The Global and Local in Phillips Curve

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Abstract

The debate over the Phillips Curve - as the relation between level of unemployment rate and inflation rate - in historical economics is shortly reviewed. By using the analysis in the Extreme Value Theory, i.e.: the rank order statistics the unemployment and inflation data over countries from various regions are observed. The calculations brought us to conjecture that there exists the general pattern that could lead from the relation between unemployment and inflation rate. However, the difference patterns as observed in the Phillips Curve might could be reflected from the range of values of the local variables of the incorporated model.

1 Introduction

Phillips Curve was originally introduced in [6] and conjectured from the empirical findings of A. W. Phillips to show the relation between the rate of unemployment and the rate of change in money wages in a national economy. This relation, however is not originally discovered by Phillips, since economist Irving Fisher has also discovered the negative correlation between the rate of goods-price inflation and the level of unemployment [2]. Theoretical explorations of economics originated in [8] then developed more advanced postulate modifying the curve to depict the relation between the inflation rate and the rate of unemployment. The expectation is thus to have analytical tool for economic policy-makers related to the various levels of unemployment and price stability.

It was shown that there exist negative correlation between the rate of inflation and the rate of unemployment [8]. Hypothetically, when the unemployment rate is lower - shown by the high absorption of workers in labor market leading to the higher demand for goods - while the firms would tend to spend higher money on wages implies higher levels of prices, and vice versa. There have been wide aspects conforming this negative relation between unemployment and inflation rate with those theories known as Keynesian economic perspectives [4]. The choice of the policy-makers can thus be simplified as to accept either the adjustment of inflation rate or unemployment.

However, latter empirical findings regarding to the negative relation between the two important variables do not always happening. There were cases where higher unemployment could lead to higher inflation (or vice versa) as occured in the 1970s economy of some countries for the hike of world oil price. More and more facts were revealed showing that the postulate is not fulfilled in general over countries and national economies. Each observed countries exhibit different patterns of Phillips Curve as shwon in figure [1].

Thus in the long history of macroeconomics, Phillips Curve has been changed and modified to conform a lot of economic perspectives and streams, be it those of built upon the work on Keynes' employment theory [5] and
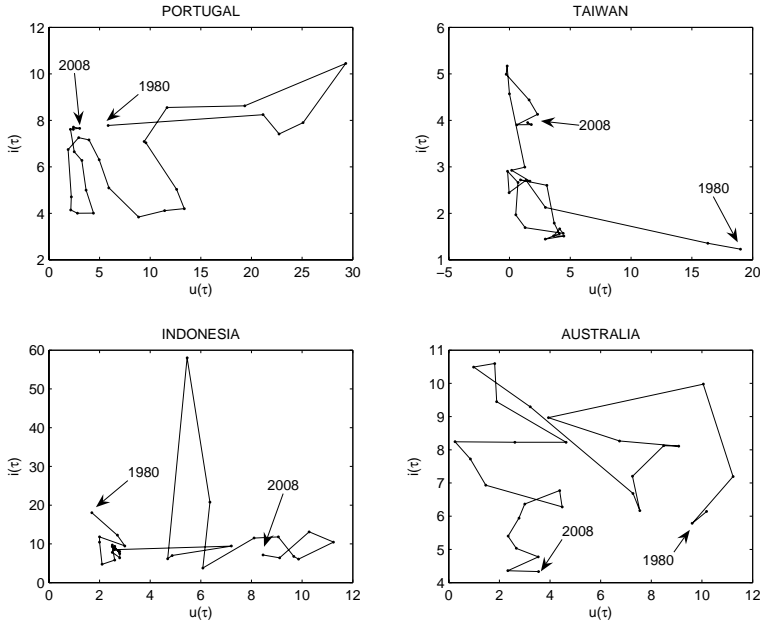
Figure 1: The Phillips Curve of Portugal, Taiwan, Indonesia, and Australia 1980-2008

its later proponents, or the monetarists' approaches and criticisms in the concept of the Non-Accelerating Inflation Rate of Unemployment (NAIRU). The latter is introduced by economist Milton Friedman in his seminal paper [3] introducing the concept on the rate of unemployment when the rate of wage inflation is stable. Some recent economic discourses related to Phillips Curve have also discussed the non-linear Keynesian macrodynamics related to the monetary policies [1].

The paper brings the discussions related to the generality as well as locality that could be seen in the Phillips Curve. We do this by bring the rank order statistical models on extreme value theories to the non-linear relation between unemployment and inflation rate over countries with yearly datasets from 1980-2008 obtained from URL: `http://www.indexmundi.com/`.

Extreme Value Theory [7] has been widely recognized to understand the large fluctuation phenomena that are found to be happened in a lot of scientific field, roughly well known as the power-law phenomena: some events that

3

are conventionally predicted to be rare, yet not really rare empirically. The rank order statistics is used in order not to neglect the supposed-to-be rare phenomena by laid the analytical ground upon the ranking of the statistical events [13]. Some phenomena based on Indonesian data are elaborated and discussed in [11], form social conflict, text analysis, to the market behavior.

2 On Phillips Curve

As Phillips Curve has motivated by the urge to find relations between the rate of unemployment and inflation rate, it can be understood as the conditional probability distribution function $p(i(\tau)|u(\tau))$ between the inflation rate $i(j,\tau)$ and the unemployment rate $u(j,\tau)$, which as proposed in [9] can hypothetically be written as,

$$p\left(i(j,\tau)|u(j,\tau)\right) \sim g\left(\theta i^n(j,\tau)u^{n\beta}(j,\tau)\right) \tag{1}$$

for each particular country j in specific period of time τ. Here, the Phillips Curve is recognized to be governed by the universal function g. This function expresses the Phillips Curve presenting the globally exhibited element of β and the locally one θ. The global variable (as well as the universal function, g) generally can be regarded as the properties of the relation between the two macroeconomic variables, while the local one expresses how the relation between the unemployment and inflation rate are found to different over countries, period of time and observations.

By having the vector expressing the rank of the value,

$$\xi^k(j,\tau) = i_k(j,\tau)u_k^{\beta}(j,\tau) \tag{2}$$

we could implement the rank order statistics as a way to deal with the so called the Extreme Value Theory [7]. If from J different national economies we have specific vectors

$$X^j = \left\{\xi^1(j,\tau),\xi^2(j,\tau),\xi^3(j,\tau),...,\xi^K(j,\tau)\right\} \tag{3}$$
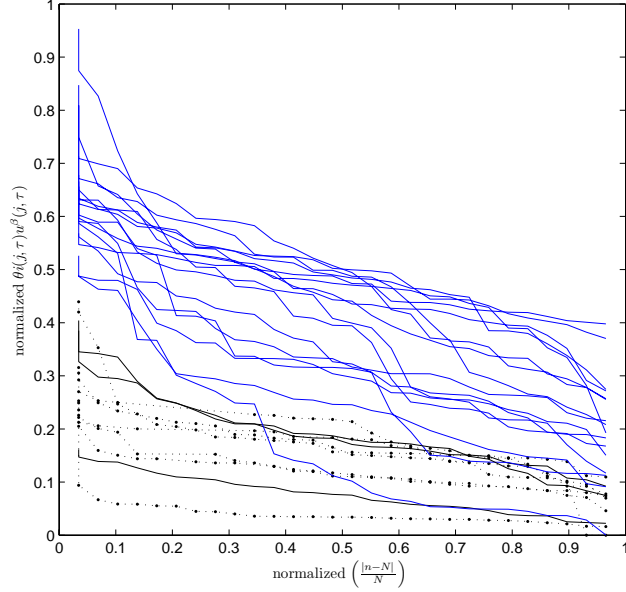
Figure 2: The rank ordered data sets from 27 countries from various regions in the world.

of increasingly sorted $\xi^k(j, \tau)$ for different timely τ dimension, as rows of matrix X which dimension is $K \times J$,

$$\xi^k(j, \tau) = \xi^1(j, \tau_1) \leq \xi^2(j, \tau_2) \leq \xi^3(j, \tau_2) \leq ... \leq \xi^K(j, \tau_T) \qquad (4)$$

for $k = 1, 2, 3, ..., K$ observation in T range of time, then we can build analysis of the events by focusing on ξ^k. As shown in [9], while the case of normality, a the value if k and K are very large, there would be standard error function of,

$$\phi\left(\frac{\xi^k(j, \tau)}{\sigma}\right) \approx \frac{k}{K} \qquad (5)$$

while the Levy distribution of which exponent γ gives,

$$p(\xi^k) \sim C|\xi^k|^{-1-\gamma} \qquad (6)$$
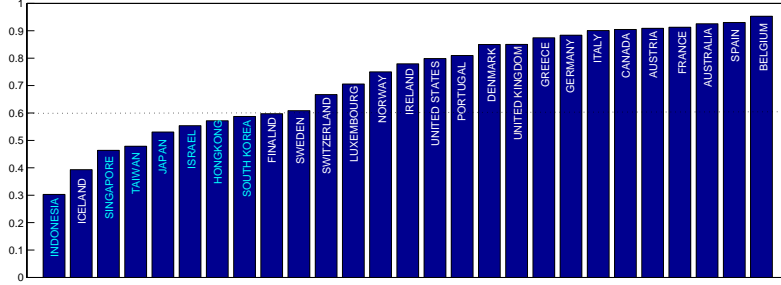
gives the relation of,

5

Figure 3: The θ coefficients of countries by calculation with $\beta = 0.25$.

$$\xi^k(j,\tau) = \left[\left(\frac{C}{\gamma}\right)\left(\frac{K\gamma+1}{\gamma(K-k)+1}\right)\right]^{\frac{1}{\gamma}} \quad (7)$$

for the smaller ranks, $K - k \ll K$ - a fact that presents the croossover patterns between the Levy regime to the normality (Gaussian).

From the equation [1], we could have the probability

$$P\left(i(j,\tau) < Cu^{-\beta}(j,\tau)\right) = \int_{-\infty}^{Cu^{-\beta}(j,\tau)} p(i(j,\tau)|u(j,\tau)di(j,\tau) \quad (8)$$

that in return,

$$P\left(i(j,\tau) < Cu^{-\beta}(j,\tau)\right) = \int_{-\infty}^{C\theta} g((z)dz = \Phi(C\theta) \quad (9)$$

where the function Φ, by normalization, is $\Phi(-\infty) = 0$ as $\Phi(\infty) = 1$.

Thus, it would bring the rank value $\xi^k(j,\tau) = f(i_k(j,\tau), u_k(j,\tau)$ that is determined by $K\Phi\left[\theta i_k(j,\tau)u_k(j,\tau)\right]$. From here, we can draw figure 2 that shows how the pattern of the unemployment and inflation rate becomes seemingly similar over countries. In the figure, we use the global parameter as pointed out in [9] to be $\beta = 0.25 \pm 0.05$ yet the differences between countries one another will let alone governed by a single variable of θ. The latest variable can be simply calculated by having the rank ordering series of

$$\theta i_k(j,\tau)u_k(j,\tau) \sim f\left(\frac{|n-N|}{N}\right) \quad (10)$$

6

that can simply be solved to approximate the good enough θ in the form of linear fit to the respective logarithmic,

$$\log \theta + \beta \log u_k(j, \tau) = \log \left(\frac{|n - N|}{N} \right) - \log i_k(j, \tau) \qquad (11)$$

The approximation of the value of the local variables θ for the 27 series of our data set is shown in table 1.

Table 1: The Result of Calculation with $\beta = 0.25$

Countries	θ	$R_{linearfit}$
AUSTRALIA	0.9255	0.89891
AUSTRIA	0.9087	0.8423
BELGIUM	0.953	0.84041
CANADA	0.9046	0.90138
DENMARK	0.8497	0.95861
FINLAND	0.5973	0.92043
FRANCE	0.9128	0.81316
GERMANY	0.8837	0.83235
GREECE	0.8744	0.81386
HONGKONG	0.57158	0.93225
ICELAND	0.3931	0.98379
IRELAND	0.7793	0.97921
INDONESIA	0.3028	0.60719
ISRAEL	0.5535	0.91954
ITALY	0.9006	0.83634
JAPAN	0.5304	0.88563
KOREA SOUTH	0.5872	0.8437
LUXEMBOURG	0.7056	0.94835
NORWAY	0.7501	0.89697
PORTUGAL	0.8097	0.91672
SINGAPORE	0.4635	0.89338
SPAIN	0.9302	0.93349
SWEDEN	0.6084	0.93957
SWITZERLAND	0.667	0.80034
TAIWAN	0.4787	0.90119
UNITED KINGDOM	0.85	0.96031
UNITED STATES	0.7987	0.89007

It is interesting to see the various values as shown in the table. However,

it is much more interesting to ponder over the detail data for each countries as shown in figure [3]. From the figure we could see apparently that all countries from Asia region have smaller values of θ while most european as well as the United States and Australia exhibit larger one $\theta > 0.6$. As we recognized that the θ represents the localilites in the probabilistic relation between the unemployment and the rate of the price index over countries, we have the apparent similarities shown by countries regarded to the economic regions. The different economic regions could obviously represents the various specific characteristic of social living as well as economic policies ruled by each governments and markets in general.

The different values of the variable is also actually shown in figure [2] for the asian countries are drawn in dotted lines while the other contries with solid ones. Thus, it is obvious there is generality expressed by the calculation with the global function and coefficient β and particular social and economic living on each localilites are shown by the local variable θ. Here we can say that there exists actually relation between the price index and the rate of the unemployment over countries in general but yet, there are levels of localities that yield the differences as we plotted the twos in conventional Phillips Curve.

3   Concluding Remarks

We use an application from the extreme value theory, i.e.: the rank order statistics to see the generality that is implicit in the relation between two macroeconomic variabels: the unemployment rate and the inflation rate. Both have been widely discussed in the representation of Phillips Curve in economics. The rank order statistics is an important tools that can be used in order to extract some information in data that might not be obvious by using conventional point of views.

Out observation with the data representing various countries in diverse social and economic regions has lead to the existence of general pattern that could see the generality of the two variables in the built model: one as the global variable and the other representing the uniqueness that might become

the source of the varisites in the classical representation of the Phillips Curve. Interestingly, we could see that there is conjecture that the local variables calculated over the data set from countries converge to the distinguishment between countries with different socio-economic regions: those representing the Asian countries with Australia, European and the United States. This might lead us to the more comprehensive understanding on why some different socio-economic region might reveal unique and particular handlings on social and economic policy while facing the general and similar problems.

4   Acknowledgement

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