CEPS WORKING DOCUMENT

Thinking ahead for Europe

Explaining the post-crisis Philips curve:
Cumulated wage gap matters for inflation

Liviu Voinea

Abstract

In this paper we build a new model for understanding the relationship between wage and inflation. We introduce the concept of a cumulated wage gap – meaning the cumulated gap between the current wage and a maximum reference wage value in the past. The permanent income hypothesis is fundamentally flawed in times of crisis, because of uncertainty of future income. In a crisis, the reference is not expected income, but rather past income. Retirement savings and linear employment prospects are uncertain. People relate to their peak gains in the not so distant past rather than to uncertain future gains. The only certain reference value lies in the past, not in the future: and that is why current consumption is influenced by past income.

The post-crisis Philips curve uses the cumulated wage gap instead of nominal wage. This is a measure of stock, not of flow. The post-crisis Philips curve is non-stationary, as it moves over time.

We build a theoretical model and then we test it for all OECD countries, for a series of wage adjustments episodes (15 or more years ago, respectively the last global crisis). The model is empirically validated for all countries - including, to varying degrees, US, UK and euro-area, as the cumulated wage gap has a strong explanatory power on the deviation of inflation from its target.

We find that inflation does not increase close to or above its target level until the cumulated wage gap is closed. In other words, for Philips curve to work, the loss of welfare from a negative cumulated wage gap must be fully compensated first – as a stock measure, not as a flow.

The policy implication from here is that countries which closed their cumulated wage gap should be much more prudent in further wage increases – because they will be seen in inflation much faster and larger than in the recent past. For countries which have not closed their cumulated wage gap the implication is that inflation will remain subdued until they close their cumulated wage gap.

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1. Introduction: Adjusting the Philips curve

Inflation has been subdued in the post-crisis years, and the Philips curve has failed to explain it. It is probably the greatest mystery of the economic science in the last decade: **where has the Philips curve gone?** There are multiple references to the fact that the Philips curve has flattened over the last decade, if not earlier (Borio, 2017, Carney, 2017, Cunliffe, 2017, Praet, 2016 and 2018 and Spencer, 2017). The flattened Philips curve and the lesser link between inflation and unemployment, inflation and output gaps, or inflation and wages, have multiple explanations. As presented in international literature, some of these explanations are: de-anchoring inflationary expectations, the labour market slack, a lower natural rate of unemployment, changes in expectations regarding the real pay growth, the decoupling between growth and inflation, the role of global value chains in keeping prices down, the role of migration in keeping wages down in the countries of destination, and others. While there is some truth in each and every of them, no alternative has been successfully suggested so far.

The main point of this paper is that, if we want to explain inflation, we need to make some adjustments to the Philips curve.

First, we work with observable variables only. The problem with econometric models which use non-observable variables is built-in: they tend to under-perform in bad times. These models need a reality check, and non-observable variables are not fit for that purpose. Potential GDP is revised retroactively. The output gap depends on potential GDP. Plus, an economy can grow above its potential without being at its full employment (this happens, but not exclusively, in catching-up economies).

Any measure of unemployment is controversial, due to the impact of insufficiently accounted factors such as the underground economy, migration, inactivity, part-time employment. A non-observable measure of unemployment, like NAIRU, is even more debatable. If Central Banks rest their decisions solely on such non-observable variables, they are at risk of getting it wrong. True, any non-observable variable becomes visible at some point in the form of a disequilibrium in other observable variables, among which the twin deficits (budget deficit and current account deficit). Yet, when it happens, it is usually too late for monetary policy.

Therefore, we drop the non-observable variables such as output gap, inflationary expectations and NAIRU – at least when the task at stake is to explain inflation in a post-crisis environment. Instead, we choose to use observable variables only. Since wage is a measurable, reliable,

accounted for, and comparable indicator, we focus on a **Philips curve where consumer prices inflation rate is explained by the cumulative wage gap**.

As for the wage Philips curve, a number of recent studies also came to the conclusion that the wage Philips curve, relatively similar with the original one as developed by Phillips (1958), is more reliable when particular attention is devoted to creating a new reference measure for unemployment (Gali, 2011 and IMF, 2017), and even unemployment gap is theorised (Alichi, 2015 and IMF, 2018).

Second, we make a fundamental change of paradigm from flow to stock. To understand the consumption behaviour, which in turn influences inflation, we introduce the concept of a **cumulated wage gap** – meaning the cumulated gap between current wage and a peak reference wage value in the past. **The permanent income hypothesis is fundamentally flawed in times of crisis, because of uncertainty of future income.** The only certain reference value lies in the past, not in the future: and that is why current consumption is influenced by past income. We also introduce the concept of an **inflation gap** – meaning the deviation of present inflation from the target inflation or, in the absence of such, from its long-time average.

Third, we allow for the Philips curve to be non-stationary: it moves over time, and it is absolutely normal to do so. Reference wage values, social preferences, jobs' characteristics, skills' endowments and even Central Banks' targets, they all change over time – hence, the impact of cumulated wage gaps on inflation cannot be the same in different time periods.

In this paper we build a new model for understanding the relationship between wage and inflation. In order to do so, we refer to cumulated wage gaps and inflation gaps, rather than wage and inflation as nominal variables. **We find that inflation does not increase close to or above its target level until the cumulated wage gap is closed**. In other words, **for Philips curve to work, the loss of welfare from a negative cumulated wage gap must be fully compensated first – as a stock measure, not as a flow. The relationship between cumulated wage gap and inflation gap explains the unexplained: its explanatory power is statistically significant in countries which experienced a wage shock, and it is stronger after a crisis.**

2.   Theoretical background

Wages, as the most important source of income for most households around the globe, stand at the basis of any consumption theory. The main problem with the prevailing consumption theories (Keynes' (1936) consumption function, Modigliani's (1966) life-cycle hypothesis and Friedman's (1957) permanent income hypothesis) is their long-term approach. This puts them at odds with our rather short and medium-term perspective on inflation, especially in times of crisis.

Our approach is closer to Duesenberry (1952), who introduced relative income instead of the rate of change as the explanation of the differences in saving at the same level of income. He referred to the influence of past living standard on current consumption. Saving depends, he wrote, on the level of current income relative to higher incomes in previous years. However,

he stopped short of calling a wage gap or of considering the influence his consumption and saving theory may have on inflation.

What matters most for consumption during and after a crisis is not the unit change of income, the savings for retirement, or the future income. **A recession is a game-changer**. In a recession, the transitory component of income becomes negative not only for one person or for a small group, but for the national or global economy. This makes it very difficult to predict future income. When nothing is steady anymore, the only valid reference remains the past income.

In a crisis, the reference is not ahead of us, but rather is in the past. Retirement savings and linear employment prospects are uncertain. People relate to their peak gains in the not so distant past rather than to uncertain future gains.

Consumption does not depend only on current income and future expectations, but also on past income.

Stock is more relevant than flow, because people have a strong reference which is their previous income levels. People do not spend as much as before when their wage drops, and they spend more if they have higher wages. While this is intuitive and apparently well theorized, everything is related to wage flows and to wage dynamics. We hold that we should account the stock as well, meaning the cumulated gap between current levels and past reference levels of income.

Cumulated wage gap is a better predictor of inflation than output gap because it is observable (can be calculated) and it refers to past consumption and price levels; while output gap is non-observable and it makes conservative assumptions for the future.

Past wages are the minimum potential wages for the wage earners. Hence, people will judge their consumption decisions based on the relation between their current wages and their past wages, adjusted for inflation. I call this difference real wage gap.

The cumulated real wage gap, instead of nominal wage, is the explanatory variable in our new Philips curve. The dependent variable is the inflation gap, which refers to the gap between inflation and the inflation target (or, in the absence of a target, an average value of inflation over a longer time-span).

Inflation gap is a more relevant variable for policy makers than the inflation rate because it puts inflation in relation to a desired level. A negative inflation gap means more demand-side measures are needed. A positive inflation gap means that the risk of overshooting is already present and policy tightening is required.

For inflation, the reference point is not in the past – but it is rather a normative value, commonly agreed to be desirable for a given society at a given point in time.

3. The wage gap model

3.1 Wage gap

This study uses cumulated real wage gap instead of wages or unemployment rate in the Phillips curve. We start by defining the wage gap:

$$W_{gap\ T_n} = W_{T_n} - W_{T_0} \tag{1}$$

where $W_{gap\ T_n}$ is the real wage gap at time T_n, W_{T_n} is the real wage at time T_n, and W_{T_0} is the real wage at time T_0, the maximum real wage value in the reference period.

The cumulated real wage gap at time T_n is defined as:

$$cW_{gap\ T_N} = \sum_{n=1}^{N} W_{gap\ T_n} = \sum_{n=1}^{N}(W_{T_n} - W_{T_0}) \tag{2}$$

A theoretical graphical representation of the real wage and the cumulated real wage gap for a 6-period model can be observed in the chart below.

At time T_1, when real wage W1 drops relative to the reference real wage W0, the cumulated real wage gap is the area A. At time T_2, when real wage drops even further, the cumulated real wage gap is the sum of areas A and B. At time T_3, the real wage starts to increase, but as it remains below the reference value, the cumulated real wage gap further deepens (A+B+C). At time T_4, when the real wage increases above the reference maximum value, the cumulated real wage gap starts to shrink (A+B+C+D). The growth of real wage makes the cumulated real wage gap to close at time T_5 (A+B+C+D+E) and to enter into the positive territory at time T_6 (A+B+C+D+E+F).

The cumulated real wage gap for the above 6-period model is described below:

$$cW_{gap\ T_1} = A = \int_{T_0}^{T_1} cW_{gap}(t)dt < 0 \tag{3}$$

$$cW_{gap\ T_2} = A + B = \int_{T_0}^{T_1} cW_{gap}(t)dt + \int_{T_1}^{T_2} cW_{gap}(t)dt = \int_{T_0}^{T_2} cW_{gap}(t)dt < 0 \tag{4}$$

$$cW_{gap\ T_3} = A + B + C = \int_{T_0}^{T_1} cW_{gap}(t)dt + \int_{T_1}^{T_2} cW_{gap}(t)dt + \int_{T_2}^{T_3} cW_{gap}(t)dt = \int_{T_0}^{T_3} cW_{gap}(t)dt < 0 \tag{5}$$

$$cW_{gap\ T_4} = A + B + C + D = \int_{T_0}^{T_1} cW_{gap}(t)dt + \int_{T_1}^{T_2} cW_{gap}(t)dt + \int_{T_2}^{T_3} cW_{gap}(t)dt + \int_{T_3}^{T_4} cW_{gap}(t)dt = \int_{T_0}^{T_4} cW_{gap}(t)dt < 0 \ \text{and} \ cW_{gap\ T_4} > cW_{gap\ T_3} \tag{6}$$

$$cW_{gap\ T_5} = A + B + C + D + E = \int_{T_0}^{T_1} cW_{gap}(t)dt +$$

$$\int_{T_1}^{T_2} cW_{gap}(t)dt + \int_{T_2}^{T_3} cW_{gap}(t)dt + \int_{T_3}^{T_4} cW_{gap}(t)dt + \int_{T_4}^{T_5} cW_{gap}(t)dt = \int_{T_0}^{T_5} cW_{gap}(t)dt =$$

$$0 \qquad\qquad (7)$$

$$cW_{gap\ T_6} = A + B + C + D + E + F = \int_{T_0}^{T_1} cW_{gap}(t)dt +$$

$$\int_{T_1}^{T_2} cW_{gap}(t)dt + \int_{T_2}^{T_3} cW_{gap}(t)dt + \int_{T_3}^{T_4} cW_{gap}(t)dt + \int_{T_4}^{T_5} cW_{gap}(t)dt + \int_{T_5}^{T_6} cW_{gap}(t)dt =$$

$$\int_{T_0}^{T_6} cW_{gap}(t)dt > 0 \qquad\qquad (8)$$

where A is the cumulated real wage gap between T_1 and T_0, B is the cumulated real wage gap between T_2 and T_1, C is the cumulated real wage gap between T_3 and T_2, D is the cumulated real wage gap between T_4 and T_3, E is the cumulated real wage gap between T_5 and T_4 and F is the cumulated real wage gap between T_6 and T_5, all being expressed as areas.

Chart 1. Real wage and the cumulated real wage gap
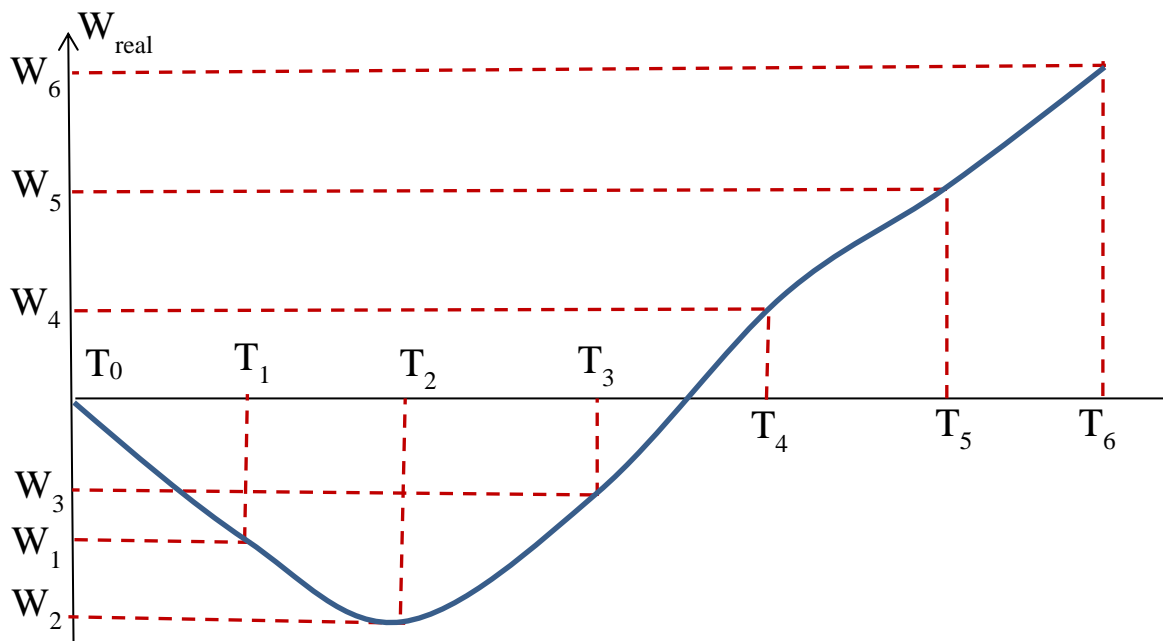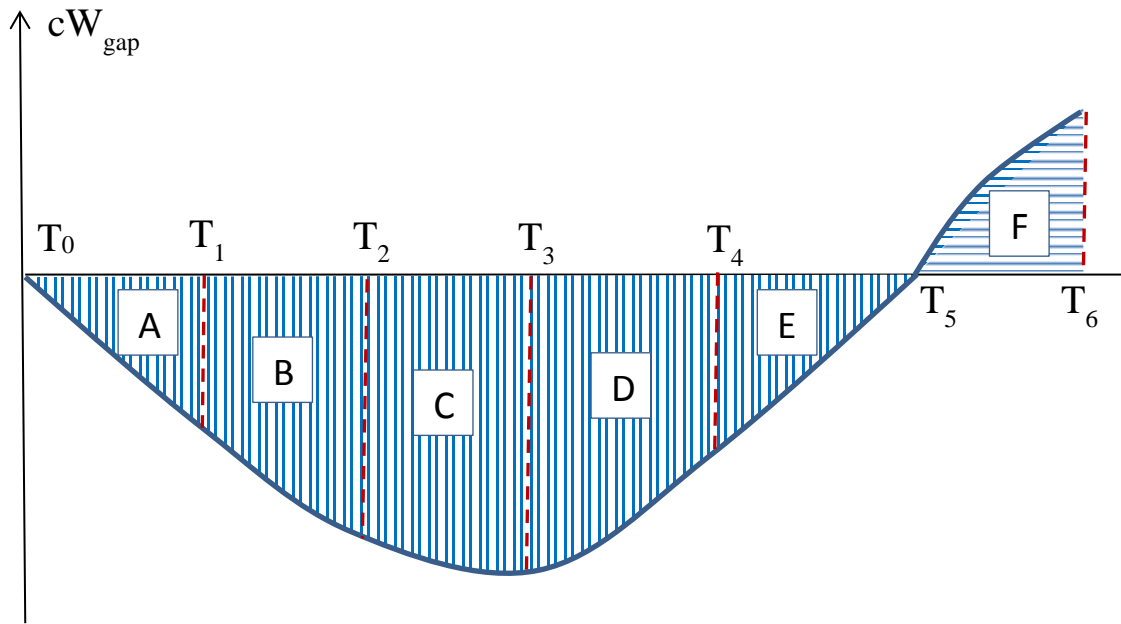
Source: Author.

In general, the formula for the cumulated real wage gap at time T_N is as follows:

$$cW_{gap\,T_N} = \sum_{n=1}^{N}(W_{T_n} - W_{T_0}) = \sum_{n=1}^{N} A_n \qquad (9)$$

where T_N is the time period and A_n is the gap between W_n and W_{n-1}, expressed as area.

If a new recession comes at T_7 (not shown in the above charts), the new reference value for the real wage is at T_6.
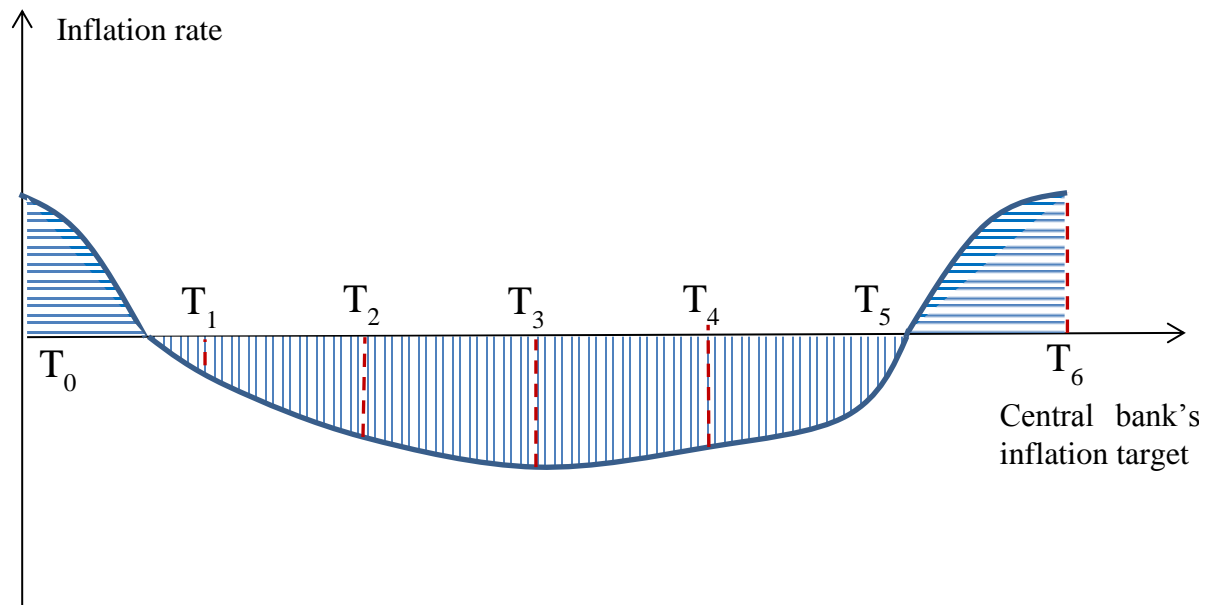
3.2   Inflation gap

The inflation gap is defined as the deviation from the central banks' target:

$$\Pi_{gap\,T_n} = \Pi_{T_n} - \Pi_{T_n}^* \qquad (10)$$

where $\Pi_{gap\,T_n}$ is the inflation gap at time T_n, Π_{T_n} is the inflation rate at time T_n, and $\Pi_{T_n}^*$ is the central banks' target at time T_n, or, in the absence of that, an average of long-time inflation.

A theoretical graphical representation of the inflation gap for a 6-period model can be observed in the next chart.

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Chart 2. Inflation rate and inflation gap

Source: Author.

The inflation gap for the above 6-period model fulfils the following relations:

$$\Pi_{gap\ T_0} = \Pi_{T_0} - \Pi_{T_0}^* > 0 \tag{11}$$

$$\Pi_{gap\ T_1} = \Pi_{T_1} - \Pi_{T_1}^* < 0 \tag{12}$$

$$\Pi_{gap\ T_2} = \Pi_{T_2} - \Pi_{T_2}^* < 0 \tag{13}$$

$$\Pi_{gap\ T_3} = \Pi_{T_3} - \Pi_{T_3}^* < 0 \text{ and } \Pi_{gap\ T_3} < \Pi_{gap\ T_2} \tag{14}$$

$$\Pi_{gap\ T_4} = \Pi_{T_4} - \Pi_{T_4}^* < 0 \text{ and } \Pi_{gap\ T_4} > \Pi_{gap\ T_3} \tag{15}$$

$$\Pi_{gap\ T_5} = \Pi_{T_5} - \Pi_{T_5}^* = 0 \tag{16}$$

At time T_0, at the maximum reference value for wages, we assume that inflation rate is above the central bank's inflation target, given the inflationary pressures caused by high wages. Therefore, inflation gap at time T_0 is positive. However, the model is valid even if this assumption does not hold. As wages enter an adjustment phase, inflationary pressures fade away and inflation rate declines. Inflation gap turns negative and reaches a minimum at time T_3, the same as the cumulated real wage gap. In the next stage, as wages resume growth, inflation rate starts rising, but it remains subdued, below the central bank's inflation target, until time T_5, when the cumulated real wage gap is closed. Afterwards, wages continue to increase, and the wage gap widens in the positive territory. Consequently, inflationary pressures strengthen, pushing up the inflation rate above the central bank's inflation target at time T_6.

3.3   Post-crisis Phillips curve: Cumulated real wage gap vs. inflation gap

The relationship between cumulated real wage gap and inflation gap is presented in Chart 3. The equation of the post-crisis Phillips curve is written as follows:

$$[\Pi_{gap\ T_n}]_N = f([cW_{gap\ T_n}]_N) + [\varepsilon_{T_n}]_N \tag{18}$$

By introducing the equations for inflation gap and cumulated real wage gap into relation (18), the Post-Crisis Phillips curve becomes:

$$[\Pi_{T_n} - \Pi^*_{T_n}]_N = f([\sum_{n=1}^{N}(W_{T_n} - W_{T_0})]_N) + [\varepsilon_{T_n}]_N \tag{19}$$

where N is the period of time for which the Phillips curve is evaluated and ε_{T_n} is the residual, which accounts for other variables influencing the inflation gap.

Chart 3. Post-crisis Phillips curve: Cumulated real wage gap vs. inflation gap
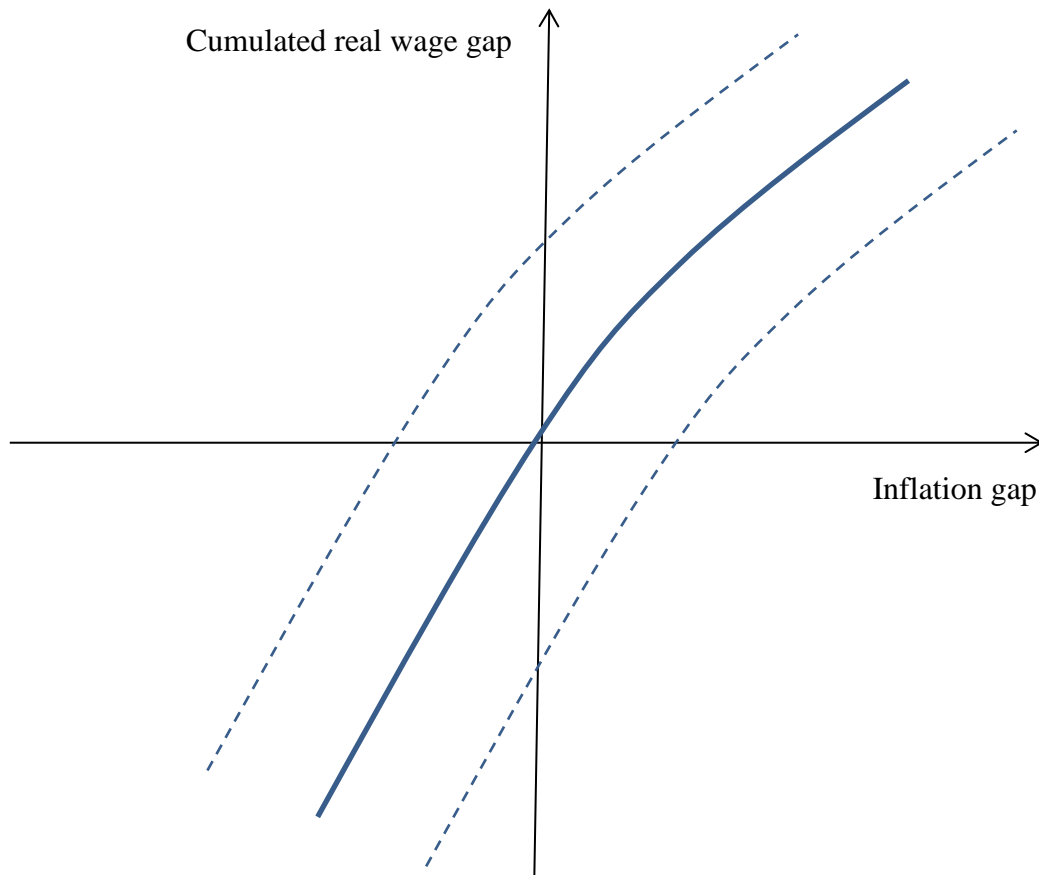
Source: Author.

The shape of the post-crisis Philips curve expresses the theoretical assumption that after the cumulated wage gap has been closed, the impact of higher wages on inflation is stronger than before, when the cumulated wage gap was negative.

The dotted lines indicate possible variations depending on other variables, both exogenous and endogenous, which influence the inflation rate.

4.   Empirical evidence

The idea about cumulated wage gap and its role on inflation popped up when inflation numbers for Romania began to look odd: after years of undershooting the inflation target, including negative inflation rates, the inflation reshuffled in October 2017, following a series of supply-side shocks, but it continued to grow by the end of that year and reached 5% in the first quarter of 2018. In the previous years, wage growth was higher than in the recent months, but it seemed to have little if any impact on inflation, even when tax-neutral inflation rate was considered.

However, as Chart 4 compellingly shows, having the last quarter of 2008 as the maximum reference point for real wage, inflation re-emerged only after the cumulative real wage gap was closed. It is worth mentioning that Romania had a recession in 2009-2010 and it witnessed a nominal wage cut in the public sector in 2010. Until 2014, wages were gradually restored and a policy of increasing the minimum wage was gradually implemented. Nevertheless, it was not until 2017 that the cumulated real wage gap closed.

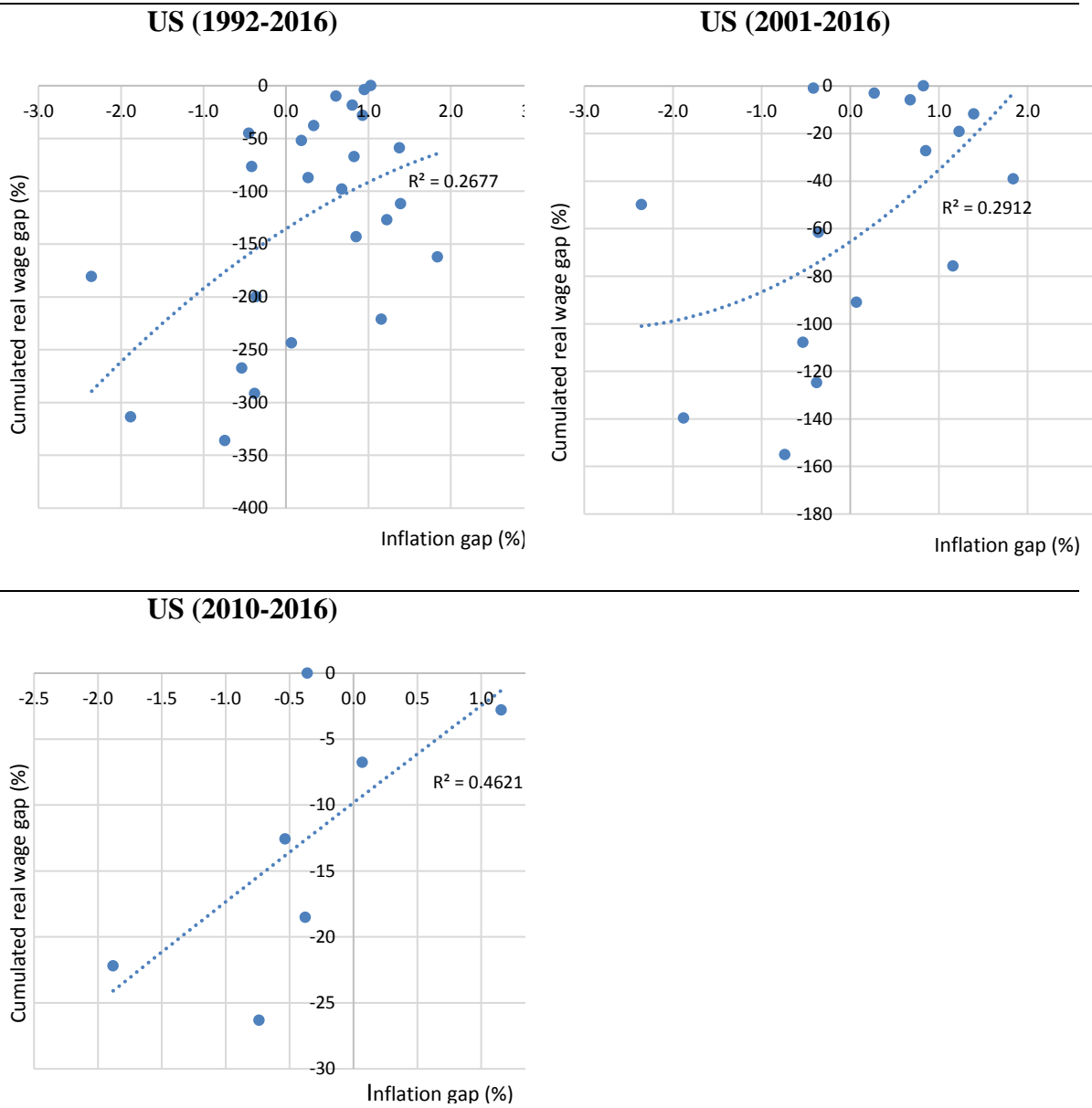*Chart 4. Cumulated real wage gap and inflation, Romania, 2008-2018*
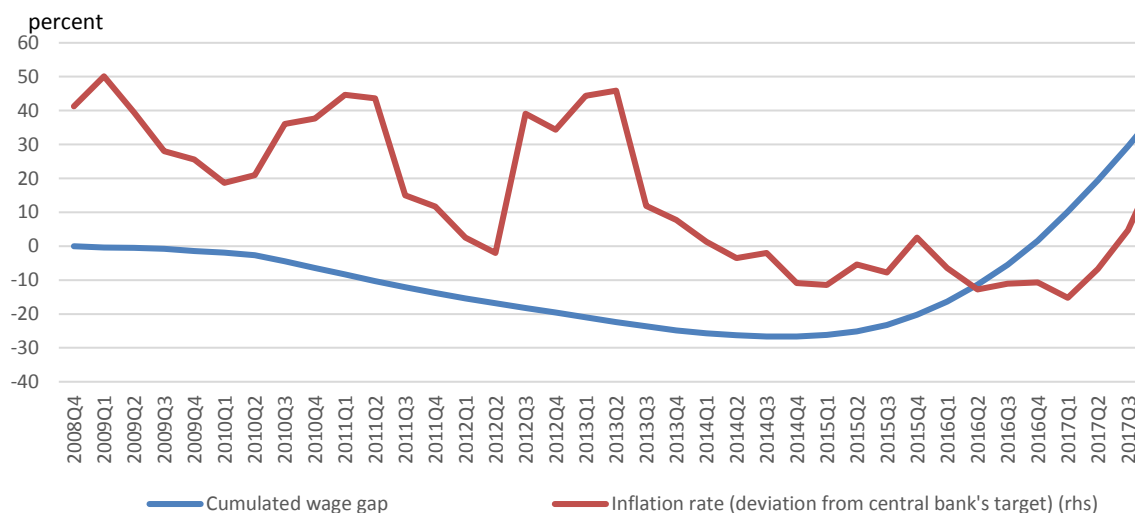
Note: Quarterly data; net average wage; inflation rate is adjusted with the impact of VAT rate changes.
Source: National Institute of Statistics, National Bank of Romania, own calculations.

Starting from this empirical observation, we built the Philips curve for the (cumulated real wage gap vs. inflation gap) for countries that experienced economic downturn and subsequent real wage adjustments (see Charts 5-8 below). We tested all OECD countries. We report a selective

list of results, for simplicity reasons. The starting year for each country corresponds to the year of the maximum reference wage value in the past, prior to the crisis.
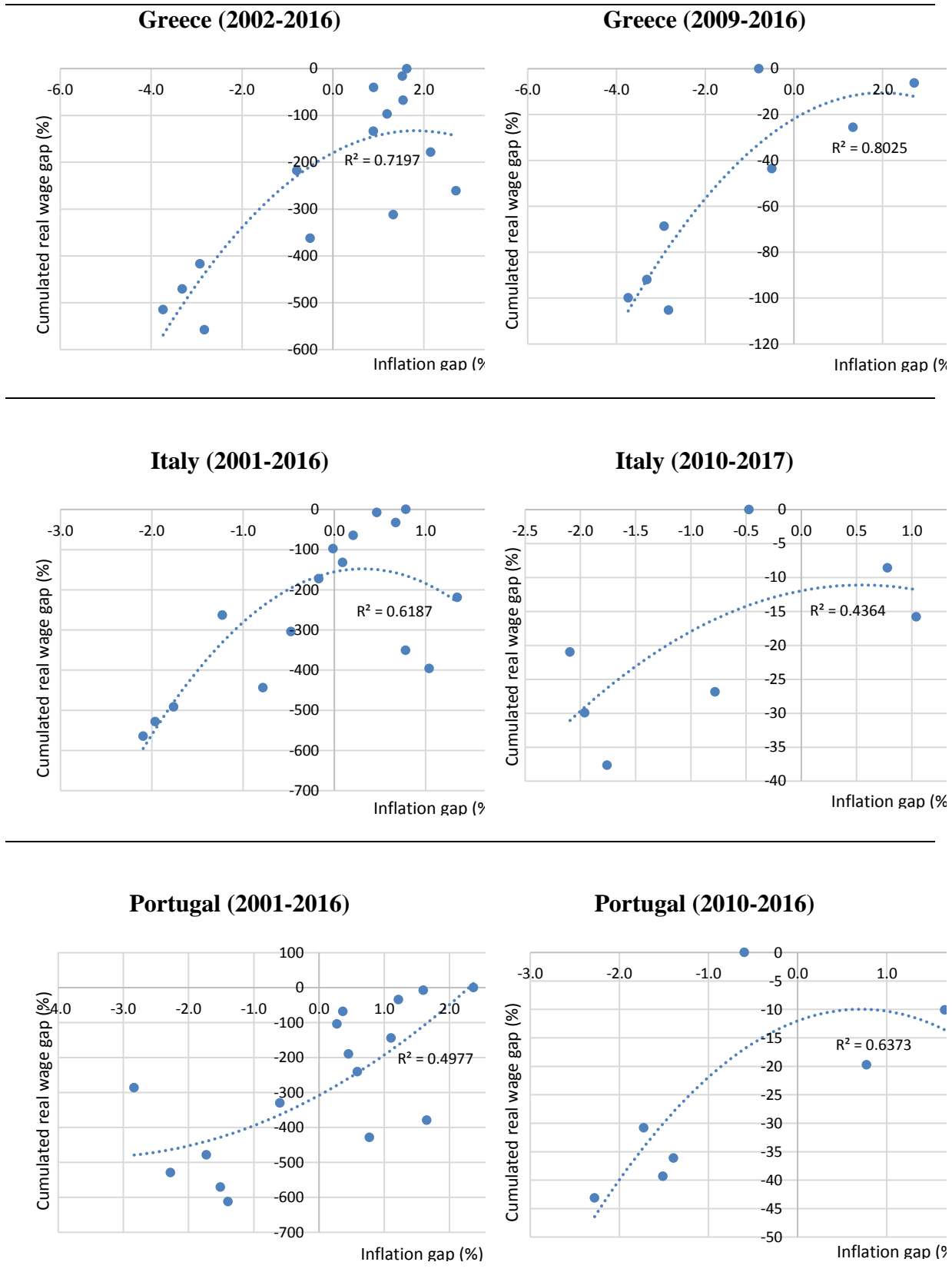
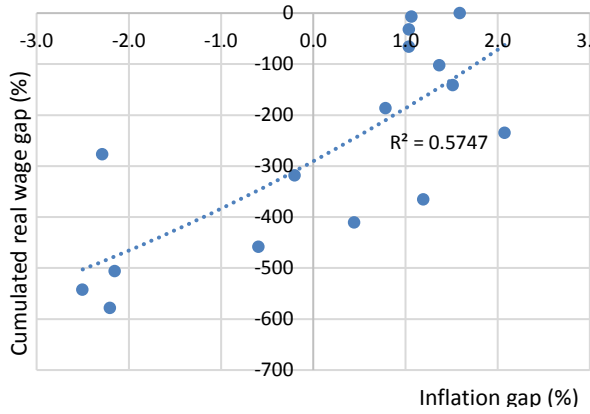*Chart 5. Post-crisis Phillips curve for the United States*

US (1992-2016)

$R^2 = 0.2677$

Cumulated real wage gap (%)

Inflation gap (%)

US (2001-2016)

$R^2 = 0.2912$

Cumulated real wage gap (%)

Inflation gap (%)

US (2010-2016)

$R^2 = 0.4621$
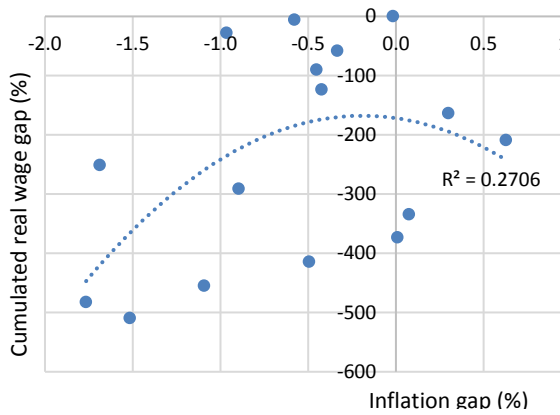
Cumulated real wage gap (%)

Inflation gap (%)

Note: Annual data; average wage; the starting year is the peak reference wage value in the past.
Source: OECD, author's calculations.

Chart 6. Post-crisis Phillips curve for selected countries, South European euro-area countries

Spain (2001-2016)

Spain (2010-2016)
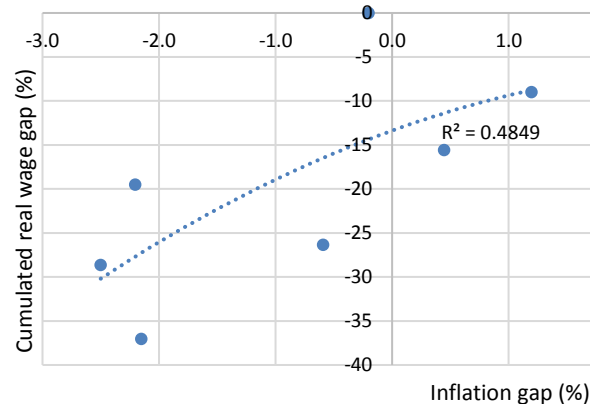
Note: Annual data; average wage; the starting year is the peak reference wage value in the past.
Source: OECD, author's calculations.

Chart 7. Post-crisis Phillips curve for core euro-area countries
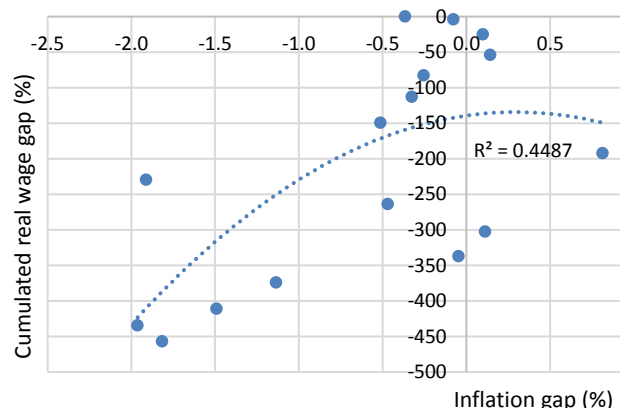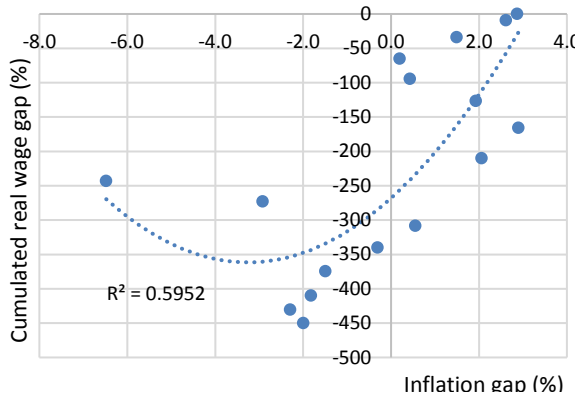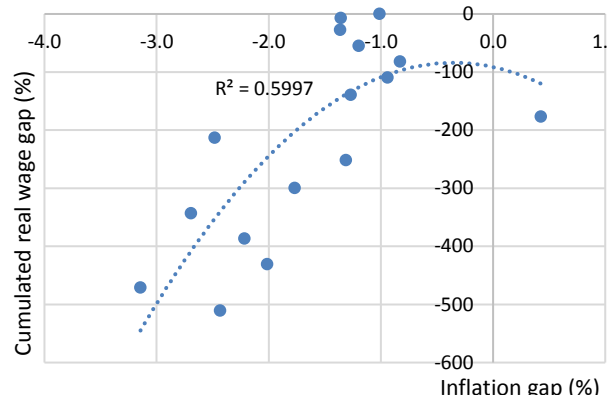
Germany (2001-2016)

France (2001-2016)
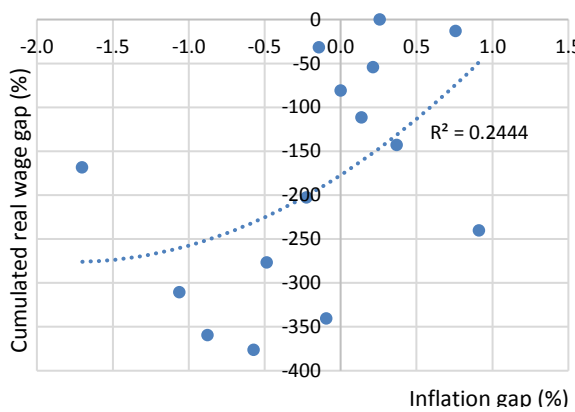
Chart 8. Post-crisis Phillips curve for other OECD countries
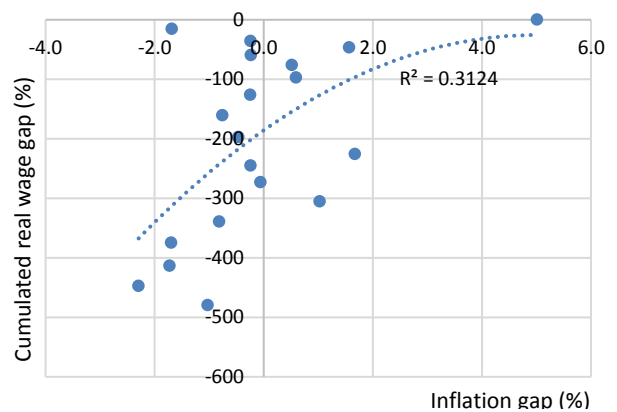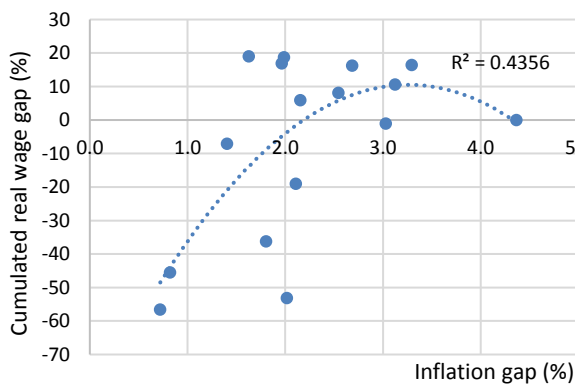
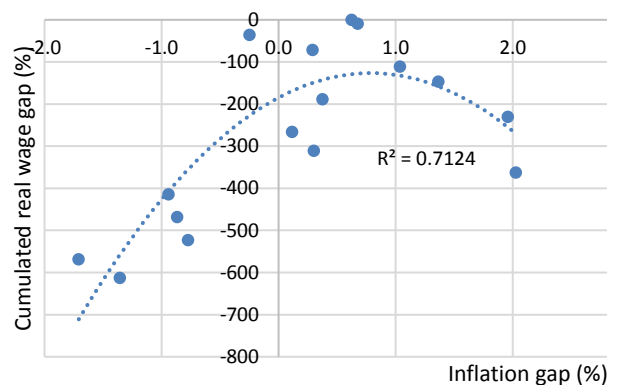### Ireland (2001-2016)

Switzerland (2001-2016)

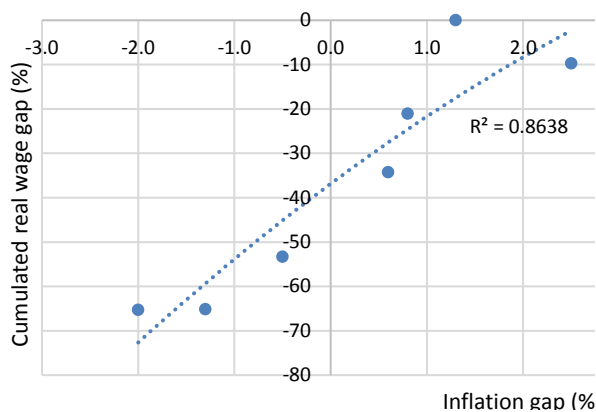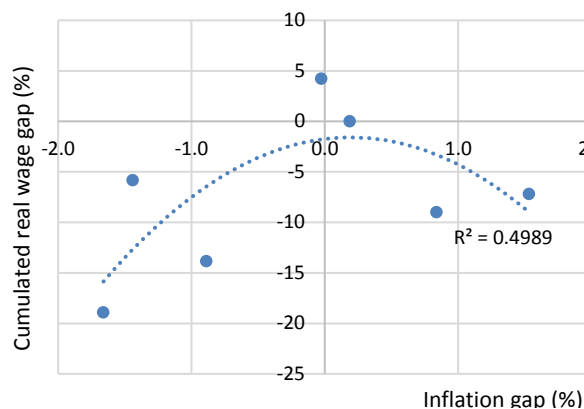### Canada (2002-2016)

Korea (1998-2016)

Mexico (2001-2016)

New Zealand (2001-2016)

UK (2010-2016)

Belgium (2010-2016)

Israel (2009-2016)
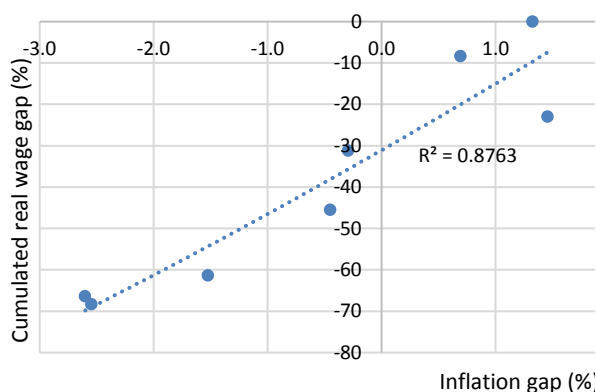
Sweden (2001-2016)
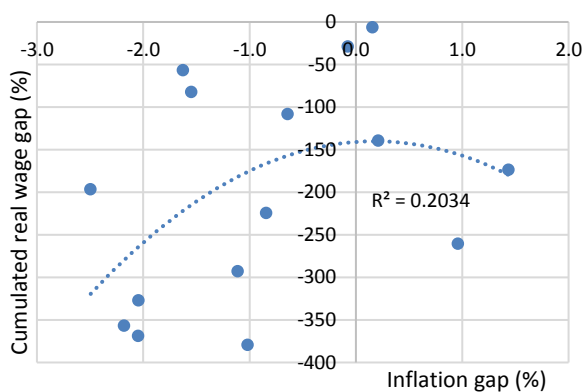
Note: Annual data; average wage; the starting year is the peak reference wage value in the past.
Source: OECD, author's calculations.

The theoretical model is confirmed: depending on the recession episode which we take as reference, the cumulated wage gap explains a significant part of the deviation of inflation from its target.

For wage adjustment episodes 15 years ago or more, the cumulated wage gap explains:

- between one-fifth and one-third of inflation gap for the US, Germany, Canada, Korea and Sweden;
- almost one-half of the inflation gap for France, Portugal, Spain and Mexico;
- around 60% of the inflation gap for Italy, Ireland and Switzerland; and
- more than 70% of the inflation gap for Greece, New Zealand.

For the most recent wage adjustment episode, the cumulated wage gap (which in most cases has not been closed yet) explains:

- almost half of the inflation gap in the US;
- almost half of the inflation gap in Italy, Spain and Belgium;
- two-thirds of the inflation gap in Portugal; and
- more than 80% of the inflation gap in Greece, Israel and UK.

Therefore, we were able to test and validate that cumulated wage gap matters for inflation. This holds true for US, UK, core and periphery euro-area countries and other OECD countries – at a level which varies, depending on the reference time and country-specific factors, but which is nonetheless significant in all cases. The subdued inflation is determined by the cumulated wage gap being still negative.

The predicted shape of the curve has also been confirmed.

5. Concluding remarks and policy implications

In this paper we introduce the concept of cumulated wage gap, meaning the cumulated gap between the current wage and a maximum reference wage value in the past. The permanent income hypothesis is fundamentally flawed in times of crisis, because of uncertainty of future income. The only certain reference value lies in the past, not in the future: and that is why the current consumption is influenced by the past income. A recession is a game-changer. In a crisis, the reference is not ahead of us, but it is rather in the past. Retirement savings and linear employment prospects are uncertain. People relate to their peak gains in the not so distant past rather than to their uncertain future gains.

We allow for the Philips curve to be non-stationary: it moves over time, and it is normal to do so. Reference wage values, social preferences, jobs' characteristics, skill endowments and even Central Banks' targets, they all change over time – hence, the impact of wage gaps on inflation cannot be the same in different time periods.

The finding of our model is that inflation depends on the cumulated wage gap: it does not increase close to or above its target level until the cumulated real wage gap is closed. We were able to empirically test and confirm our hypothesis for all OECD countries, including US, UK, core and periphery euro area.

For Philips curve to work, the loss of welfare from a negative cumulated real wage gap must be fully compensated first – as a stock measure, not as a flow. **The policy implication from our finding is that countries which closed their cumulated real wage gap should be much more prudent in further wage increases – because they will be seen in inflation much faster and larger than in the recent past. For countries which have not closed their cumulated real wage gap the implication is that inflation will remain subdued until they close their cumulated wage gap.**

Further work needs to be done to extend the model to a fully-fledged stock model, by introducing the cumulated inflation gap. This would be relevant for a proper calibration of inflation targeting, should the cumulated inflation gap be consistently negative or positive. However, the model we propose in this paper is very relevant for policy makers, as it helps

explain why inflation has been subdued since the last crisis. Our finding is that inflation has been subdued because the cumulated wage gap has not been closed yet. When this happens, inflation will re-emerge fast.

References

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