ominous prophets heralding the decline. Economic reasoning makes it possible to put some order in this jumble and to select the most likely. It is possible to sketch the two scenarios as follows.

4.1.1 Scenario A

Optimists say that a dynamic recovery has been guaranteed by the governments' measures taken at an early stage, to support incomes and protect the means of production. Consumers have simply delayed their purchases during the confinement and are eager to return in their favorite shops to spend a large part of their available savings. Firms are ready to respond to a buoyant demand. This can come about subject to two conditions. (1) Production capacities have been sufficiently preserved. If not, excess demand will lead to inflation and economic policy will turn restrictive. (2) Households, once freed from constraints, will be willing to spend and dissave. If these two conditions are met, growth prospects will become favorable, inflation will stay under control and the real interest rate will pick up, if we believe in the key result of our paper. Public debt reduction would be desirable but eased by inflation.

4.1.2 Scenario B

Households, once free, may not choose to dissave aggressively for at least three reasons: (1) because they expect higher future taxes to repay the debt accumulated during the pandemic, (2) because after the negative experience of year 2020, they have revised upward the risks they have to cover in the future, and (3) because part of the consumption that would have been done in 2020, by nature, could not be postponed and is definitively lost. Thus, the rebound may be modest, and inflation would not be a serious problem. In addition, abundant savings allow governments to keep running large debts without suffering high interest rates. Then, prospect of slow growth is even more likely than before the covid, that will be added to the list of headwinds of Gordon's (2012) analysis.

In fact, those two scenarios differ on the way the private sector will come back to reality. If private sector's purchasing power exceeds firms supply, there are two

possible outcomes (consistent with market equilibrium): either inflation or frugality. Limiting additional economic casualties would require fine tuning fiscal and monetary policy so as to prevent excess demand during the recovery and to help firms to restart and/or to replace destroyed capacities.

The savings behavior of households seems to be a key element in discussing how the economy will emerge from the pandemic. It is important to estimate the proportion of households which are liquidity constrained.¹⁴

If globally, saving has surged during the pandemic, individual situations are quite different. The case of excess savings concerns middle or high-income households, not low-income earners. Some people have still undergone income losses or have lost their jobs. For those people, the main concern is not to accumulate savings but to maintain consumption close to a decent level. As a result, their consumption profiles will tend to get closer to the propensity to consume behavior, with a consumption tightly linked to current disposable income. Most savings are held by high income earners for whom the motivation is forward looking wealth management rather than short term spending flow.

4.2 Coping with the public debt

The “whatever it costs” policy has been unanimously approved during the pandemic (including by ourselves), but at the end, the question is: “who is going to pay?” Governments’ interventions during the pandemic have gone much farther than a pure counter cyclical reaction. The shock is not a usual cyclical fluctuation, small, high frequency, and mean reversing. It is unprecedently large, unique, and not reversible. Therefore, it is unlikely that someday, an abnormally large boom will automatically fill the coffers. This means that the large increase in debt will persist, and in this case, the bill will be repaid later, or transferred to future generations. If households decide to spend and dissave massively (Scenario A), governments could face significant increases in the rates of interest when refinancing their debt. On the contrary, if consumers remain cautious and do not spend too much, then the situation could stay sustainable (Scenario B). Governments’ debt management should be very prudent and will have to trade off continuously between sustaining activity and reducing the debt, at a pace which would be dictated by the change in private absorption and saving behaviors.

The fact that interest rates are low is undoubtedly a favorable condition for weathering the covid shock without too much damage, however this does not ensure sustainability if we simply replicate the fiscal policy that prevailed before the shock. Blanchard and Pisani-Ferry (2021) argued that the level of debt is not too serious a problem, because as long as real interest rates are lower than the growth rate, the debt ratio will decline without having to do anything. This is true if the deficit/GDP ratio is stable. In fact, the crises which followed one another were more and more serious and gave rise to increasingly large deficits. If we look back to the trend in the debt ratio for 40 years (Fig. 1), it is hard to believe that it will stabilize in the coming

¹⁴ See Christelis et al. (2020).

years if we do nothing. The debt can be stabilized and reduced, but for that, we have to do a lot more than we have ever done.

4.3 Monetary policy miracles?

The covid shock came when central banks were already oriented towards expansionary monetary policies in place since practically the previous recession, and there is little chance this orientation will be called into question in the near future. Central banks have embarked on so called “quantitative easing” the aim of which was to supplement the governments in an expansionary policy mix. These massive purchases of government bonds have eased tensions on the bond market, thus easing borrowing, but have not led to inflation and to increases in the interest rates, as was feared.

The continuation of this policy in order to manage the additional indebtedness caused by the covid crisis does not raise a fundamental problem, but it is complicated by the development of a new debate on the possibility of cancelling the debt held by the central banks. This option, putting aside the legal obstacle, would reduce one counterpart of the money supply, would lead to inflation (unless the monetary base would be cut) and would incur a capital loss to the central bank, and ultimately to the state. If so, central banks may have to reduce the money supply to prevent a surge of inflation and to avoid the risk of dis-anchoring.¹⁵

One question is: what are the implications for the interest rates and particularly the rate on government bonds to be issued? This brings us back to a fundamental question of the influence of monetary policy on real activity. Undoubtedly, monetary policy affects real activity in the short term and constitutes a precious tool in the field of countercyclical policy. In normal times, the central bank controls short-term rates on the monetary markets and affects liquidity by lending to the banking sector. Its monetary mission is to ensure price stability by targeting a low rate of inflation. In principle, the central bank should not provide finance to the government, and thus, there is no reason that the central bank would affect the real rates on long-term bonds. It affects the long-term nominal rate through the expected rate of inflation. Conventional monetary policy (inflation targeting) affects only short-term rates and therefore the term structure of the interest rates, not the long-term rate. The question remains as to whether quantitative easing may affect the real long-term rates.

As for the long term, our empirical investigation provides two important pieces of evidence. First the Fisher effect is strong, probably full in recent decades,¹⁶ which means that the nominal interest rate moves one for one with the expected rate of inflation. No doubt that monetary policy affects nominal rates through inflation and there is no reason to think that the excellent central banks’ credibility should be undermined in the coming years. This means that the real rates of interest depend essentially on potential growth and additional (real) determinants. Second, fiscal policy is important not only because large (structural) deficits may affect the rate

¹⁵ P. De Grauwe (2021) has expressed a similar point of view.

¹⁶ See Appendix 5 in Tables 6, 7 and 8.

of interest, but also because high debt may affect productivity negatively. Finally, as we said, saving behaviors are arguably the key to future developments and the main constraint to fiscal policy, as well as the condition of corporate investment, and ultimately the condition of the response to the multiple challenges our societies will have to face in the coming years.

Appendix 1: Basic model (AS–AD—Including demand and supply shocks)

The expression "conventional theory" which we sometimes use is a shorthand which refers to the AS–AD model which one finds in all the textbooks of macroeconomics in more or less elaborate forms. In this appendix, we limit ourselves to recalling the qualitative effects of the shocks which we discuss in this article. This information is presented in a table that contains the signs of the multipliers. This table presents in row the endogenous macroeconomic variables and in column the variables which undergo a positive exogenous variation (shock). A negative shock reverses the indicated sign. In a combination of simultaneous shocks, the effects which can lead to a sign ambiguity. The analytical processing makes it possible in certain cases to remove the ambiguities of sign (Table 2; Fig. 3).

This model is appropriate for comparative static exercises. Transposing this results in a dynamic context may give some indications but is not rigorous and may be misleading. However using the AS–AD framework for evaluating the short-term consequences of the covid shock (Sect. 3 of the paper) is appropriate. The production fall is unambiguous but the effects on the price level and on the rate of interest are theoretically ambiguous. The figure below represents the observed case of a negative effect on both.

Appendix 2: The Lucas supply curve and the natural rate of unemployment.

The Lucas supply curve can be derived from two assumptions.

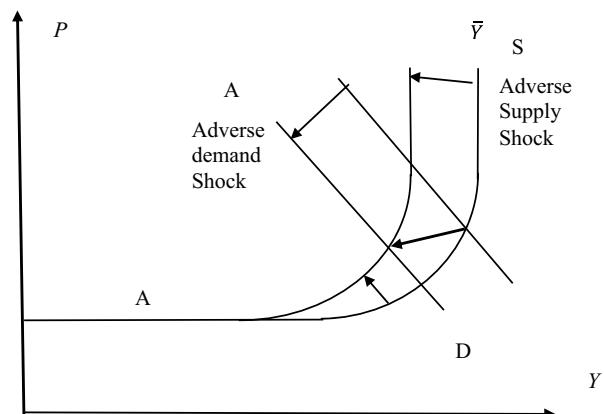
The natural rate of unemployment hypothesis

This means that although some inflation unemployment trade-off may exist in the short run, there is only one rate of unemployment \bar{U} , the natural rate of unemployment, consistent with the absence of inflation surprise in the long run. One general expression for this assumption is a relation between inflation surprise and the unemployment gap, the difference between the rate unemployment U and the natural rate \bar{U} :

$$\dot{p}_t - \tilde{p}_t = -\beta(U_t - \bar{U}) \quad (9)$$

Table 2 The signs of the multipliers

Shock variables	Public expenditures G	Taxes T	Money supply M	Demand shock	Supply shock
Production Y	+	-	+	+	+
Price level P	+	-	+	+	-
Interest rate r	+	-	-	-	+

Fig. 3 The AS–AD analysis of the covid shock as a mixed supply and demand shocks

where \dot{p}_t is the rate of inflation and its expected value \tilde{p}_t . Note that NAIRU (Non-Accelerating Inflation Rate of Unemployment) is the case for which $\tilde{p}_t = \dot{p}_{t-1}$

The Okun's law

It is the short run relation between the unemployment rate and the level of production. This can be written as a relation between the unemployment gap and the output gap.

$$U_t - \bar{U} = -\zeta(y_t - \bar{y}) \quad (10)$$

The coefficient ζ , called Okun's coefficient, measures the reduction of the unemployment resulting from a one percent increase in production.

The Lucas supply curve

is obtained by replacing the unemployment gap $U_t - \bar{U}$ in (1) by its expression taken from (2).

$$\dot{p}_t - \tilde{p}_t = \mu(y_t - \bar{y}) \text{ with } \mu = \beta\zeta \quad (11)$$

Therefore, assuming a Lucas supply curve implies the natural rate hypothesis.

Appendix 3: Relation between the debt ratio and the risk indicator

The notion that high public debt generates high interest rates is widely accepted although evidence is mixed. In dramatic cases of unsustainable indebtedness, things are rather clear but when considering intermediate situations often qualified as “excessive indebtedness” what has been found is that some limited risk premia arise (see Alesina et al. 1992). In addition, other factors can affect the interest rate. What lies behind the relation between the interest rate and debt is simply that the private agents are inclined to see the level of the debt ratio as an indicator of default risk.

To test this assumption, we have built a (crude) risk indicator based on the Moody’s rating and we have run a panel regression for the four samples. The indicator varies from 0 (no risk) to 1 (default almost certain) at a pace of 0.5 between two successive value of Moody’s rating (Table 3). The statistical relation between the risk indicator and the debt ratios is clearly confirmed. (Table 4).

Appendix 4: Sources and information on the database

In this paper, we have conducted a statistical and econometric analysis on nineteen selected OECD countries for which most macroeconomic annual data are available from 1960 to 2019. The list includes Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Korea, the Netherlands, New Zealand, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. Source: OECD Economic Outlook (Table 5).

The definitions of the variables used in our paper to describe the economies are the following:

- Real growth is the annual growth rate of Gross Domestic Product in volume at 2010 market prices.
- Inflation is the annual growth rate of the Consumer Price -Index (CPI).
- The nominal interest rate is the interest rate on the 10 years fix rate government bonds.
- The Debt/GDP ratio is the general gross financial liabilities as a percentage of GDP.
- The fiscal balance corresponds to the general government net lending as a percentage of GDP.
- The risk indicator based on ratings is defined in Appendix 3 in Tables 3 and 3.
- Potential growth is the growth rate of potential output in volume as estimated by the OECD.
- The output gap is the difference between GDP in volume and potential GDP, in percent of potential GDP.
- The real exchange rate is proxied as the ratio of the Consumer Price Index (CPI) and the deflator of GDP at power $(1-\lambda)$. The rate of growth of the real exchange rate is simply the difference between the inflation rate and the rate of growth of

Table 3 Moody's rating and risk indicator

Moody's rating	Risk indicator	Moody's rating	Risk indicator	Moody's rating	Risk indicator
Aaa	0	Baa1	0.35	B2	0.7
Aa1	0.05	Baa2	0.4	B3	0.75
Aa2	0.1	Baa3	0.45	Caa1	0.8
Aa3	0.15	Ba1	0.5	Caa2	0.85
A1	0.2	Ba2	0.55	Caa3	0.9
A2	0.25	Ba3	0.6	Ca	0.95
A3	0.3	B1	0.65	C	1

Table 4 Test of the relation between the Interest rate and debt ratio $rp = \beta_0 + \beta_5(d/y) + \varepsilon$

Endogenous variable: risk indicator	All countries	G7+Belgium & Sweden	GIPS	Non-GIPS
Sample	(1)	(2)	(3)	(4)
Debt/GDP	0.187*** (0.0119)	0.1101*** (0.00926)	0.539*** (0.0346)	0.0695*** (0.00839)
Constant	-0.0612*** (0.00905)	-0.0554*** (0.00809)	-0.310*** (0.0373)	-0.0106** (0.00488)
Observations	719	377	128	591
R-squared	0.259	0.278	0.664	0.143
Number of countries	19	9	4	15

Standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

the GDP deflator. The deflator of GDP is used as a proxy for the producer price. It is calculated as the ratio of GDP at current prices to GDP in volume.

- The structural balance is the cyclically adjusted general net lending, as a percentage of potential GDP.
- Expected inflation estimated as effective inflation less the inflation surprise, as calculated from the estimated Lucas supply curve.

Appendix 5: Additional econometric results

Some restrictions were retained in the choice of our “best estimate” (we would rather say: our most sensible estimate). In particular, was the two-step estimation reasonable and was the idea of using the Lucas supply curve distortive or informative? As a simple test we estimated the model by replacing the expected inflation by its determinants and to re-estimate this equation without constraints. The result in Table 3 indicates clearly that these determinants turn out to be significant and of the right sign and as for the other estimated coefficients are very close to the two those

Table 5 Country weights in total GDP of the 19 selected countries

Countries	Country weights calculated from GDP in volume at constant PPP 2015 (US dollar, 2015) (%)
Australia	2.48
Belgium	1.16
Canada	3.55
Denmark	0.62
Finland	0.52
France	6.05
Germany	8.65
Greece	0.64
Italy	4.98
Japan	11.43
Korea	4.30
Netherlands	1.90
New Zealand	0.38
Portugal	0.68
Spain	3.61
Sweden	1.07
Switzerland	1.22
United Kingdom	6.17
United States	40.59
Overall	100.00

Table 6 Two steps weighted and unweighted estimations

	All countries	
	Unweighted	Weighted
Expected inflation	0.911*** (0.0302)	0.830*** (0.0309)
Potential growth	1.570*** (0.0985)	2.110*** (0.114)
Risk indicator	0.131*** (0.0110)	0.0160 (0.0268)
Structural balance	-0.377*** (0.0351)	-0.301*** (0.0379)
Nb Obs	731	731
Nb Ctr	19	19
R2	0.716	0.638
Adj R ²	0.707	0.627

Standard errors between brackets

*** $p < 0.01$

Table 7 Alternatives weighted and unweighted estimations

	All countries	
	Unweighted	Weighted
Inflation	0.932*** (0.0301)	0.712*** (0.0371)
Output gap	-0.299*** (0.0324)	-0.342*** (0.0336)
Real exch rate	-0.158** (0.0674)	-0.295*** (0.0972)
Potential growth	1.580*** (0.0979)	2.179*** (0.121)
Risk indicator	0.103*** (0.0117)	0.00422 (0.0265)
Structural balance	-0.373*** (0.0334)	-0.277*** (0.0387)
Nb Obs	731	731
Nb Cntr	19	19
R ²	0.744	0.648
Adj R ²	0.736	0.636

Standard errors between brackets

*** $p < 0.01$, ** $p < 0.05$ **Table 8** Econometric estimation of model (10): bests selected results

	Dependent variable	All countries	
	1984–2019	Unweighted	Weighted
Expected inflation	1.064*** (0.0438)	1.025*** (0.0738)	
Potential growth	1.583*** (0.102)	2.904*** (0.101)	
Risk indicator	0.127*** (0.011)	0.065*** (0.020)	
Structural balance	-0.310*** (0.0382)	-0.245*** (0.0344)	
Nb of observations	650	650	
Number of countries	19	19	
R-squared	0.690	0.694	
Adjusted R-squared			

Standard errors between brackets

*** $p < 0.01$

of the two-step estimation, indicating that there is no reason to fear that the method used has violated the data. Table 4 Two steps weighted and unweighted estimations (selected estimation) (Table 6, 7 and 8):

The other question we tried to address concerns the Fisher effect, for which a high coefficient but nevertheless significantly less than one was obtained. After some attempts, we found that our model performed less accurately in the remote years but much better in the recent years. Estimation of our selected equation over the sub-sample 1984–2019 indicate a full Fisher effect, with coefficients not significantly different from one

Appendix 6: An updated estimation of the two factors Lucas supply curve

The key idea behind the two factors Lucas supply curve is that inflation expectation errors could come not only from unexpected domestic real shocks (on the output gap) but also on unexpected external real shocks (the real exchange rate) as indicated in Eq. (6). This relation is discussed and estimated in Bismut and Ramajo (2018). The table below contains updated estimation of the two parameters of this relation that were used for calculating expected inflation (Table 9).

Table 9

Country	Sample	Output Gap	Real Exchange Rate	R ²	F-statistic	DW
Australia	1975–2017	0.37* (0.21)	0.16 (0.23)	0.07	1.58	2.30 ^b
Belgium	1971–2017	0.36*** (0.11)	0.29 (0.24)	0.23***	6.54	1.84 ^b
Canada	1966–2017	0.32*** (0.10)	-0.01 (0.17)	0.22***	6.74	1.97 ^b
Denmark	1971–2017	0.23** (0.11)	0.54*** (0.19)	0.21***	6.00	1.87 ^b
Finland	1975–2017	0.18*** (0.06)	0.08 (0.16)	0.17**	4.23	1.43 ^a
France	1961–2017	0.35*** (0.11)	0.85*** (0.21)	0.35***	14.48	1.43
Germany	1966–2017	0.37*** (0.05)	0.11* (0.06)	0.48***	22.95	1.75 ^b
Greece	1975–2017	0.13 (0.08)	0.41* (0.23)	0.12*	2.62	1.42 ^a
Ireland	1977–2017	0.14 (0.12)	0.22 (0.19)	0.07	1.38	1.57 ^a
Italy	1963–2017	0.54*** (0.12)	0.50 (0.32)	0.29***	10.58	1.61 ^a
Japan	1970–2017	0.44*** (0.20)	-0.11 (0.43)	0.11*	2.75	2.29 ^b

Table 9 (continued)

Country	Sample	Output Gap	Real Exchange Rate	R ²	F-statistic	DW
Korea	1975–2017	0.45** (0.19)	0.48 (0.29)	0.14*	3.22	1.97 ^b
Netherlands	1972–2017	0.27*** (0.08)	0.46*** (0.16)	0.29***	8.96	1.58 ^a
New Zealand	1980–2017	0.49* (0.26)	0.41 (0.32)	0.12	2.43	2.17 ^b
Portugal	1971–2017	0.02 (0.09)	1.23*** (0.20)	0.51***	22.85	2.36 ^b
Spain	1979–2017	0.17*** (0.05)	0.70*** (0.22)	0.27***	6.80	1.99 ^b
Sweden	1967–2017	0.39*** (0.11)	0.53** (0.21)	0.26***	8.52	2.31 ^b
Switzerland	1978–2017	0.24*** (0.09)	0.47*** (0.18)	0.29***	7.44	2.05 ^b
United Kingdom	1970–2017	0.39** (0.18)	0.21 (0.36)	0.10*	2.49	2.11 ^b
United States	1964–2017	0.32*** (0.07)	1.05*** (0.19)	0.53***	28.73	1.35

Notes Standard errors in parenthesis, below estimated coefficients

Stars indicate that a coefficient is significant at 10% (*), at 5%, (*) or at 1% (***)

Based on the Durbin–Watson statistic, error autocorrelation is rejected at 5% (b), or test inconclusive (a), or not rejected (no indication)

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