The post-crisis Phillips Curve and its policy implications

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Summary

- The post-crisis Phillips curve makes 3 fundamental changes to the wage Philips curve: it uses observable variables only; it changes the paradigm from flow to stock; and it allows the curve to be non-stationary.
- We introduce the concept of a **cumulative wage gap** meaning the cumulative gap between current wage and a peak reference wage value in the past. People relate to their peak gains in the past rather than to uncertain future gains. They judge their consumption decisions based on the relation between their current wages and their past wages, adjusted for inflation.
- The shape of the post-crisis Phillips Curve expresses the theoretical assumption that the inflation rate stays below its target until the cumulative real wage gap closes, and that it increases above its target when the cumulative real wage gap becomes positive.
- We test our hypothesis using data for 35 OECD countries for the period 1990-2017. We are able to confirm our hypothesis, as the coefficients have the expected sign and are statistically significant for the OECD panel as well as for most of the individual countries.
- Bottom-line, inflation depends on the cumulative wage gap: it does not increase close to or above its target level until the cumulative real wage gap is closed.
- For Phillips Curve to work, the loss of welfare from a negative cumulative real wage gap has to be fully compensated first as a stock measure, not as a flow.
- The policy implication from this finding is that, for those countries which have not closed their cumulative real wage gap (most of the developed economies), inflation will remain subdued until they close their cumulative wage gap.

Distinguished guests,

I would like to thank the organizers, Central Banking, for inviting me to speak about a very topical issue: subdued inflation.

Inflation has been subdued in the post-crisis years, and the Phillips Curve has failed to explain it. It is probably the greatest mystery of the economic science in the last decade: where has the Phillips Curve gone? There are multiple references to the fact that the Phillips Curve has flattened over the last decade, if not earlier (to mention just a few: Forder (2014), Leduc and Wilson (2017), Borio (2017), Carney (2017), Cunliffe (2017), Praet (2016, 2018), Spencer (2017), Murphy (2018), Bullard (2018)).

The flattened Phillips 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 labor 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.

I think that the Phillips Curve needs a reality-check. If we want to explain inflation, we need to make some adjustments to the Phillips curve. The following presentation is based on two working papers that I recently published with Center for European Policy Studies (CEPS)ⁱ, respectively and Global Labor Organization (GLO)ⁱⁱ.

Three major changes are needed to the Phillips curve.

First, we should 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. 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 (in particular, but not exclusively, in catching-up economies).

Any measure of unemployment is controversial, given 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 them 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 this 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 wage Phillips Curve where consumer prices inflation rate is explained by the difference between past wages and current wages.

Second, we should make a fundamental change of paradigm from flow to stock. To understand the consumers behavior, which in turn influences inflation, we introduce the concept of a cumulative wage gap – meaning the cumulative 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.

Third, we should allow for the Phillips 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 cumulative wage gaps on inflation cannot be the same in different time periods. In fact, even Phillips (1958) mentioned that he ignored years in which import prices rise rapidly enough to initiate a wage-price spiral. He stated that his hypothesis that the rate of change of money wage rates can be explained by the level of unemployment is supported except in or immediately after such years. In doing that, he effectively acknowledged the non-stationarity of his curve. He referred to those years as events that occur very rarely except as a result of a war. Our approach embraces these events, except that in modern times it is not war that makes the difference, but recessions; and recessions happen more often than wars. We try to explain what happens during and after recessions – which is exactly what is omitted by the original Phillips curve.

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' consumption function (1936), Modigliani's life-cycle hypothesis (1966) and

Friedman's permanent income hypothesis (1957)) 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 of income 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. A global financial crisis is a global 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 it 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 explained, everything is related to wage flows and to wage dynamics. We hold that we should account the stock as well, meaning the cumulative gap between current levels and past reference levels of income.

Cumulative wage gap is a better predictor of inflation than output gap because it is observable 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 in the mind of wage earners. We assume that people judge their consumption decisions based on the relation between their current wages and their past wages, adjusted for inflation.

The cumulative real wage gap, instead of nominal wage, is the explanatory variable in our new Phillips 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.

Please bear with me for a short presentation of the cumulative wage gap model (please see the attached slides).

We start by defining the wage gap:

$$W_{gap T_n} = W_{T_n} - W_{T_0}$$

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 peak value of real wage in the reference period.

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

$$\mathcal{E}W_{gap T_N} = \sum_{n=1}^{N} W_{gap T_n} = \sum_{n=1}^{N} (W_{T_n} - W_{T_0})$$

A theoretical graphical representation of the real wage and the cumulative real wage gap for a six-period model can be observed in the attached figures.

At time T_0 real wage is at peak. Of course, wage earners are not aware of this peak until the next year, when real wage drops.

Area A is the cumulative real wage gap between T_1 and T_0 , area B is the cumulative real wage gap between T_2 and T_1 , area C is the cumulative real wage gap between T_3 and T_2 , area D is the cumulative real wage gap between T_4 and T_3 , area E is the cumulative real wage gap between T_5 and T_4 and area F is the cumulative real wage gap between T_6 and T_5 .

At time T_1 , when real wage W_1 drops relative to the peak value W_0 , the cumulative real wage gap is the area A (equal to the real wage gap). At time T_2 , when real wage drops even further, the cumulative 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 peak value, the cumulative real wage gap further deepens (A+B+C). At time T_4 , when the real wage increases above the peak reference value, the cumulative real wage gap starts to shrink (A+B+C+D). The growth of real wage makes the cumulative 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 cumulative real wage gap for the above 6-period model is described in the chart. Therefore, equation (2) can be written as follows:

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

where A_n is the real wage gap between T_n and T_{n-1} , expressed as area.

If a new recession comes at T_7 (not shown in the figures), the new peak value for the real wage is the one recorded at T_6 .

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

$$\Pi_{gap T_n} = \Pi_{T_n} - \Pi_{T_n}^*$$

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 six-period model can be observed in the attached figure.

At time T_0 , at the peak value of real wage, 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 relationship is valid even when 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 cumulative 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 cumulative 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 .

The equation of the post-crisis Phillips Curve is written as follows:

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

By introducing the equations for inflation gap and cumulative real wage gap into relation (18), the post-crisis Phillips Curve becomes:

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

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.

At time T_0 , cumulative real wage gap is considered zero, while inflation gap is considered positive. This is one of the reasons why the curve does not cross exactly at the intersection of the two axes. The other reason relates to the dynamic (non-stationary) feature of the curve, expressing its different expected coefficients during different time periods.

The shape of the post-crisis Phillips Curve expresses the theoretical assumption that the inflation rate stays below its target until the cumulative real wage gap closes, and that it increases above its target when the cumulative real wage gap becomes positive.

The graphical representation assumes different slopes before and after closing the cumulative real wage gap. A sharper slope after closing the cumulative real wage gap means that the same amount of a cumulative real wage gap leads to less inflation as the cumulative gap is negative, and to more inflation as the cumulative gap turns positive. We will test separately these two assumptions: the shape of the curve and the break in the slopes.

In terms of methodology, the analysis covers the OECD countries over the period 1990-2017, except for the United States where the data covers the period 1989 – 2017. Data sources for wages and inflation are the OECD and the FRED databases (for US), annual data. The reason for this selection is the availability of long-time data series on wages at OECD (they are only available since 1990), while for US the FRED database allows us to start from a known peak year, which was 1989. We used the following date: the average annual wage in 2017 constant prices at 2017 USD PPPs, exchange rate (national currency units/US dollar) and inflation (CPI) – annual growth rate, from the OECD database, and the real median household income in the United States, 2017 CPI-U-RS adjusted dollars, from the FRED database. We transformed the average annual wage into local currency for ensuring comparability with the inflation rate, which reflects changes in local prices.

Data sources for the inflation target of central banks are from the respective central banks' websites. If a central bank targets a corridor rather than a level of the inflation rate, then the midpoint of the target band is considered.

The year T_0 is the peak year. We define a wage adjustment episode the adjustment in real wages that follows after the peak year. For each wage adjustment episode in a country, the data sample starts at year T_0 (the peak year) and it ends when a new peak is detected (at year $T_{0 new}$ – 1). We apply this only if the cumulative real wage gap has been closed before reaching the new peak. If the cumulative wage gap has not been closed, then we continue to consider the new peak as part of the same adjustment episode. A wage adjustment episode within a larger wage adjustment episode is not considered. This approach prevents data overlapping and it secures research consistency and integrity.

In the analysed period, there were three historical episodes of wage adjustments. Data shows that the cumulative real wage gap was closed in all countries which experienced the first wage adjustment episode, with the exception of two countries (Japan and Korea). In the case of the second wage adjustment episode, the cumulative real wage gap has not yet been closed, with the exception of other two countries (Mexico and Latvia). These latter two countries entered a new wage adjustment episode, the third one.

For simplicity reasons, the wage adjustment episodes are numbered with reference to the time periods and not to the country-specific episodes. We considered as the first wage adjustment episode any episode which started in the last decade of last century (1990-1999) and the second wage adjustment episode any episode which started after the year 2000. For example, Canada did not have a wage adjustment during the first historical period, but it experienced one during the second period. We refer to the latter as the second episode of wage adjustment in Canada.

Peak years are country-specific; hence they are not the same in all countries. This means that the first wage adjustment episode, including the peak years, may have lasted, for example, 7 years in Italy, 8 years in Germany and France, 9 years in US, 20 years in Korea or 28 years (and counting) in Japan.

Of the 35 countries analysed, 21 countries experienced the first historical episode of wage adjustments, 33 countries experienced the second historical episode of wage adjustments and only 2 countries experienced the third historical episode of wage adjustments.

This is why the total number of observations is much higher for the second wage adjustment episode, compared against the first wage adjustment episode. In the case of the third wage adjustment episode, the total number of observations is much lower.

And now we move to the juicy part. We present the graphical representation of our results for all OECD countries which experienced wage adjustments (21 countries for the first wage adjustment episode and 33 countries for the second wage adjustment episode).

The results are statistically significant and with the expected sign for the first two adjustment episodes. For the third adjustment episode, the sign of the relationship is as predicted, but the number of observations is too limited to have statistical significance.

The theoretical model is confirmed: the cumulative wage gap explains a significant part of the deviation of inflation from its target: more than one third of the inflation gap in the first wage adjustment episode and more than one fifth of it in the second adjustment episode (which has not been closed yet). We also present graphical representations for selected countries which have statistically significant coefficients.

For the first wage adjustment episode the cumulative wage gap explains more than 60% of the inflation gap in Iceland, about two thirds of the inflation gap in the US and Ireland, more than half the inflation gap in Finland and Switzerland, close to half of the inflation gap in Netherlands. It even explains almost one quarter of the inflation gap in Korea, despite the fact that this country has not closed the first wage adjustment episode yet.

For the second wage adjustment episode, the cumulative wage gap, which in most cases has not been closed yet, explains more than 60% of the inflation gap in Slovenia and Slovak Republic, between 40% and 60% of the inflation gap in Greece, Italy, Portugal, and Spain, and between 20% and 40% of the inflation gap in Australia, Canada, Denmark, France, Hungary, Ireland, Netherlands, New Zeeland, Switzerland and United States.

We checked the robustness of our results separately, in the standard method, as well as the log-normalized method.

The results confirm the strong relation between cumulative real wage gap and inflation gap in the OECD countries. Cumulative real wage gap explains a large share of the inflation gap, in particular in the countries which experienced severe economic recessions and subsequent material wage adjustments.

When aggregated for all OECD countries, having a large number of observations (197 for the first wage adjustment and 525 for the second one), the estimated slopes of the postcrisis Phillips Curve are statistically significant at the 5% level, in case of the first wage adjustment episode, and at the 1% level, in case of the second wage adjustment episode. The coefficients' sign is positive, in line with the theoretical assumptions. The individual results also confirm the strong and positive relation between cumulative real wage gap and inflation gap. In the case of the first wage adjustment episode, out of 21 countries, 8 of them have positive and statistically significant coefficients; other 7 countries have positive but not statistically significant coefficients. While the remaining 6 countries have negative but not statistically significant coefficients. In the case of the second wage adjustment episode, out of 33 countries, 16 of them have positive and statistically significant coefficients; other 9 countries have positive but not statistically significant coefficients, while the remaining 8 countries have negative coefficients, out of which only 2 are statistically significant. Regarding the third wage adjustment episode, out of 2 countries, one has positive and statistically significant slopes and one has positive but not statistically significant slopes.

The minority negative or not statistically significant coefficients could be attributed to the low number of observations, as well as to various specific factors that temporarily interrupted the positive and strong relation between cumulative real wage gap and inflation gap.

The estimated coefficients of cumulative real wage gap using the log-normalized data point to robust results and are more meaningful for policy makers. Results show that an increase/decrease of cumulative real wage gap by 10% led inflation gap to rise/deepen by 0.561% during the first wage adjustment episode, by 0.846% during the second wage adjustment episode and by 0.454% during the third wage adjustment episode.

We deepen the robustness check analysis and test if the inflation gap accelerates after the cumulative real wage gap closes. In that respect, we estimated the slope of the post-crisis Phillips Curve before and after the cumulative real wage gap was closed. The results in the standard method, as well as the log-normalized method are presented attached.

The log-normalized results show that a fall of the cumulative real wage gap by 10% corresponds to a decline of the inflation gap by 0.9%. On the other hand, a 10% increase of the cumulative real wage gap after closes leads to an increased inflation gap by 2.2%.

This confirms the theoretical prediction that there a break in the slope of the curve, as the coefficients are higher after the cumulative wage gap closes than before this happens.

Bottom-line, inflation depends on the cumulative wage gap: it does not increase close to or above its target level until the cumulative real wage gap is closed. For Phillips Curve to work, the loss of welfare from a negative cumulative real wage gap has to be fully compensated first – as a stock measure, not as a flow. The policy implication from our finding is that countries which closed their cumulative 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 cumulative real wage gap the implication is that inflation will remain subdued until they close their cumulative wage gap.

Monetary policy cannot work in isolation. Its efficiency is influenced by the fiscal policy, by the wage policy in both the public and the private sector. Monetary policy is not a new-born. It matters that we did not only last summer, but quite some time ago.

My two daughters, now 10 and 6 years of age, are still fascinated by the Disney's animation "Frozen". In that movie, Princess Elsa convincingly sings that "Past is in the past". However, fairytales do not apply in real life. **The past still influences our current consumption choices, and therefore inflation and monetary policy decisions.**

Moreover, monetary policy is less effective if it is done from an ivory tower. Theoretical models, as captivating intellectual efforts as they are, need a reality check from time to time. The signs are here for us all to see. In another fascinating Disney movie, "Tangled", princess Rapunzel follow the signs she spots in the sky to beat its fears and escape from its ivory tower. I think we should do the same. **Outside central banks, the greatest danger is populism.** The fact that in so many developed countries the cumulated wage gap has not been closed not only subdues inflation, but it also fuels dissatisfaction of voters giving rise to populism. Inside central banks, the greatest danger is dogmatism. We need to fight both with common sense, with more data-dependent policies, and with a deeper understanding of the factors influencing consumer choices and society as a whole.

Real wage and real wage gap



Attached figures

ⁱ Voinea, Liviu, 2018, *Explaining the post-crisis Philips curve: Cumulated wage matters for inflation*, No. 2018/05, June 2018, CEPS Working Document

ⁱⁱ Voinea, Liviu, 2019, *The Post-Crisis Phillips Curve: A New Empirical Relationship between Wage and Inflation*, GLO Discussion paper Series 303



Cumulative real wage gap



Inflation gap

Source: Voinea, 2019





Post-crisis Phillips Curve, 21 OECD countries, 1st wage adjustment









Source: Voinea, 2019

| Country | | No. of | | R- | | |
|-----------------------|------------------------------------|--------------|-------------|---------|--|--|
| | Period | observations | Coefficient | squared | | |
| All OECD countries | 1 st wage adjustment | 197 | 0.0028** | 0.362 | | |
| | 2 nd wage adjustment | 525 | 0.0045*** | 0.255 | | |
| | 3 rd wage adjustment | 18 | 0.0099 | 0.477 | | |

Panel estimation with country fixed effects, standard method

Source: Voinea, 2019

Panel estimation with country fixed effects, log-normalized

| Country | | | | |
|--------------------|------------------------------------|--------------|-------------|---------|
| | | No. of | | R- |
| | Period | observations | Coefficient | squared |
| All OECD countries | 1 st wage adjustment | 197 | 0.0561** | 0.217 |
| | 2 nd wage adjustment | 525 | 0.0846*** | 0.265 |
| | 3 rd wage adjustment | 18 | 0.0454 | 0.126 |