болгарським сільським господарствам на основі критеріїв і індикаторів показує, що загальна стійкість управління перебуває на "хорошому", але дуже близькому до "задовільного", рівні. Окрім того, існує значна диференціація на рівні Інтегрального управління стійкістю різних агросистеми країни. Окремі показники з найвищими і найнижчими значеннями стійкості визначають "критичні" фактори, які посилюють і стримують конкретну й цілісну стійкість управління оцінюваної агросистеми. Результати інтегральної оцінки стійкості аграрного сектора, що спираються на мікро- (фермерство) і макро- (статистичні) дані, демонструють певні розбіжності, які необхідно враховувати при аналізі та інтерпретації, у міру того, як удосконалюються показники, методи оцінки та джерела даних. З огляду на важливість цілісних оцінок такого роду для поліпшення стійкості сільського господарства в цілому і стійкості управління сільським господарством зокрема, слід підвищувати їхню точність і репрезентативність.

Ключові слова: стійкість управління, оцінка, сільське господарство, підсектори, агрорегіон, агроекосистеми, сільськогосподарські організації, Болгарія.

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ОЦЕНКА УПРАВЛЕНЧЕСКОЙ УСТОЙЧИВОСТИ БОЛГАРСКИХ СЕЛЬСЬКОХОЗЯЙСТВЕННЫХ ПРЕДПРИЯТИЙ

Необходимость добавления "четвертого" столпа управления в концепцию понимания системы и оценки общей устойчивости сельского хозяйства становится все более оправданной в академической литературе и находит свое место в правительственных, международных, частных и других организаций. В Болгарии, как и во многих других странах, практически не существует всесторонних оценок устойчивости управления сельским хозяйством и значения устойчивости для общего аграрного развития. Данная работа является попыткой заполнить указанный пробел и предлагает целостную структуру для понимания и оценки устойчивости управления болгарским сельским хозяйством. Новый разработанный подход "тестируется" в широкомасштабном исследовании для оценки устойчивости управления сельским хозяйством страны на национальном, секторальном, региональном, экосистемном и фермерском уровнях. Исследование показало, что важно включать недостающий "столп" управления в оценку комплексной устойчивости сельского хозяйства и устойчивости агросистем различных типов. Комплексная оценка устойчивости управления болгарским сельским хазяйством, на основе критериев и индикаторов, показывает, что общая устойчивость управления находится на "хорошем", но очень близком к "удовлетворительному", уровне. Существует значительная дифференциация на уровне интегрального управления устойчивостью различных агросистеми страны. Отдельные показатели с самыми высокими и низкими значениями устойчивости определяют "критические" факторы, усиливающие и сдерживающие конкретную и целостную устойчивость управления оцениваемой агросистемы. Результаты интегральной оценки устойчивости аграрного сектора, основанные на микро- (фермерство) и макро- (статистических) данных, показывают некоторые расхождения, которые необходимо учитывать при анализе и интерпретации, по мере того, как совершенствуются показатели, методы оценки и источники данных. Учитывая важность целостных оценок такого рода для улучшения устойчивости сельского хозяйства в целом и устойчивости управления сельским хозяйством в частности, следует повышать их точность и репрезентативность.

Ключевые слова: устойчивость управления, оценка, сельское хозяйство, подсектора, агрорегионы, агроэкосистемы, сельскохозяйственные организации, Болгария.

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THE PHILLIPS CURVE: A CASE STUDY OF THEORY AND PRACTICE

This paper develops a detailed case study of the Phillips Curve as it has evolved since Phillips classic work of 1958. An explicit narrative in the paper involves the evolution of the argument using economics and systems thinking, to develop underlying data generating models. These are shown to underpin the inverse relationship between inflation and unemployment in economics. The paper considers the political exigencies relating to the Great inflation of the 1970s and the Great Recession post 2008 in terms of interpretations of the Philips curve. The paper hypothesises that economic ideas have meaningful significance within the context of historical eras with concomitant political imperatives whence such notions become somnolent once crises have abated. This This historical narrative is implicit in the latest research reflections on Philips curves. A particularly useful finding is the relevance of systems thinking and systems dynamics to the interpretation of issues relating to aggregation problems in macroeconomics involving inflation and unemployment causal relationships. The paper concludes that seemingly moribund the Philips curve is alive may have been hibernating. Identifying the Phillips curve requires a wide range of variability of non-aggregative data streams. This allows the negative slope of the curve to be revealed, else the Philips curve slope is pushed towards the vertical plane. Endogenous central banking and inflation targeting intensifies this effect which is evident from a systems thinking /dynamics perspective.

Keywords: Phillip' Curve, Business Cycles, Economic issues, System Dynamics.

1. Introduction. This paper introduces the concept of the Phillip's curve, and uses it as aa case study to test two hypotheses which constitute the narrative of this paper. The two hypotheses are:

- Hypothesis 1 (section 3): economic notions have no meaning unless studied in the historical context in which the underlying theories were formulated, used and possibly discarded.
- Hypothesis 2 (section 4): Systems Dynamics is seen as a useful tool for scrutinizing complex interdependencies in macroeconomic models.

The study involves an extensive literature survey of the Phillips curve from its inception, to recent thinking and research findings. The dominant inverse relationship between inflation and unemployment is developed and then linked to the predator prey models of Lotka and Volterra.

These mathematical models can then be portrayed as a microcosm of cyclical activity in the economy. Accumulating evidence on the Phillips curve is conveyed against the background of the new classical resurgence and its rehabilitation in new Keynesian theory. The paper finishes with speculation about the future of the Phillips Curve.

2. The Phillips curve: derivation and practice. The Phillips curve was introduced by A.W. Phillips in 1958 using sample data from the United Kingdom from 1861–1957 to test the relationship between unemployment and the wage inflation. Phillips (1958) found that an inverse relationship between existed the two data streams: the higher the employment rate, the faster the wage rate rises. Since the original paper, which offered pioneering formal statistical evidence of the relationship between wage inflation and unemployment in the United Kingdom, the trade-off between inflation and real economic activity has been studied continually, both in theoretical and empirical research. Samuelson (1960) hypothesized the same trade-off existed for the US economy, arguing that it provided a menu of policy options where governments could always reduce unemployment by suffering some inflation. Moreover, these findings contended that Keynesian counter-cyclical policy tools (quantitative easing), where efficacious being intrinsically related to the assumption of non-neutral impact of monetary policy.

Phelps (1967) established the *expectations-augmented Phillips curve* by modelling firms' wage and price-setting behaviour. From an intertemporal perspective, he argued that inflation expectations would induce future changes in the trade-off between inflation and unemployment since the adjustments of wages and prices would be based on inflation forecasts. Lucas (1976) argued that,in the presence of rational agents,inflation expectations could not systematically differ from actual inflation, establishing what was dubbed the new *Classical Phillips Curve* or vertical Phillips curve (VPC).Thereafter microeconomic foundations of the Phillips curve were based on time delayed prices and monopolistic could assume key role. The standard *new Keynesian Phillips curve* (NKPC) therefore specifies that current inflation is a function of forward-looking inflation expectations of future real marginal costs. Whence the short-run non-neutrality of money caused by nominal and real rigidities was re-established. (Christiano et al 2005) This contention validated the idea that increasing inflation might reduce unemployment (Blanchard, 2007; Fuhrer,1995; Ghali 1999).

However, from a wider empirical perspective, the vast literature presents a wide range of issues (Gordon,1985). In general, there is much debate whether the Phillips curve baseline is appropriate for tracking national inflation dynamics. This is because despite the evidence from Stock (1999) and Ghali (1999) in favour of the inflation-unemployment correlation, the studies of Atkeson & Ohanian (2005) revealed that these results relied on the particular sample periods and where forecast horizons so were not universal but epoch specific and not persuasive. Recent literature (Hooper et al, 2019) utilising US regional inflation and wage data makes a strong case against studies that predicted the demise of the Phillips curve (Stock, 2009) and is supported by this and other studies. (MacLear, 2018).

2.1. Mathematical derivation of the modern Philips curve: Slack in the Economy. In the short run, the supply of output depends on the natural rate of output and on the difference between the price level and the expected price level. This relationship is expressed in the aggregate-supply equation:

$$Y = Y + \alpha(P - P_e).$$

The Phillips curve is an alternative way to express aggregate supply. It provides a simple way to express the tradeoff between inflation and unemployment implied by the short-run aggregate supply curve. The Phillips curve posits that inflation π depends on the expected inflation rate π_e, on cyclical unemployment $u - u_n$, and on supply shocks, e:

$$\pi = \pi_e - \beta(u - u_n) + e.$$

Both equations yield the same information in a different way: both imply a connection between real economic activity and *unexpected* changes in prices.

Many empirical results reproduced the classic inflation versus unemployment trade evident in the original British case estimated by Phillips. These results offered a clear and significant signal for macroeconomic policy. These classic Phillips curve relationships still appear to confront administrations, in Mexico and Nigeria according to recent research (Irewole, Oluwasefunmi, 2019).

An example of conceptual transferability is the notion of predator-prey cycles developed by Lotka and Volterra over one hundred years ago. In this cyclical model are two entities which were inversely related and interdependent. These entities are modelled by the two non-linear, simultaneous linked equations given below:

$$\begin{cases} \frac{dH}{dt} = rH - aHP \\ \frac{dP}{dt} = bHP - mP. \end{cases}$$

There are two variables (P, H) and several parameters: H (density of prey), P (density of predators), r (intrinsic rate of prey population increase), a (predation rate coefficient), b (reproduction rate of predators per 1 prey eaten) and m (predator mortality rate). When plotted against time, both H and P show sinusoidal behaviour Fig. 3.

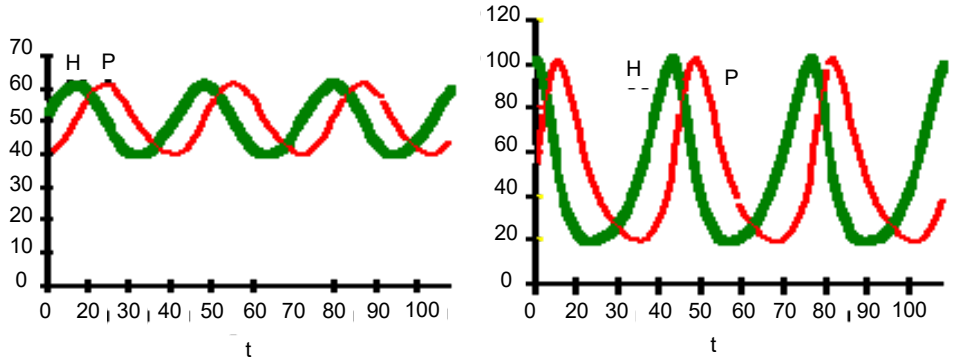

Fig. 1. Sinusoidal Behaviour

Metaphorically, one could extend this to unemployment (U) and inflation (I) which Phillips (ibid) has shown to be similarly related:

$$d(U)/dt = a.U - b.U.I$$
$$d(IR)/dt = c.U.I - d.I.$$

Solving the equations would then give a familiar business cycle where unemployment and inflation are in a dynamic equilibrium. These can be seen in Fig. 2−6 variables against each other (in mathematics called a phase plane), one gets a closed loop denoting cyclical behaviour.

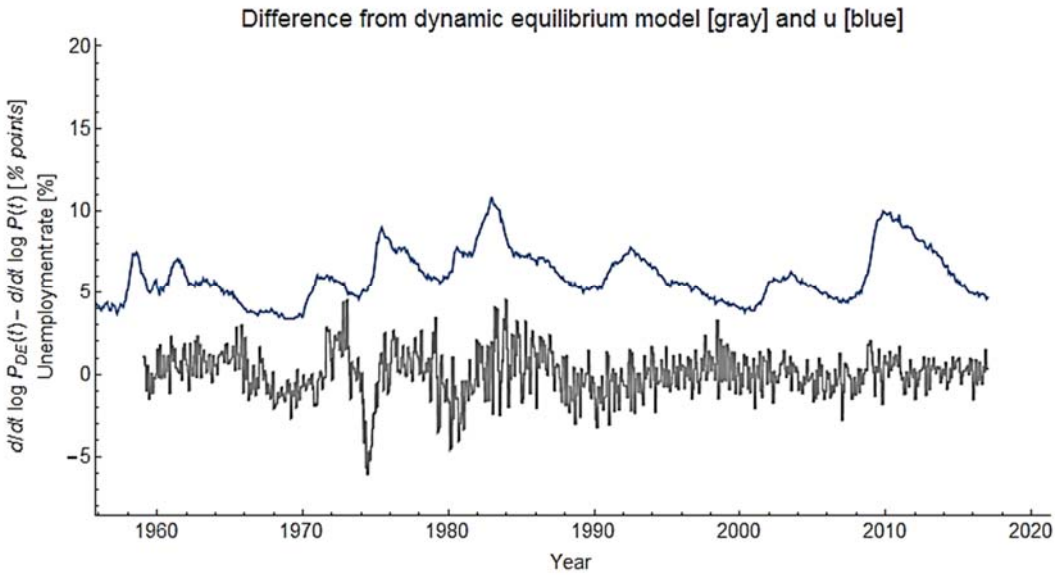

Fig. 2. Dynamic Equilibrium

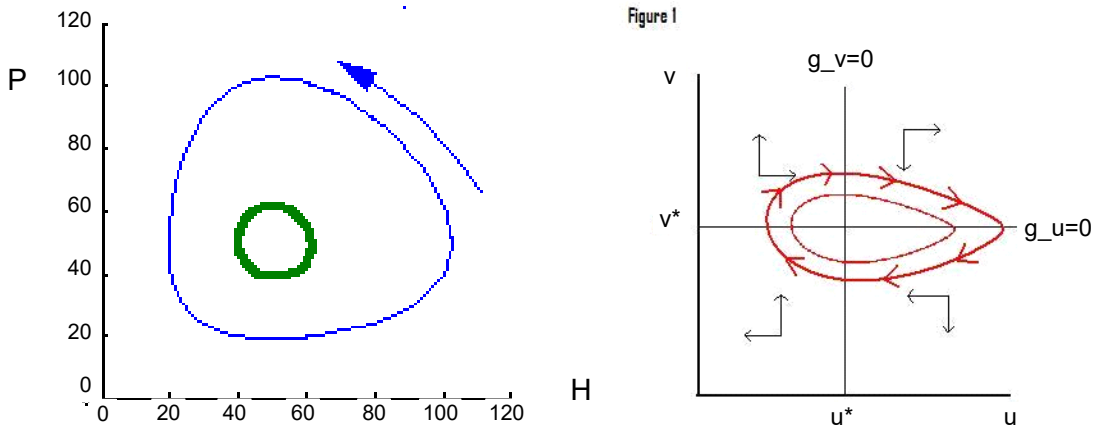

Fig. 3. Phase Plane

The Fig. 1−3 indicate the causal directions of interaction in the typical activity of business cycles between boom and slump. The equations imply that typical business cycles fundamentally contain trigger mechanisms which create the inverse relationships between inflation and unemployment in the context of income expansion/contraction. In cyclical activity, and the propagation mechanisms are complex and linked to a dynamic multiplier processes which cause cumulative and dynamic changes.

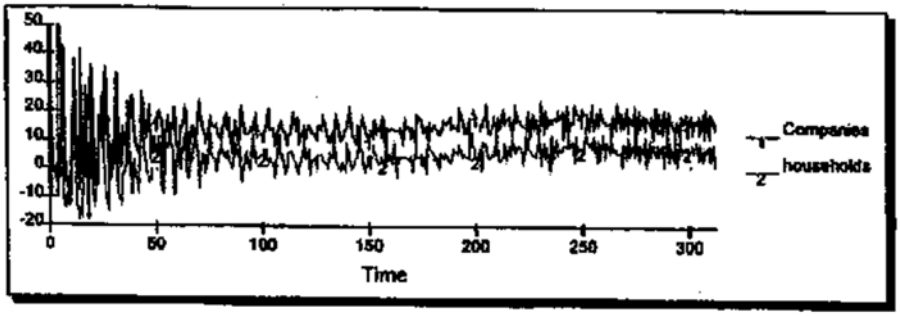

Fig. 4. Classical Equilibrium

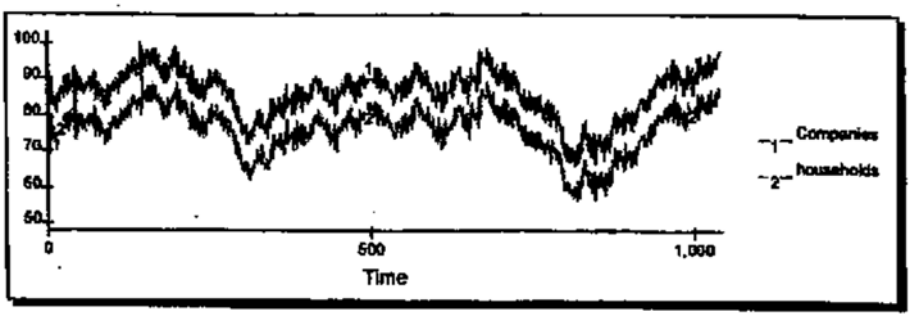

Fig. 5. Dynamic Equilibrium

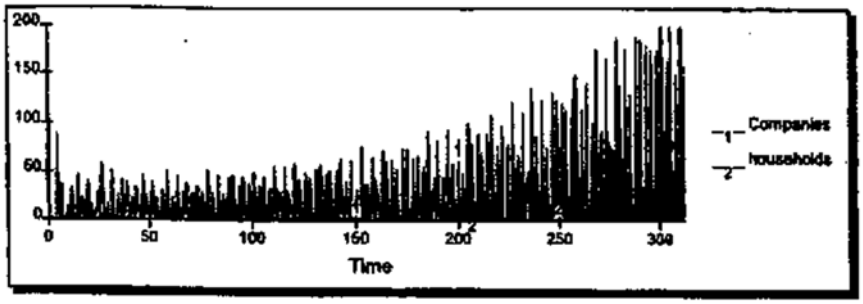

Fig. 6. Potential Chaotic behaviour

The Phillip's curve is suggested in the lower sections of figure three. Intrinsically therefore the notion of the Phillips curve is innate in the business cycle. These are developed in a fully systems macroeconomic dynamic model in the appendices figure. Graphs 4,5 and 6 depict dynamic equilibrium for a macroeconomic time paths based on the systems dynamic platform.

2.2. Phillip's Curve and Capacity Utilisation. The Lucas Crtique (ibid) argued that the inverse relationship between inflation and unemployment exists only in the short run. The rationale being that by keeping ouput /employment at a level higher than its natural rate, inflation would keep rising, and both employers and employees would take this into account when setting new wage rates. Therefore, once inflation reached a certain point employers would no longer want to hire at such wage rates and employees would no longer want to work at the prevailaing wage rate (ultimately leading to an increase in the unemployment rate).This twiped out the inverse relationship suggested by the Phillips curve whenever the government tried to exploit it.

In these *macroeconomic models* with *sticky prices*, there is a positive relation between the rate of inflation and the level of demand, and therefore a negative relation between the rate of inflation and the rate of unemployment. This relationship is often called the "New Keynesian Phillips curve"(NKPC). The NKPC implies that increased inflation can lower unemployment temporarily but cannot lower it permanently.

2.3. Central Bank (Utility) functions: Endogenous Monetary Policy. Central banks now select an optimal rate of inflation and try to maintain that target around the natural level of output (unemployment) over the business cycle (Barro, 1983). Deviations in outcomes push the central bank into manipulating the function (MR) to generate disinflation, but what type of strategy for disinflation ? The MR function exhibits the endogeneity revealing the path of the stabilising interest rate from *C* to *A* in Fig. 1.

The choice of strategy by the central bank depends on the inflation aversion of the bank: if the bank is inflation averse, then a " cold turkey" approach could be considered, that is it goes straight to the inflation target level and risk ever higher levels of unemployment until reaching the stabilization point. However, if the bank is less inflation averse then a "gradualist" approach would be considered, that is the central bank would reach its inflation target slowly but in a longer period of time.

Fig. 7 shows the interaction for different levels of *PC*, (under supply shocks) (*VPC*) and the Monetary Rule to achieve a target inflation target. Central bank inflation bias occurs when the bank tries to reduce unemployment to a level below the natural rate of output, y_e. The central bank tries to minimize the loss function:

$$L = (y_t - y_e)^2 + \beta\,(\pi - \pi^T)^2.$$

Where *ye* is the natural output level, β is the relative weight attached to the loss from inflation and π^T is target inflation rate. The relative weight is determined by historic trends and socio-political ethics of the central banker.

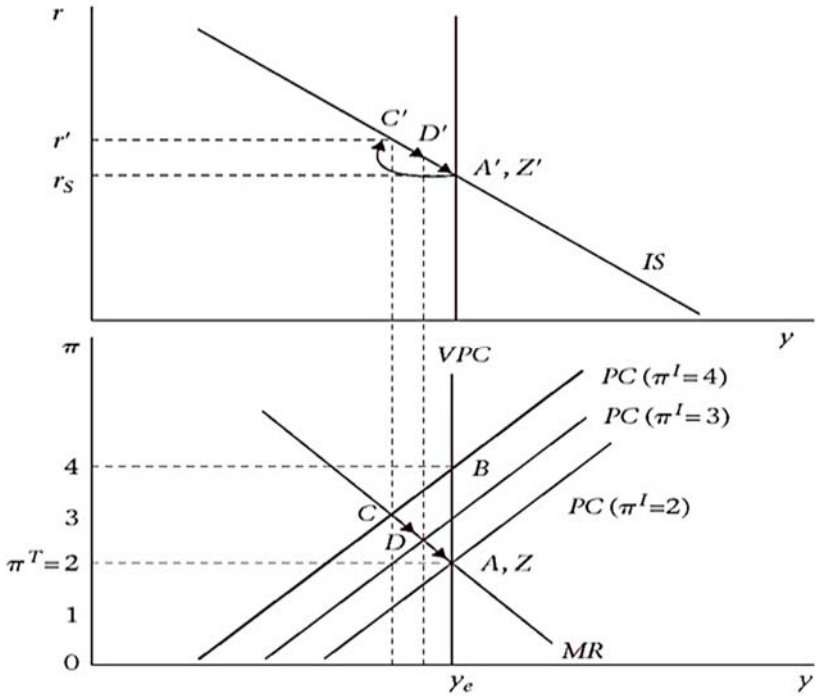

Fig. 7. Inflation Targets

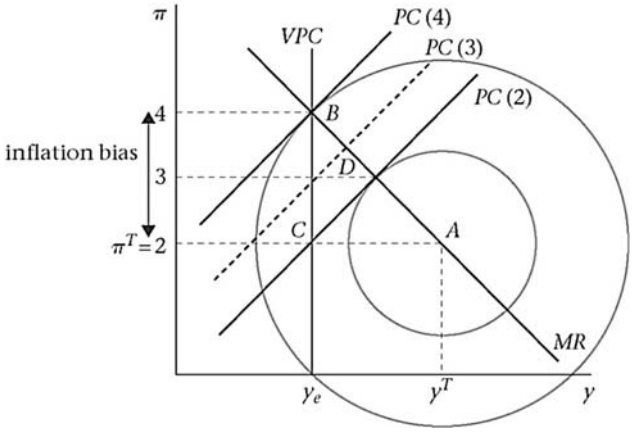

Fig. 8. Inflation bias

Fig. 8 shows how inflation bias works, the circle represents the central bank utility curve with each circle corresponding to a different indifference curve, Y^T is the target level of output which is higher than the natural level *ye*, this would correspond to a higher inflation level and short run Philips curve shifts upwards , and the process continues until point *B* is reached: at point *B* inflation is higher than target and output is lower than its target.Critically the movement from *B* to Din Fig. 2 shows the small change in the stabilising interest rate required – the small variability is a serious obstacle to empirical observation of the Phillips curve – it hibernates. Aggregative national data time series snuff out linear variations in the Phillips curve (Kiley, 2015).

2.4. Some Observations on inflation Targeting. Scepticism about the efficiency of inflation targeting emerged after the 2008 global financial crisis. Critics have argued that the foundation of inflation targeting, the Taylor Rule (1993) is contentious being simply determined by historical benchmarks that are postulated as static. Moreover, the concept of optimal level of inflation is controversial, since there is no solid theoretical model that can specify the optimal inflation level. Notwithstanding Fieldstein (1997), argues for a zero -inflation rate. This has been criticized because of lack of realism and since a possible consequence is an increased possibility of chronic deflation in emergent economies. However, Tatliyer (2017) contends that: "there is no theoretical threshold over which inflation rates starts to hurt the economy". Tatliyer (ibid) continues: "real economic variables such as economic growth and employment level, not to mention income distribution, attracted much less attention in the evaluation of the regime". Finally, inflation is not always bad thing, this has been seen in the global pandemic where countries have increased anticipated inflation rates to escape recession and revive locked down economies (Choi, 2003).

In the setting of the Barro, (1983) model (Fig. 1) attempts to uncover a Phillips curve with aggregative data leads to fundamental econometric identification problems. Fig. 2 plots the Phillips curve in the model alongside the monetary policy targeting rule. In equilibrium the Phillips curve is non observable, but rather translates as points of intersection between the two loci. A study applying basic regressions would always fail to capture a quiescent Phillips curve even in economies characterised by strong inflation bias (Liung, 1978).

3. Hypothesis One. Hypothesis One states that economic notions have no meaning unless studied in the historical context in which the underlying theories were formulated, used and possibly discarded. A system's view (holistic) must be taken in economic cases where the "et ceteris paribus" assumptions that are usually discarded are seen as particularly relevant with regards to issues relating to politics, history and practice.

3.1. Interdependencies – Social, Economic and Political Issues. What is an economy? Economic agents are social beings and as such form social entities which can range from families, to social groups, companies, nations to the whole global community. The actions and interactions of these entities have economic consequences. A first definition of an economy could therefore be:*" the set of economic actors and the connections between them"*. One such connection is via measurement and the subsequent production of "economic "data. Examples of this are employment and interest rates. Employment is not an obvious term to define but it is possible to reach agreement about what is included under this heading. One can then use mathematical techniques to measure levels of employment. Similarly, as for interest rates – agreement can be reached as to definitions and measurement. The definition of an economy could thus be extended to include terms such as: productivity, spending, consumption, supply, demand, multiplier etc. Hence a fuller definition of an economy could be: *"the set of economic actors, the connections between them, the terminology and measurements that they make*". A further extension would be to include the hypotheses that link these terms together so that an economy then becomes: *"the set of economic actors, the connections between them, the terminology and measurements that they make and the correlations they believe to exist between these terms"*.

Phillips analysed empirical data and noticed inverse correlations between inflation and unemployment. Hence, one could argue (using relevant economic hypotheses) that unemployment can be regulated by interest rates – there is an inverse relationship. This must be included in our definition: hence a wider definition of an economy could be: *"the set of economic actors, the connections between them, the terminology and measurements that they make, the correlations they believe to exist between these terms and the economic consequences resulting from the actions taken between them".*

Let us examine these consequences more deeply. If unemployment is rising, the central bank reduces interest rates in an effort to stimulate growth and increase employment. There are three elements to this correlation:

- A belief that such an inverse relationship holds (economic);
- A desire to ameliorate unemployment (social);
- The authority to affect the cut (political).

Therefore, this act (ostensibly an economic one) also encompasses political and social consequences. Every action that social actors /agents make has economic consequences. What this suggests is that it is not possible to separate Economics from other disciplines which leads to the idea of Unus Economicus Mundus (Moscardini, 2020). This is a unified multi-discipline approach which uses analogies and results from all areas of knowledge.

3.2. The Political Economy of Inflation in the UK. The political economy of the inflation and unemployment debates relate to fundamental causes and effects. These are best viewed via the lens of economic history of government policy. Thus, from the 1950s through to the late 1960s was dubbed the Golden Age of Keynesian fiscal policy in the UK and USA. In this era in the UK / USA and Europe, the political consensus was Full Employment and Price Stability. From Harold Wilsons government in the UK in 1964, this policy target implied big government fiscal investment bolstered by government infrastructure initiatives to maintain full employment at 2-3 % GDP with inflation hovering 1-2 per cent (O'Hara, 2007). By 1970 inflation arrived on the political agenda with the election of the Health government in the UK. This government was elected on an anti -inflation ticket. With inflation edging towards 5 per cent per annum Heath argued that inflation was the primary aim of government economic policy. This governmental ethos intensified in the Barber boom of 1971-1972. This approach was mirrored in the USA. The political /economic conventional wisdom in UK and USA reacted to these macroeconomic policy changes with the increased manipulation of the Phillips curve eventually creating stagflations in the 1970s. However, stagflation could not be interpreted within the Keynesian Income Expenditure paradigm. The significant academic reaction heralded the New Classical Revolution in macroeconomics pioneered by Lucas (1972, 1972a) and Sargant (1973, 1979). Both of these theorists argued that the Phillips curve policy-based regimes represented econometric failure on a large scale. Therefore, the short run Phillips curve, as a policy tool /trade-off was moribund in the late 1970s. Sargant (1979) dramatically argued that: given rational expectations and continuous market clearing macroeconomic monetary / fiscal policy seeking to enhance employment would only succeed in creating more inflation.

The oil price shocks in the 1970s and subsequent supply/ wage push induced inflation meant that the Labour government under Callaghan abandoned full employment as a primary aim of macroeconomic policy which instead now sought to conquer inflation as the key objective. This became mission critical for successive UK administrations until 1997. The 1970s are now referred to as the era of the Great Inflation. (Black, 2004)

So, by 1979, with the election of Margaret Thatcher, inflation control became the dominant government macroeconomic policy target. Moreover, subsequent Thatcher administrations maintained a tough monetary stance exhibiting a progressive focus on inflation as a policy target. Subsequent administrations in the UK/USA have tended towards inflation targeting based on central bank discount rates (the stabilising interest rate) as the frontline tool of monetary policy. The Bank of England's inflation targeting regime superseded controlling the money stock as the basic lever to nudge the economy since the Blair administration of 1997. Thereafter, the newly instituted independence of the Bank of England meant that, all subsequent governments now needed only to meet prescribe inflation targets to central banks. In this new era central banks and theorists become increasingly interested in the notion of the new Keynesian Phillips curve (NKPC). Proper understanding of this concept based on forward looking agents assists inflation targeting manoeuvres. Optimal monetary responses to aggregate demand and supply shocks encapsulate implicit derivation of families of Phillips curves which confront the central banks loss function. Within these families of Phillips curves,the work of Ball (1994) explicates how disinflations might lead to a boom: these typically occur when central banks tighten money supply or, announce credible inflation targeting regimes.To understand the occurrence of the paradox, models based on Calvo-type pricing models (Calvo, 1983), and associative utility functions, argued that firms in monopolistic competition, facing free entry and anticipated lower expected inflation futures, start lowering prices immediately after an announced credible deflation. So, that firms operating in Calvo-type models expand output

anticipating an increase in demand as inflation starts to fall. Optimal monetary policy based on aggregative data may yield strange phenomena. Additional papers by Bloch (2013) Smets, (2007 ibid), and others aimed at reinterpretation of the paradox, and emphasised monopolistic competition models as the foundation of the riddle. The anomaly is highly likely given low variability in aggregative data and small inflations.

3.3. Inflation, Unemployment, Persistence Issues. Some NKPC advocates admonish policy makers not to rely upon /NAIRU relationships because changes in policy may break the connection between the expected inflation and the weighted average of the past inflations. (Lucas, 1976 ibid) Moreover, there may be a statistical relationship between current and lagged inflation as well as unemployment. The existence and persistence of both fundamental trends is an issue. (Fuhrer, 1995).

There is a long deep debate as to whether the coefficients of econometric Phillips curves are stable over time. If persistence of inflation breaks down due to unstable coefficients there is no structural relationship at all (Fuhrer ibid). In which case should the central bank should avoid gradualist policies and go for a cold turkey shock therapy disinflationary policy? However, the potential impact on employment regions of a cold turkey policy initiative might be overwhelming. A key contention here is that once economic theories no longer seem politically appropriate, they are discarded – this appears to the case some versions of the Phillips Curve. Why should this be so? inflation and unemployment have not been a burning political issue since the 2008 banking crisis? Environmental concerns versus growth conflicts have all but surpassed inflation and unemployment as global problems. The final impact of the current pandemic may change this narrative whence mass unemployment may once more emerge as an all-consuming political issue.

Notwithstanding, the political economy of the Phillips curve provides a narrative, not only in the development of the theoretical models from arising from controversial theoretical perspectives, but also on the political exigencies of the times. In the broad sweep of British and American economic history, after 1945 until the end of the 1960s, inflation as an economic phenomenon hardly visible on the political spectrum despite the fact that the Phillips curve was formulated in 1958. This period experienced the post war boom so that the original curve was formulated at a time of high growth, full employment and price stability (Dutton, 1997). From the devaluation of sterling in 1967 till the end of the 70s, the UK and USA experienced the epoch known as the Great Inflation (Maclear, 2018; Clarida, 2019). British and other western governments battled against the cost supply shocks delivered OPEC oil price increases and concomitant interactions of powerful labour unions headed in the UK by the NUM and TUC. In this era, wage bargaining used oil price increases as the parameter for wage annualised bargaining which intensified cost push inflation and supply shocks in a way that successive governments found it difficult to manage. The Philips curve of Samuelson (1960) based on labour productivity gains seemed to offer a blueprint for the trade-off for the governments between inflation and unemployment. Labour productivity gains became the wage bargaining benchmark and with pay rises justified in terms of labour productivity until the Social Contract between government and trade unions collapsed in the UK in 1978/79. (Williamson, 2016) The Phillips curve created a political dialogue and narrative both for trade unions and government with regards to pay rounds, pay freezes, pay pauses, incomes policy and all manner of price controls (Broadberry, 2003). By the time of Margaret Thatcher's incumbency, the inflation game changed almost as fast as the economic paradigm when Milton Friedman received the Nobel prize in 1976 the prominent monetarist of the age. Friedman's Nobel lecture (1968) espoused general ideas about the natural rate of unemployment and evinced the case for free market neoliberal government with minimal interference. Margaret Thatcher was elected on a Friedmanite monetarist ticket with Adam Smith free market values in the vanguard. Mrs Thatcher's monetarism experiment lead to huge debate within economics such that in 1981, 364 academic economists publicly disavowed economics policies expressed in the balanced Budget with the concomitant cuts and tax rises of that year. This large (364 economists) vocal lobby argued that government spending cuts were likely to lead to massive unemployment and de-industrialisation in the UK. (This turned out to be the case but impelling economic priority had now shifted: inflation control became paramount. By the late 1990s, the mood music had now changed as UK adopted Friedman's case for floating exchange rates. The advent of central bank independence meant that inflation targeting would be delivered in the UK along the lines of Taylor Rules. This became the political flavour of the month and continued to be so until the global financial collapse of 2008. Between 2010–2019 the UK endured a sustained governmental austerity programme – a subtle rebranding of the 1930s, Treasury View which favoured balanced Budgets. This notion had impelled Keynes to write the General Theory. The notorious Treasury View was a perspective which Keynes disparaged and denounced. The political economy paradigm change in the UK shows the pace and ferocity in which long standing economic paradigms are discarded and deprecated. (Toye, 2013)

4. Hypothesis Two: Links to Systems Dynamics. When the subject, Economics, originated 250 years ago, the dominant paradigm was the scientific paradigm initiated by Newton. This presumed, a deterministic, logical, harmonious, predominately linear structure where chance does not play a significant role. Its success rests upon its ability to "*analyse*" which rests on the assumption that parts of the whole can be analysed and improved in isolation and then assembled into the whole. The systems paradigm takes a holistic or "*synthesising*" view. It stresses that all observable parts are inter-dependent. Moreover, significantly, that all forces are knowable allowing for non-obvious and sometimes unexpected dependencies between agents and encompasses the idea of self-adaption. (Lawler et al., 2019).

Within the systems paradigm, there are various methodologies such as Systems Thinking, Cybernetics, Soft Systems Methodology and System Dynamics. This paper uses the ideas of System Dynamics created by Forrester in the 1950's. Kennedy [16] emphasises that a key feature of SD is the concept of feedback, which is construed in the context of a loop that is comprised of several variables that are in turn, interconnected by their effects. It soon became clear that there are two identifiable perspectives related to SD, namely: (1) the quantitative; and (2) the qualitative paradigms. Coyle (2000) identified five roles for qualitative models: (1) they simplify the description of very complex problems; (2) they effectively show relationships between items in the model; (3) they facilitate the easy identification of feedback loops which help explain system behaviour; (4) they help "identify the wider contexts of a modelling task" and (5) they serve the basis for a quantified model. Most researchers, such as Richardson (1999), now take a balanced view and assert that both paradigms have advantages and limitations and that the researcher must know when to 'map' and when to "model".

The hypothesis under examination states that both the qualitative and the quantitative aspects of System Dynamics are useful to model economic issues such as the Phillips curve. Fig. 9 is a causal diagram consisting of two negative and one positive feedback loop. It could now be used to build a quantitative model (System Dynamics Model) which would involve entering data, and graphs and tables can be obtained as output. In this paper, we only construct the causal model and show how this, by itself, can led to meaningful debate. The central loop shows the inverse Phillips relation at a national level. A rise in national unemployment will be controlled by the government by lowering interest rates i.e. decreasing inflation and visa-versa. But this brings in the issue of aggregation. A rise in Inflation may decrease regional spending and therefore increase unemployment at a regional level. This would destroy the inverse Philips relationship.

A correlated but knotty issue concerns the measurement and variability unemployment of the active workforce. With a hibernating aggregative Phillips Curve how is unemployment to be construed? This is normally defined in terms of involuntary unemployment, (Keynes, Keynesian) voluntary unemployment, (New Classical). The potential occurrence of mass unemployment remains a problematical and highly controversial issue. Unemployment takes many forms, there can be for example, structural unemployment, a key issue in the declining staple industries in the UK since the 1930s (endemic staple industry decline in the iron, coal, cotton and railway industries.). Moreover, the concept of cyclical unemployment which is determined by the trade cycle was first clarified by Keynes in 1936 to describe the mass long term unemployment (dubbed involuntary unemployment) which occurred after the Wall Street crash and the ensuing Great Depression (Mehra, 1994).

In modern times, the measures of unemployment have become ever more sophisticated in G7, the claimant count by unemployed workers verifying their idleness in the previous 2–4 weeks is the normalised measure. However, this has led to controversy that this is not a true aggregative measure because many women do not sign the unemployment register nor do casual workers or gig economy workers. This measure of unemployment is always likely to be an understatement. Hence the Phillips curve which relies upon accurate measurements of inflation rates and the unemployment is in complex territory because both key variables, notably: price inflation's and employment are notoriously challenging to measure with precision. Despite the fact that many indices exist for measuring inflation and unemployment and there are no internationally agreed measures of both. Moreover, it should be understood that there is dispute in academic economics as to how precisely these variables can quantified in the empirical world. (Powell, 2016).

Moreover, these tensions are likely to be non-linear and inversely proportional. The US shows that exogenous macroeconomic shocks imposed by internal or external factors reverberate across the economy creating disproportional impacts on regional employment and inflation trends. Hooper's (ibid)regional data for the US is explicable in terms of Fig. 9, given the two negative loops that are shown. (Clarida, 2019).

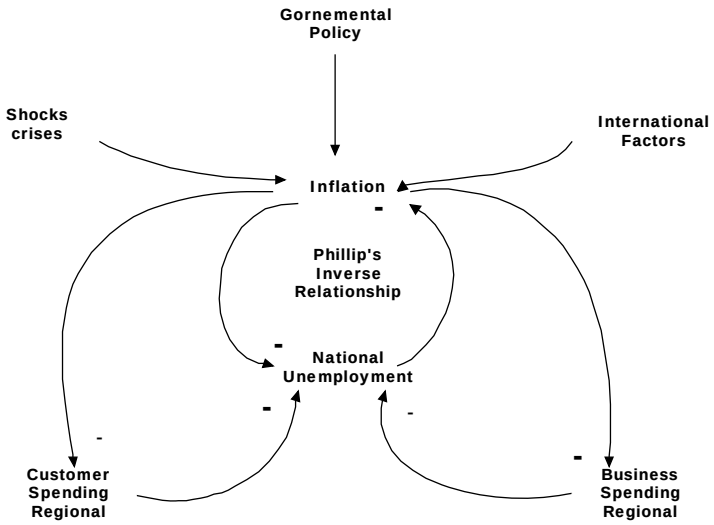

Fig. 9. Causal Model for Unemployment

If economic policies aim at higher output growth rates and lower unemployment rate what how is NAIRU to be interpreted regional sectors of the economy (Fair, 2000).The causal loop models in the appendices identify potential lags and negative loops. Remarkably, versions related to the classic case still endure, whence some unsophisticated Phillips Curve manifestations outperform modern versions in the context of a monetary expansion. (Mankiw, 1989; Blanchard et al, 2015) Nonetheless Mankiw (ibid) portrayed this case embodying the mysterious, curious but inexorable significance of Phillips curves in the economic paradigm.

5. The Death of the Phillips Curve? However, (Hooper, 2019), argues that there are robust reasons why the evidence of a vanishing Phillips curve is feeble. First the Feds success maintaining US inflation at 2 per cent per annum de-sensitised inflationary expectations in US labour markets. Second the, econometric methods designed to pick up a classic Phillips curve fail because of insufficient variance in the US aggregative macroeconomic data when the unemployment rate is within per cent of the natural rate. This implies that non linearities in the gradient of the Phillips curve cannot be observed when the power of the econometric tests is low. Moreover, when there is a positive shock to inflation, the Fed tightens monetary supply to keep inflation under control, causing unemployment to rise. Therefore, endogenous monetary policy creates a positive correlation between inflation and the unemployment gap which shifts the slope coefficient of the Phillips curve toward zero (*VPC* in Fig. 3.)

This suggests that most estimates of the slope of the Phillips since 1997 have understated the underlying relationships when effective inflation targeting is accomplished. Inspection of Fig. 9, implies that if shocks causing contractions are external the impact on regions could be devastating even in the context of endogenous monetary policy. The recent Brexit of the UK combined with the supply shock of Covid 19, might create negative loops for regions building up into severe income contraction multipliers.

However, the arguments about variability and endogeneity suggest that researchers should use data that has more variation than the typical aggregative macro time-series data, which is not subject also to possible bias from endogenous inflation targeting (Schwarz, 1978 ibid). In same vein Hooper (ibid) used data for the wage inflation reported by 50 US states, and the price inflation data reported in 23 major Metropolitan Statistical Areas (MSAs). In these data, there exists a plethora of observations of very tight labour markets. US Monetary policy is national, and so all states and MSAs face external shocks. Therefore, these monetary shocks can be treated as exogenous for state and MSA data.

Fig. 9–11 show Hooper's (ibid)estimate reveal the classic wage -price spiral endemic in the original Phillips curves. This was captured in regional data analysis. Hooper's empirical evidence show that Phillips curve survives, and reports of its demise are greatly exaggerated. The regression lines showed a steep, significant slope, with significant non-linearities in the responsiveness of wage and price inflation to tight labour markets.

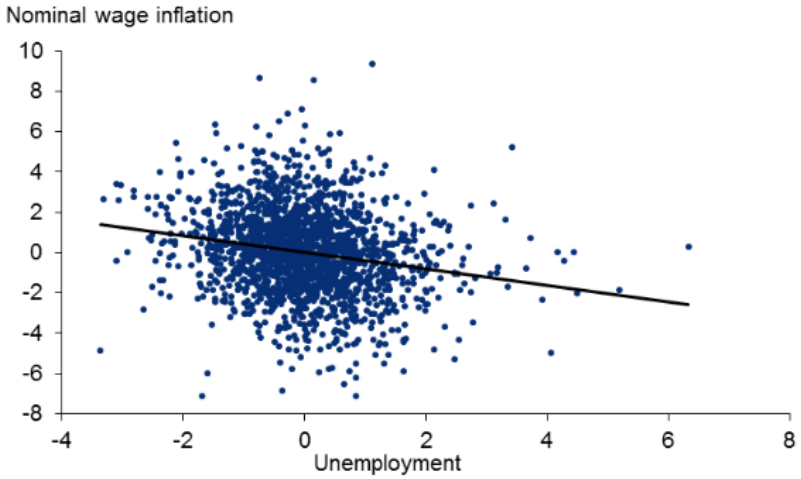

Fig. 10. Nominal wage Phillips curve, US states, 1981–2017

Source: Hooper's (2019).

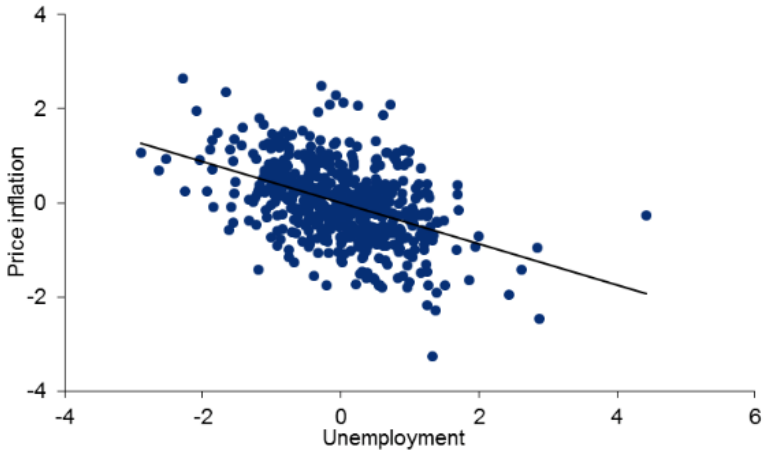

Fig. 11. US Metropolitan Statistical Areas, 1990–2017

Source: Hooper's (ibid).

This regional US regional evidence shows why the aggregated US macro time-series data on the death of the Phillips curve cannot be trusted. Fig. 11 suggests that the Phillips curve is very much alive, but hibernating.

6. Conclusion and discussion. The theme of this paper highlights the significance of the interplay between the economy, social /political issues and institutions (Yellen, 2015). This is manifest in the context of the history of post UK political economy. The argument offered here features the usefulness of systems thinking in helping unpick complex theoretical issues underlying and generating the Phillips curve and hints squarely at non-linear relationships (Nalewaike, ibid.) This includes the data generating mechanisms underlying the Phillips curve and systems dynamics analysis points to critical factors that ensure that its survival is enduring in a competitive free market economy. Systems thinking assists in understanding the wider interdependencies that govern

political exigencies and establish the case for encapsulating the Phillips curve in regional data.

Surprisingly changes to the monetary policy targeting rules (arising from crises, policy errors, lags or changes in policymaker preferences) may also help capture a somnolent Phillips curve.(Cecchetti, 2017) This case study shows the power of systems dynamics and the systems approach in focusing on the causal loop processes that reveal cyclical activity. The systems dynamics graphs show that the Phillips curve is a component in the dynamics of the business cycle (Fig. 3, and 4). Indeed, it makes it difficult to conceive of a Phillips curve mechanism outside business cycle dynamics. Systems thinking emphasises leads and lags in policy implementation with concomitant aggregation data issues. This is especially the case in inflation and regional/national data flows and variability. This is evident the vicissitudes in the political significance of the Phillips curve and central bank behaviour. Basically, the normal political focus on inflation/unemployment on national trends. This is misplaced given the issues uncovered in regional trends in US data analysis of Hooper and in Fig. 10 and 11 in this paper.

The observed inflation-output gap relationship may depend on the relative magnitude of cost-push and targeting-rule shocks in the richly divergent nature of regional sectors in the economy. (Fitzgerald, 2014). Nonetheless the Covid-19 pandemic may inadvertently exacerbate the tensions between national /regional given structural breaks national supply chains that occurred. If the latter are dominant, the identified parameter will be closer to the true slope of the Phillips curve. Shocks to the central bank targeting rule shift the equilibrium along the Phillips curve, rather than shifting the curve itself (Fig. 2). If the variance of the targeting-rule shocks is robust, then successfully controlling for cost-push shocks such as changes in oil prices might help recover the Phillips curve using standard OLS techniques. The enormous VAR literature on the identification of exogenous monetary policy shocks in aggregate data can be bewildering and are inconclusive as they stand (Dotsey, 2017). However, systems dynamics in terms of the causal loop configurations and dynamic equilibrium graphs demonstrate the clear impact without recourse Var models. Generally, Var models based on aggregate data are unreliable given the strength of the evidence cited by Hooper (ibid) and in discussed in (Gordon, 1985).

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КРИВА ФІЛІПСА: АНАЛІЗ ТЕОРІЇ І ПРАКТИКИ

Проведено детальне дослідження кривої Філіпса в міру її розвитку з часу класичної роботи Філліпса 1958 р. Виклад включає в себе еволюцію аргументації з використанням економічної теорії та системного мислення для розробки базових моделей генерування даних. Показано, що вони лежать в основі зворотного зв'язку між інфляцією та безробіттям в економіці. У термінах інтерпретації кривої Філіпса розглянуто гострі політичні потреби, зумовлені Великою інфляцією 1970-х років і Великою рецесією після 2008 р. Висунуто гіпотезу про те, що економічні ідеї мають важливе значення в контексті історичних епох при супутніх політичних імперативах, від яких ці ж самі ідеї впадають у сплячку, коли криза слабшає. Такий екскурс в історію проглядається в останніх дослідженнях кривих Філіпса. Особливо корисним є висновок про актуальність системного мислення і системної динаміки для інтерпретації питань, пов'язаних із проблемами агрегування в макроекономіці, включаючи причинно-наслідкові зв'язки інфляції і безробіття. Зроблено висновок про ймовірність того, що крива Філіпса жива, і лише перебувала у сплячці. Визначення кривої Філіпса вимагає широкого діапазону мінливості неагрегірованих потоків даних. Це дозволяє проявлятися негативному куту нахилу кривої, в іншому випадку нахил кривої Філіпса спрямовано у вертикальній площині. Ендогенний банкінг та інфляційне таргетування підсилюють цей ефект, що очевидно щодо системного мислення або динаміки.

Ключові слова: крива Філіпса, ділові цикли, економічні проблеми, динаміка системи.

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КРИВАЯ ФИЛЛИПСА: АНАЛИЗ ТЕОРИИ И ПРАКТИКИ

Представлено подробное исследование кривой Филлипса по мере ее развития со времени классической работы Филлипса 1958 года. Подробное изложение включает в себя эволюцию аргументации с использованием экономической теории и системного мышления для разработки базовых моделей генерирования данных. Показано, что они лежат в основе обратной связи между инфляцией и безработицей в экономике. В терминах интерпретации кривой Филипса рассмотрены острые политические потребности, обусловленные Великой инфляцией 1970-х годов и Великой рецессией после 2008 года. В работе выдвинута гипотеза о том, что экономические идеи имеют важное значение в контексте исторических эпох при сопутствующих политических императивах, от которых эти же самые идеи впадают в спячку, когда кризисы ослабевают. Такой экскурс в историю подразумевается в последних исследованиях кривых Филлипса. Особенно полезен вывод об актуальности системного мышления и системной динамики для интерпретации вопросов, связанных с проблемами агрегирования в макроэкономике, включая причинно-следственные связи инфляции и безработицы. В работе сделан вывод о том, что, похоже, кривая Филипса жива, просто она пребывала в спячке. Определение кривой Филипса требует широкого диапазона изменчивости неагрегированных потоков данных. Это позволяет проявляться отрицательному углу наклона кривой, в ином случае наклон кривой Филлипса устремляется в вертикальной плоскости. Эндогенный банкинг и инфляционное таргетирование усиливают этот эффект, который очевиден с точки зрения системного мышления или динамики.

Ключевые слова: кривая Филиппса, бизнес-циклы, экономические проблемы, системная динамика.