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Combining the Beveridge and the Phillips Curve into an Integrative Model: The Modified Output Gap

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Abstract: We present a new theoretical concept: *modified output gap* (MOG), based on the Phillips and on the Beveridge curve. Both of these pillars are derived analytically and combined with each other, revealing the explicit positive relationship between the vacancy ratio and the inflation rate. It is shown how a deterioration in the matching process on the labor market leads to shifts in both curves, but also in the MOG. This indicates that a loss in the efficiency of matching in the labor market, when combined with an increase of the demand in the markets for goods will push up inflation. As a result, a sort of second "policy ineffectiveness lemma" emerges: at high levels of mismatch, expansive measures of monetary and/or fiscal policies will lead to higher inflation in the first place with little (positive) repercussions on the real side of the economy.

Keywords: Mismatch, Modified output gap, Macroeconomic policy, Unemployment, Inflation

JEL Classifications: J64, E31, E60

1. Introduction

The Beveridge curve and the Phillips curve are the two of the theoretical tools commonly used by economists during last century for understanding the unbalances of the labor market. In this paper, we combine both the theoretical concepts to bring about the relationship herein referred to as modified output gap (MOG) (Sell and Reinisch (2013)). This combination will allow us to explain the positive relationship between inflation and the level of job vacancies. The logic is the following. On the one hand, when the job market becomes tight and the number of vacancies rises, unemployment decreases following the so-called Beveridge curve.

On the other hand, when the unemployment decreases and demand condition becomes tight, price level increases following the so-called Phillips curve. As a result, we must see a positive relationship between vacancies and inflation in the general equilibrium.

It is important to distinguish movements along the MOG and shifts of such relationship. The idea of a shift of this relationship is quite simple: deterioration in the matching efficiency of the labor market will tend to push any existing Beveridge curve outwards. At the same time, such a structural change will also affect the long-run level of inflation. Rational agents will anticipate this and revise their inflation expectations upwards with the effect that short-run Phillips curves shift to the right. As a consequence of both shifts, the MOG will shift also upwards leading to higher inflation, ceteris paribus. In addition, the theoretical combination of Beveridge and Phillips curve

into the analytical framework of the MOG will allow us to understand better another ineffectiveness of the macroeconomic policy when there is a negative shock, which affects the efficiency of adjustment in the labor market, also known as mismatch (Petrongolo and Pissarides (2001)).

2. The Beveridge Curve following Landmann and Jerger (1999: 53-58)

The Beveridge curve, after its coining, has been used continuously by well-known economists to address the theoretical underpinning and the empirical relevance. The concept of the Beveridge curve is based on a presumed existence of a general mediation function on the labor market (Cahuc and Zylberberg (2004)). It is assumed that there is a positive relationship between the likelihood of a job to be filled and the number of current vacant positions in firms. The probability that an unemployed person will re-enter the formal labor market again after one period of unemployment (η), is approximated by the following mediation function:

$$\eta = g(\theta) \tag{1}$$

In which:

$$\theta = \frac{V}{U}; \text{ and } U = \frac{V}{\theta}$$

In equation (1), the variable V denotes the number of unfilled job vacancies in the market and U the size of unemployment. The function $g(\theta)$ is characterized by decreasing marginal returns:

$$g'(\theta) > 0, g''(\theta) < 0$$

In the following, we will make use of a rather simple mediation function which has the required properties (Landmann and Jerger (1999: 54–58)[1]:

$$\eta = \eta_0 \theta^{0.5} \tag{2}$$

Taking the existing flow variables on the labor market into account, we can define the change in the number of the employed persons as the difference between the quantity of the former unemployed persons who found a new job in the same period (ηU), on the one hand, and the number of those individuals who lost their job in the corresponding period (sA), on the other hand. The product sA is equal to the probability to lose one's actual job (s) times the number of employed people (A). Therefore, the change of employment within a period t denotes (Albek and Hansen (2004)):

$$\Delta A_t = \eta U - sA \tag{3}$$

Inserting (2) into (3) gives:

[1] As an alternative, one may use directly a more sophisticated matching function, which, however, leads to the same convex Beveridge curvature (compare Blanchard and Diamond (1989a), De Francesco (1999), Wall and Zoega (2002), Ruesga et al. (2015). Note that 0.5 for the elasticity of the matching function with respect to labor market tightness is a standard parameter in models calibrated to labor markets of industrialized countries. An alternative approach would be to solve the equations (1) through (6) numerically for different values of this elasticity and show how the results of the model change.

$$\Delta A_t = \eta U - sA = \eta_0 V^{0.5} U^{-0.5} U - sA = \eta_0 (VU)^{0.5} - sA \tag{4}$$

In the case of flow equilibrium ($\Delta A_t = 0$), it is possible to calculate the equilibrium size of unemployment:

$$\Delta A_t = 0 \rightarrow sA = \eta_0 (VU)^{0.5} \tag{5}$$

This equation leads us directly to the Beveridge curve [2].

$$v = \left(\frac{s}{\eta_0}\right)^2 \left[\frac{1}{u} - 2 + u\right] \tag{6}$$

where v and u are the vacancy and unemployment rate, respectively. Ceteris paribus, changes in $\left(\frac{s}{\eta_0}\right)^2$ induces the shift of the curve meaning that unemployment (vacancies) changes for a given vacancy rate (unemployment rate). The curvature of this function can be easily accessed by taking the first and second derivatives of v with respect to u. The first derivative leads to:

$$\frac{\partial v}{\partial u} = \left(\frac{s}{\eta_0}\right)^2 \left[-\frac{1}{u^2} + 1\right] < 0, \text{ for } u < 1 \tag{7}$$

As the unemployment rate is only defined for values between 0 and 1, the first derivative $\frac{\partial v}{\partial u}$ is always less than 0, i.e., the function establishes a negative relationship between both the variables[3]. Notice that $\left(\frac{s}{\eta_0}\right)^2$ not only affects the shift, but also the trade-off between vacancy and employment. Other things being equal, any increase in $\left(\frac{s}{\eta_0}\right)^2$ will make the Beveridge curve steeper. The second derivative discloses how skewed the function is:

$$\frac{\partial^2 v}{\partial u^2} = \left(\frac{s}{\eta_0}\right)^2 \left[-\frac{-2}{u^3}\right] > 0 \tag{8}$$

As s, η and u always exceed 0, the second derivative, according to equation (8), will always be positive. Hence the implied Beveridge curve describes a negative convex relationship between the unemployment rate (u) and the vacancy rate (v). From equation (6), we can see that the term $\left(\frac{s}{\eta_0}\right)$ seems to be decisive for the position of any Beveridge curve. A simple procedure to analyze the impact of this term is to set: $u = v$, which is equivalent to consider all points of the different Beveridge curves located on the 45 degree line. This leads us to:

[2] Notice that, as an alternative, one may first specify a matching function with constant returns to scale, define equilibrium, where the number of separations equals the number of matches, assuming a fixed separation rate and intercept to achieve a negative relationship between the unemployment and the vacancy rate (Wall and Zoega 2002: 259).

[3] The negative relationship between vacancy and unemployment rate is a consequence of the evolution of business cycle and expectancies of economic growth and employment creation by firms. Thus, in the period of economic slowdown, the firms have a negative expectation of the future profitability of a new vacancy, so they post less vacancies in the labor market and, because of that, the level of unemployment grows. And so on in a period of economic expansion (Pissarides (2011)). Therefore, the evolution of the business cycle shifts the equilibrium within the Beveridge curve, leading to a different combination of unemployment and vacancies.

$$v = \left(\frac{s}{\eta_0}\right)^2 \left[\frac{(1-v)^2}{v}\right] \tag{9}$$

So

$$v = \left(\frac{s}{\eta_0}\right)(1-v) \tag{10}$$

If we solve equation (10) now for the variable v, we get a new equation which enables us to determine the factors responsible for such points on the Beveridge curve, which, at the same time, belong to the 45 degree line:

$$v = \frac{\frac{s}{\eta_0}}{1+\frac{s}{\eta_0}} \tag{11}$$

From the interpretation of equation (11), it seems to be quite easy to assess the most likely consequences that the structural policies, on the labor market, will have on the position of the Beveridge curve. Any proposal/policy instrument, which either tends to increase the probability to be fired (s) and/or to reduces the efficiency of the matching process (η_0), lowers the efficiency of mediation in the labor market, and, at the same time, increases the relevant values of u and v, ceteris paribus.

3. The Phillips Curve following Blanchard (2006: 165-173)

Henceforth, we follow a well-known textbook version of developing the classical (as opposed to a New-Keynesian style) Phillips curve (Blanchard (2006: 165ff.)). According to this author, the overall nominal wage rate (W) is given by:

$$W = P^e F(u^-, z^+) \tag{12}$$

The impact of the independent variables on the wage rate is:

- W will be the higher, the grater the expected price level P^e is;
- W will be the higher, the lower the unemployment rate u is;
- W will be the higher, the larger the value of z, where z assembles all those further variables which will be explained later (see below).

Aggregate price setting behavior of firms is given by the following equation:

$$P = (1+\mu)\frac{W}{a};\ (a = MPL = 1) \tag{13}$$

Where μ stands for the mark-up vis-a-vis to marginal wage costs; the higher the market power of the firms involved, the more the price charged to consumers will deviate upwards from the wage rate. Inserting equation (12) into (13) allows us, by eliminating the wage rate W, to define:

$$P = P^e(1+\mu)F(u^-, z^+) \tag{14}$$

Assuming a simple, but still specific form of the function F, one may state:

$$F(u,z) = 1 - \alpha u + z \tag{15}$$

Notice that α is a reaction parameter which indicates to what extent the nominal wage rate changes in response to an alteration of the unemployment rate. In contrast, z, is a sort of "catch-all variable" which exerts a positive impact on the wage rate demanded by unions. Introducing expression (15) into equation (14) yields:

$$P = P^e(1+\mu)(1-\alpha u + z) \tag{16}$$

The overall price level prevailing in the economy is, thus, the higher, the higher the existing price expectations, the more pronounced market power of the relevant firms and the more significant the determinants of the catch-all variable z. It will be, on the contrary, the lower, the higher the existing unemployment rate and the greater the elasticity of the wage rate with regard to the rate of unemployment. Taking equation (16) as a point of departure, one may derive in a few steps a modified Phillips curve. In the first place, we introduce a time index t and, in the second place, we divide both sides of equation (16) by the price level of the previous period:

$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}}(1+\mu)(1-\alpha u_t + z) \quad |: P_{t-1} \tag{17}$$

The L. h. s. of this equation may be transformed to become:

$$\frac{P_t}{P_{t-1}} = \frac{P_t - P_{t-1} + P_{t-1}}{P_{t-1}} = \frac{P_t - P_{t-1}}{P_{t-1}} + 1 = \pi_t + 1 \tag{18}$$

By analogy, the first term on the R. h. s of (17) may be transformed accordingly. Hence, we achieve:

$$\pi_t + 1 = (1+\pi_t^e)(1+\mu)(1-\alpha u_t + z) \tag{19}$$

We now divide both sides of (19) by the expression $(1+\pi_t^e)(1+\mu)$, so we get:

$$\frac{(\pi_t + 1)}{(1+\pi_t^e)(1+\mu)} = (1-\alpha u_t + z) \tag{20}$$

This formulation may now be simplified when one makes use of some approximation rules:

$$(1+x)(1+y) \approx (1+x+y) \tag{21}$$

And

$$\frac{(1+x)}{(1+y)} \approx (1+x-y) \tag{22}$$

It follows from (21):

$$(1+\pi^e)(1+\mu) \approx (1+\pi^e+\mu) \tag{23}$$

and

$$\frac{(1+\pi)}{(1+\pi^e+\mu)} \triangleq \frac{(1+x)}{(1+y)} \tag{24}$$

where

$$y = \pi^e + \mu \tag{25}$$

and because of (22)

$$\frac{(1+x)}{(1+y)} \triangleq 1 + x - y = 1 + \pi - \pi^e - \mu \tag{26}$$

we may write:

$$\frac{(1+\pi)}{(1+\pi^e+\mu)} = 1 + \pi - \pi^e - \mu \tag{27}$$

Equation (19) hence becomes:

$$\pi_t + 1 - \pi_t^e - \mu = 1 - \alpha u_t + z \tag{28}$$

or

$$\pi_t = \pi_t^e + (\mu + z) - \alpha u_t \tag{29}$$

Equation (29) looks very much like any other modified Phillips curve. Whenever actual and expected inflation rates correspond to each other ($\pi_t = \pi_t^e$), the natural rate of unemployment is easy to calculate:

$$u_n = \frac{\mu + z}{\alpha} \tag{30}$$

The natural rate of unemployment is hence the higher (lower), the higher (lower) the mark-up factor μ and the catch-all variable z und the smaller (greater) the elasticity of the wage rate vis-a-vis to the unemployment rate, α. What kind of economic forces drive the catch-all variable z? At least one can think of the following three determinants:

(i) The well-known distortionary effects of the income tax on the allocation of labor: Under the prevailing conditions, workers will only supply the same amount of labor hours at correspondingly higher nominal wages.

(ii) We have to consider additional distortionary effects of social policy: social transfers create a sort of minimum income which has the same effects as a higher reservation wage rate. The latter, as is well known, lowers the incentives to engage in the labor market.

(iii) There are additional distortionary effects on labor supply stemming from the impact of (subjective plus objective) mobility barriers: These barriers tend to incentive workers to demand clearly higher wages to overcome space and the disadvantages of such mobility barriers.

4. The Analytical Derivation of the Modified Output Gap (MOG)

We intend to show in the following section that the Beveridge curve can be combined with the new Phillips curve. This idea is based on Blanchard and Diamond (1989b: 51): "the model suggests an integrated way of thinking about the Phillips curve and the Beveridge curve together". The result of this combination is a new economic function with a positive relationship between the vacancy ratio on one hand and the inflation rate on the other[4]:

$$\pi_t = f(v_t); \frac{\partial \pi_t}{\partial v_t} > 0 \tag{31}$$

Rearranging the Beveridge curve in equation (6):

$$v = \left(\frac{s}{\eta_0}\right)^2 \left[\frac{1}{u} - 2 + u\right] \tag{6}$$

$$v = \left(\frac{s}{\eta_0}\right)^2 \left[\frac{1 - 2u + u^2}{u}\right] \tag{32}$$

$$v = \left(\frac{s}{\eta_0}\right)^2 \frac{(1-u)^2}{u} \tag{33}$$

gives us an expression which is in fact a quadratic term. Such a term usually has two solutions:

$$uv = \left(\frac{s}{\eta_0}\right)^2 (1-u)^2 \tag{34}$$

$$uv = \left(\frac{s}{\eta_0}\right)^2 (1 - 2u + u^2) \tag{35}$$

$$uv = \left(\frac{s}{\eta_0}\right)^2 - 2u\left(\frac{s}{\eta_0}\right)^2 + u^2\left(\frac{s}{\eta_0}\right)^2 \tag{36}$$

$$\left(\frac{s}{\eta_0}\right)^2 - 2u\left(\frac{s}{\eta_0}\right)^2 + u^2\left(\frac{s}{\eta_0}\right)^2 - uv = 0 \tag{37}$$

$$\left(\frac{s}{\eta_0}\right)^2 + u^2\left(\frac{s}{\eta_0}\right)^2 - \left(2\left(\frac{s}{\eta_0}\right)^2 + v\right)u = 0 \tag{38}$$

[4] Notice that a relationship between inflation and the vacancy ratio exists implicitly in any Diamond-Pissarides-Mortensen (DMP) random research model with sticky prices (e.g. Blanchard and Gali (2010); Ravenna and Walsh (2011)). Contrary to these authors our aim is to find an explicit relationship which we call MOG.

$$u_{1,2} = \frac{2\left(\frac{s}{\eta_0}\right)^2 + v \pm \sqrt{\left(2\left(\frac{s}{\eta_0}\right)^2 + v\right)^2 - 4\left(\frac{s}{\eta_0}\right)^4}}{2\left(\frac{s}{\eta_0}\right)^2} \tag{39}$$

$$u_1 = 1 + \frac{v}{2\left(\frac{s}{\eta_0}\right)^2} + \frac{\sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}}{2\left(\frac{s}{\eta_0}\right)^2} \tag{40}$$

$$\frac{\partial u_1}{\partial v} = \frac{1}{2\left(\frac{s}{\eta_0}\right)^2} + \frac{\frac{1}{2}\left(4\left(\frac{s}{\eta_0}\right)^2 + 2v\right)}{4\left(\frac{s}{\eta_0}\right)^2 \sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}} = \frac{1}{2\left(\frac{s}{\eta_0}\right)^2} + \frac{2\left(\frac{s}{\eta_0}\right)^2 + v}{4\left(\frac{s}{\eta_0}\right)^2 \sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}} > 0 \tag{41}$$

This first solution is mathematically correct, but lacks economic meaning because $u_1 > 1$ is beyond the range of permitted values for the unemployment rate. The second solution reads:

$$u_2 = 1 + \frac{v}{2\left(\frac{s}{\eta_0}\right)^2} - \frac{\sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}}{2\left(\frac{s}{\eta_0}\right)^2} \tag{42}$$

$$\frac{\partial u_2}{\partial v} = \frac{1}{2\left(\frac{s}{\eta_0}\right)^2} - \frac{\frac{1}{2}\left(4\left(\frac{s}{\eta_0}\right)^2 + 2v\right)}{4\left(\frac{s}{\eta_0}\right)^2 \sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}} = \frac{1}{2\left(\frac{s}{\eta_0}\right)^2} - \frac{2\left(\frac{s}{\eta_0}\right)^2 + v}{4\left(\frac{s}{\eta_0}\right)^2 \sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}} < 0 \tag{43}$$

This solution is both mathematically correct and economically meaningful, now that the unemployment rate is in the range of plausible values between 0 and 1. The explicit form of the MOG curve can now be gained by introducing the solution u_2 into the Phillips curve as given by equation (29):

$$\pi_t = \pi_t^e + (\mu + z) - \alpha\left[\left(1 + \frac{v}{2\left(\frac{s}{\eta_0}\right)^2} - \frac{\sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}}{2\left(\frac{s}{\eta_0}\right)^2}\right)\right] \tag{44}$$

$$\frac{\partial \pi_t}{\partial v} = \frac{-\alpha}{2\left(\frac{s}{\eta_0}\right)^2} + \frac{\alpha\left(2\left(\frac{s}{\eta_0}\right)^2 + v\right)}{4\left(\frac{s}{\eta_0}\right)^2\sqrt{4\left(\frac{s}{\eta_0}\right)^2 v + v^2}} > 0 \text{ [5]} \tag{45}$$

This function is, hereinafter, referred to as the modified output gap (MOG), as opposed to the classical output gap (Burda and Wyplosz (1997: 337)). Its economic intuition is related to the mismatch in the labor market; whenever the profiles of labor demand and labor supply differ significantly, an economic upswing (and a concomitant drop in the number of unemployed) will limit the rise in the production to a level lower than the hypothetical output available when mismatch is absent. The reason for this is the inability of the firms to fill the vacant posts on time. If the rise in production lags behind the rise in total demand, a higher inflation rate can be expected on the markets for goods and services. Leaving aside, for a moment, the direct costs of posting and "conserving" vacant posts in the firms, a significant vacancy ratio reflects specific higher costs: if there is an increase in the total demand for goods, and the labor market cannot deliver enough additional qualified working force, three effects can be observed: Firstly, firms will compete for scarce qualified labor force, which will give the latter a sort of "market power" and will lead to higher wages. Secondly, firms will invite their actual employees to work for additional hours. This would not be for free. Thirdly, firms might have to try to increase the capital intensity of production. In doing so, they will often face higher interest rates. All of these three "channels" will lead to higher costs.

5. A Graphical Interpretation of the Modified Output Gap (MOG)

In this section, we present a graphical analysis of the model (see Figure 1). The first quadrant (I) of Figure 1 depicts a convex Beveridge curve (BC) as equations (7) and (8) postulate. This curve will be shifted outwards (from BC^0 to BC^1) if either the probability to be fired (s) increases and/or the scale efficiency parameter of the matching function (η_0) decreases.[6] Both the effects tend to lower the efficiency of mediation on the labor market, and, at the same time, increase the relevant values of the unemployment and vacancy rate, ceteris paribus. Thus, the equilibrium in the labor market goes from point a to point b.

In the second quadrant (II), we find two convex Phillips curves (PC^0, PC^1) based on equation (29) and their respective long run Phillips curves (from PCL^0 to PCL^1). The lower efficiency of mediation in labor market automatically produces an outward shift of PC (to PC^1), in a short and long run both (to PCL^1)[7], increasing the level of natural unemployment rate. In this regard, the new

[5] For plausible values of the implied parameters, this inequality will always hold.

[6] The likelihood of getting a job is the ratio η/u.

[7] The idea is simple: rational agents will anticipate the change in the long-run level of inflation caused by a higher separation rate (s) or a lower matching efficiency (η_0). Therefore, they will revise their inflation expectations upwards. In order to keep the algebra simple, we have renounced on endogenizing inflation expectations accordingly.

equilibrium in the Phillips curve quadrant leads to a higher combination of unemployment and inflation[8] (see point d).

With the set of the vacancy ratios, unemployment rates and inflation rates are determined jointly by the Beveridge and the Phillips curve. The fourth quadrant (IV) shows the different combinations of vacancy ratios and inflation rates implied. This new function with a positive slope is labeled as the MOG. Both the shifts experienced in the Beveridge and in Phillips curves produce an outward shift of MOG (from MOG^0 to MOG^1), which leads to a new combination of inflation and vacancy rate (stating the new equilibrium in point f). Notice that policy shocks can induce both the shift and slope change simultaneously (see above). In order not to complicate too much Figure 1, we stick here to the shift effect alone.

All in all, when economic shocks occur, the combination of the Beveridge and Phillips curve indicates that a lower efficiency in the mismatch will worsen the macroeconomic performance leading to even higher level of inflation.

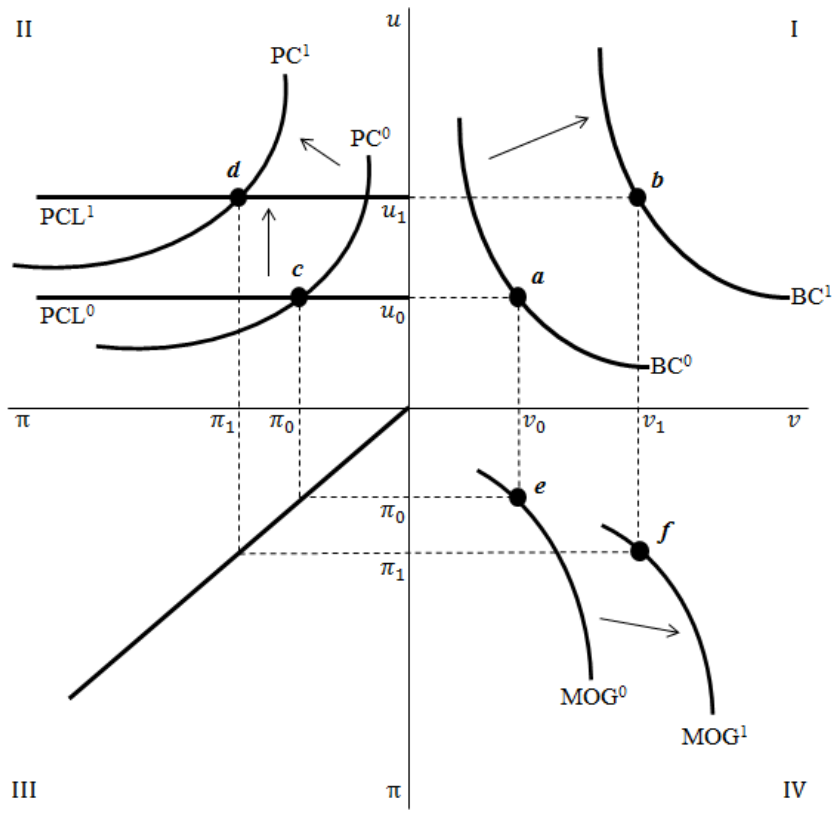

Figure 1 The Beveridge, the Phillips curve and the Modified Output Gap

***Source*:** Self-elaborated.

In this regard, any positive shock to the economy that would increase the aggregate demand combined with the existence of lower efficiency in the mismatch will cause an increase in the level

[8] Given certain values of the inflation rate along the Phillips curve in the second quadrant, the third quadrant (III) contains a line from the origin with an angle of 45 degrees which enables us to translate the corresponding inflation rates into the fourth quadrant.

of prices, because the firms cannot hire (qualified and less qualified, since there is no heterogeneity in terms of workers' skill and no explicit bargaining process in the MOG model) workers to increase their production level and will have to use their labor factor intensively, which will eventually increase the production costs.

6. Policy Implications

In conclusion, this analysis emphasizes the need to simultaneously combine fiscal economic stimulus policies and structural reforms, in order to expand the aggregate demand and adapt the economy to a new economic model. According to the President of the Federal Reserve Bank of Philadelphia, Charles Plosser (O'Grady (2011)), "you can't change the carpenter into a nurse easily, and you can't change the mortgage broker into a computer expert in a manufacturing plant very easily. Eventually that stuff will work itself out. People will be retrained and they'll find jobs in other industries. But monetary (and fiscal) policy can't retrain people. Monetary (and fiscal) policy can't fix those problems". Thus, combining demand and supply side policies, will increase effectiveness and efficiency of both. Each of these policies alone can easily fail: improving the mediation in the labor market when a lack in total demand is the key reason for a crisis can hardly overcome unemployment. As far as demand policies are concerned, a second "policy ineffectiveness lemma" emerges: at high levels of mismatch, expansive measures of monetary and/or fiscal policies will lead to higher inflation in the first place with little (positive) repercussions on the real side of the economy.

7. Summary of Findings and Conclusion

The concept presented herein may perhaps be innovative for the following reasons:

(i) While it is true that the Beveridge curve relates the vacancy ratio to the ratio of unemployment, whereas the Phillips curve, in turn, relates the rate of unemployment to the rate of inflation. A simple economic logic suggests that, given these two pillars, another direct relationship between the vacancy ratio and the rate of inflation should exist. The same argument applies in principle to the widely accepted AD curve (AD = aggregate demand), which in fact is derived by simply combining the IS and the LM curve following the tradition of John R. Hicks and Alvin Hansen. The influence of this curve is so convincing that none would question the merits of the AD curve and think to renounce it within the discipline of macroeconomics.

(ii) Secondly, the MOG curve raises explicitly a point treated only implicitly in the recent literature (see Ravenna and Walsh (2011) [9]; Blanchard and Gali (2010); Ravenna and Walsh (2011)).[10] It

[9] "If vacancies could be posted free of charge, firms only need to pay workers a wage equal to worker's outside opportunity (Ravenna and Walsh (2011: 8)) ... Thus the marginal cost faced by retail firms would remain constant, as would inflation" (Ravenna and Walsh (2007: 15)). Obviously, this is not the case and firms have to face higher marginal costs alongside an increase of the number of vacant jobs. This in turn, will raise the supply price of goods, ceteris paribus, and hence will create a positive rate of inflation.

[10] Note that this is done here without going back to random search models and/or to the assumption of sticky prices.

points at the supply restrain and hence results in inflationary effect of the mismatch in the labor market.

(iii) Thirdly, contrary to the derivation of the AD curve, it is not trivial to identify the "correct" MOG curve.

(iv) First empirical estimates of the MOG curve (Sell and Reinisch (2013: 199–200)), using data for countries of the Eurozone during the economic turmoil between 2007 and 2010 revealed significant coefficients with the correct sign.

(v) Therefore, we suggest that the MOG concept could be a theoretical framework for further research on this field.

References

[1] Albek, K. and Hansen, H. (2004). "The Rise in Danish Unemployment: Reallocation or Mismatch?", *Oxford Bulletin of Economic and Statistics*, 66(4): 515–536.

[2] Blanchard, O., and Diamond, P. (1989a). "The Aggregate Matching Function", *NBER Working Paper* No. 3175.

[3] Blanchard, O., and Diamond, P. (1989b). "The Beveridge Curve", *Economic Activity*, 1(1): 1–76.

[4] Blanchard, O. (2006). *Macroeconomics*. 4th ed. New Jersey: Pearson Prentice Hall Upper Saddle River.

[5] Blanchard, O., and Galí, J. (2010). "Labor Markets and Monetary Policy: A New Keynesian Model with Unemployment", *American Economic Journal: Macroeconomics*, 2(2): 1-30.

[6] Burda, M., and Wyplosz, C. (1997). *Macroeconomics. A European Text*. 2nd ed. Oxford: Oxford University Press.

[7] Cahuc, P., and Zylberberg, A. (2004), *Labor Economics*. Cambridge, Massachusetts: The MIT Press.

[8] De Francesco, A. (1999). "The Relationship between unemployment and vacancies in Australia", *Applied Economics*, 31(5): 641–652.

[9] Landmann, O., and Jerger J. (1999). *Beschäftigungstheorie*. Berlin: Springer Verlag.

[10] O'Grady, M. A. (2011). "The FED's Easy Money Skeptic", *Wall Street Journal*, 2/12/2011.

[11] Petrongolo, B., and Pissarides, C. (2001). "Looking into the Black Box: A Survey of the Matching Function", *Journal of Economic Literature*, 34(2): 390–431.

[12] Pissarides, C. (2011). "Equilibrium in the Labor Market with Search Frictions", *American Economic Review*, 101(4): 1092–1105.

[13] Ravenna, F., and Walsh, C. (2007). "Vacancies, Unemployment, and the Phillips Curve", *Kiel Institute for the World Economy Working Paper* No. 1362, Kiel.

[14] Ravenna, F., and Walsh, C. (2011). "Welfare-Based Optimal Monetary Policy with Unemployment and Sticky Prices: A Linear-Quadratic Framework", *American Economic Journal: Macroeconomics*, American Economic Association, 3(2): 130–162.

[15] Ruesga, S., da Silva J., and Pérez-Trujillo, M. (2015). "La Gran Recesión y sus efectos sobre la eficiencia del mercado laboral. Un estudio aplicado a nivel regional para determinar el mismatch agregado en España", *Estudios de Economía Aplicada*, 33(1): 175–200.

[16] Sell, F. L., and Reinisch, D. (2013). "How do the Eurozone's Beveridge and Phillips curves perform in the face of global economic crisis?", *International Labour Review*, 152(2): 191–204.

[17] Wall, H., and Zoega, G. (2002). "The British Beveridge Curve: A Tale of Ten Regions", *Oxford Bulletin of Economic and Statistics*, 64(3): 257–276.