Spectra of economic inflation

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Abstract: In this article, we derive relations between inflation and rate of unemployment for a set of economic systems, using a theoretical model developed under the spell of Maxwell's electrodynamics. Inflation in a place, in the model, is proportional to the frequency of economic power flow to the place from outside. Rate of unemployment in that place is a power law function of the frequency. Relations are of power law types i.e. inflation varies inversely as a power of rate of unemployment. Consequently, we get a spectrum of inflationary exponents. Exponents obtained are 2/5, 2, 2/(5+4l), 6.7; 1/6, 1/4, 1/(2l+6), 0.26; 1/4, 1/2, 1/(2l+4), 0.61; -2/3, -2/7, 2/(4l-3), -0.2; 1, -1, 1/(2l+1), -0.4 respectively; where, l is a positive integer. We draw few representative Phillips curves i.e. graphs of inflation vs rate of unemployment, discuss about the consequences of the spectra and surmise about the relevance of CPI over WPI from the model.

Keywords: inflation; spectra; Phillips curve; model of economics; electrodynamics

JEL classification: P00; E31; E40; F00; J21; J24; J64; L16; P51

Introduction:

Inflation is quite common in physics due to cosmology. Cosmological inflations occur in early universe [1- 4] and at late time [5]. In the standard model of cosmology, early universe inflation leads to Harrison-Zeldovich scale- invariant spectrum [6, 7] of density fluctuation. Microscopic mechanism behind inflation is an active area of research. It's natural to look for inflation in other areas of knowledge. In another domain, where it is oftquoted is economics with empirical relations between inflation of different kinds and rate of unemployment far from few. Deriving the empirical relations, notably Phillips curve, [8], is challenge for economic models. Apart from derivation, do we get a spectrum of inflation? In this letter, we proceed to get a spectra, an effort in the same spirit as toy model calculation in physics. We proceed recounting the development of research in inflation in economics.

The famous observation "...money...first quickens the diligence of every individual, before it increases the price of labour" way back in 1752 by celebrated David Hume, [9], contemporary of Adam Smith, [10], is about wage inflation. Almost two hundred years passed by before A. W. Phillips, [8], plotted the datas of wage inflation rate vs. unemployment rate in the context of U.K. for the period 1861-1957 and fit it with a power law curve. That followed a flurry of research for correlations between inflation and unemployment with a motivation for policy making, [11-16]. Samuelson and Solow plotted the datas for USA for the same period 1861-1957, with price inflation vs unemployment rate [17]. They considered supply-side inflation. The corresponding price index is wholesale price index or, WPI. With time, wage rate as a standard waned in importance, price index took the center stage. The rate of change of price index as a measure of inflation became commonplace. Here, following a theoretical framework developed by us, [18], we derive relationship between inflation and unemployment rate, like in Phillips curve, with various exponents.

Our work is in line with kind of study undertaken in econophysics. Econophysics is application of physics to economics, [19, 20]. It got initiated with Louis Bachelier, [21], in the year 1900, was followed by Mandelbrot in 1961, [22], and others who have been applying stochastic equation to stocks in stock market, [23]. Apart from application of tools of statistical physics, [24-26], to statistical properties of income or, price fluctuations, use is being made of non-linear dynamics, Random Matrix Theory and network theory, [27]. On the other hand, the earlier work of us, [18], is proposition of a model of economics, developed under the shadow of electrodynamics. Our analysis is local, model is theoretical rather than descriptive or, applied.

In the model of economics, [18], we have proposed, economic power flow is a vector analogous to Poynting vector in electrodynamics. Economic power flow, flows with time, through three space. Three dimensional space is locally composed of two dimensional plane and a " third dimension". A " third dimension" is the third dimension, communication is being made along that electrically or, electromagnetically i.e. by landline or, through satellite. Economic power flow vector is composed of space-time varying competition flow and profit flow vectors, intertwined. Once, economic power flow vector reaches a place, it induces competition flow and profit flow through the populace, through scattering/absorption of appropriate type depending on the nature and extent of human and capital infrastructure available to that region at that time, generating employment, generating inflation. Often inflation and employment rates are correlated. Rate of inflation vs rate of unemployment in many cases, for short time scale, has power law dependence. The exponent varies depending on where, economic activity flow is making the landfall and what kind of economic activity flow it is.

We consider economic systems visualisable as ''absorber" or, "scatterer", absorbing or, scattering through economic interactions, analogue of electromagnetic interaction. Economic power flow to those systems are considered to be from other economic systems, envisioned as ''radiators", radiating economic activity in ways similar to electromagnetic radiation.

In the section II, we review our earlier work, [18], as suited for the purpose of this paper. In the next section, section III, we describe the electromagnetic radiations/ scatterers as studied for our purpose. In the section IV, we elucidate on deductions of Philips curve. This we do in the monetary sector. In the following section, section V, we describe economic systems conceivable as "radiators/ scatterers". In the section VI, we deduce spectra of inflation. We discuss CPI vs WPI in the section VII. After the acknowledgement section, section VII, we go on to end the paper with bibliography in the section IX.

MODEL

The four equations of economics, in this model, [18], are

$$s_0 \nabla . \vec{c} = -n,$$

$$\nabla . \vec{P} = k_0 \rho_K,$$

$$\nabla \times \vec{c} = -\frac{\partial}{\partial t}\vec{P} - k_0 \vec{K},$$

$$\nabla \times \vec{P} = s_0 k_0 \frac{\partial}{\partial t}\vec{c} - k_0 \vec{M}.$$

with continuity equations,

$$\nabla \cdot \vec{M} + \frac{\partial}{\partial t} n = \frac{\partial}{\partial t} n_p,$$

$$\nabla \cdot \vec{K} + \frac{\partial}{\partial t}\rho_K = \frac{\partial}{\partial t}\rho_{K_p}$$

Where, n_p is the amount of money being printed or, destroyed in a mint and ρ_{K_p} is the density of capital being created or, destroyed. The four equations are covariant under the duality transformation

$$\vec{c}' = \vec{c} cos\delta + c\vec{P} sin\delta,$$

$$c\vec{P}' = -\vec{c} sin\delta + c\vec{P} cos\delta,$$

$$-cn' = -cncos\delta + \rho_K sin\delta,$$
$$\rho'_K = cnsin\delta + \rho_K cos\delta,$$
$$-c\overrightarrow{M'} = -c\vec{M}cos\delta + \vec{K}sin\delta,$$
$$\vec{K}' = c\vec{M}sin\delta + \vec{K}cos\delta,$$
$$cPi'_c = cPi_c cos\delta + Pi_s sin\delta,$$
$$Pi'_s = -cPi_c sin\delta + Pi_s cos\delta,$$

Moreover, $c^2Pi_c^2 + Pi_s^2$ remains invariant under duality transformation. [28]

The main economic variables here are competition flow $\vec{c}$, profit flow $\vec{P}$, money flow $\vec{M}$, capital flow $\vec{K}$, money density i.e. money per unit volume n, capital density ρ_K, price index desirable by a consumer (a supplier) $Pi_{c(s)}$, economic power flow $\overrightarrow{E_p}$, economic activity E_a, inverse of basic strength-scale of currency s_0 and basic technical knowhow+political power k_0 respectively.

Consumer price-index, Pi_c, appears through $\vec{c} = -\nabla(-Pi_c)$, implying $\nabla^2 Pi_c = -n\frac{1}{s_0}$. As money density increases, price-index also increases, we see inflation. Price index over space and time is determined by two considerations, by prices and consumption ratios of various items at a place at a given time and by prices and consumption ratios of items at another time and/or at another place, compared to the base prices and consumption ratios. The prices and consumption ratios of items change continuously over the space and time. Hence, price index, $Pi_{c(s)}$, changes continuously over space and time and consumer price index, Pi_c, is analogous to negative of electrodynamic scalar potential, $\emptyset_e$. A relevant fact worth mentioning in this context is that gas index in U.S.A is based on the price of gas at a point where majority of the gas pipelines intersect.

Moreover, competition flow is analogous to electric field, profit flow to magnetic field, negative of money flow to electric current density, negative of money density to electric charge density, s_0 to vacuum permittivity, ϵ_0, k_0 to vacuum permeability, μ_0, s to permittivity of a medium, $\epsilon_0\epsilon_r$, k to permeability of a medium, $\mu_0\mu_r$, $\vec{E}_p$ to Poynting vector, E_a to energy density and employment generation rate < *employment* > to σ_{cross} multiplied by power < P > respectively.

Here, we note that money density, n, means nominal money density. $\frac{n}{s_0}$ refers to real money density. Again, along competition flow vector, number of persons move. Flux of competition flow vector, i.e. number of persons crossing per unit area per unit time radially inward for a spherical region of unit radius, containing real money density $\frac{n}{s_0}$ is $\frac{1}{4\pi}\frac{n}{s_0}$. Again, n may refer to a constrained note, say an advertised job. In that case along competition flow vector, number of applications move.

ELECTRODYNAMIC RADIATORS/SCATTERERS

Equations and concepts of our model are in correspondence with those of electrodynamics. Radiation and absorption/scattering are predicted to occur in electrodynamics and so are predicted to take place in economics systems by our model. We describe, in the following, power law radiator in electrodynamics and some media scattering/absorbing through electromagnetic interaction, for the purpose of translation to economic systems.

Dish, horn, dipole antennas are common sight due to mobile towers. Those receive and transmit electromagnetic radiations. There are various sources of electromagnetic radiation, [29, 30]. Amidst the macroscopic sources, we have Hertzian dipole or, short dipoles of electric or, magnetic types, [31, 32]. For both types, radiated power varies as ω^2. Then there are long dipoles of half-wave type, [32, 33]. Emitted power is independent of frequency. There are different other types of broad-band antennas like log-spiral, V-antennas etc., [34]. For horn antenna, in a specific domain, power emitted depends on frequency square, [34, 35]. For microscopic antennas like electric/magnetic dipoles, quadrupoles etc. or, in general for l-pole, total energy spewed off per unit time, goes as ω^{2+2l}, [32, 36]. l is a positive integer. Here, charges move with non-relativistic velocity. For point charge moving with ultra-relativistic velocity, accelerating as well, emission is over a broad-range of frequencies. For a gas of such particles, like Crab nebula, emitted power varies as $\omega^{-\delta}$, where, δ = 0.35,1.50; [32, 37], for frequencies up to ultraviolet and beyond ultraviolet respectively.

When an electromagnetic radiation falls on a medium, following things, [32], happen depending on the frequency of radiation and the medium.

For very low frequency, absorption takes place. For infinite medium like sea water, absorption cross-section goes as $\omega^{\frac{1}{2}}$, [32]. For low frequency, absorption takes place in the neighbourhood of a resonance frequency, ω'. The cross-section, [38], σ_{cross}, or, probability for the process to occur at a frequency, ω, being

$$\sigma_{cross} \sim \frac{\Gamma}{(\omega - \omega')^2 + \Gamma^2}$$

where, Γ is dissipative factor. At the resonance frequency, naturally we have a bump in the cross-section. For high frequency if the system is finite, classical scattering occurs, known as Rayleigh scattering with $\sigma_{cross} \sim \omega^4$[32]. If that frequency falls in the range of critical phenomena, $\sigma_{cross} \sim \omega^2$, [32].

For higher energy (frequency), quantum mechanical processes start taking over. For lower end of the higher energy band, photoelectric effect is the dominant process. As the energy increases of the infalling radiation, Compton scattering starts becoming important. At still higher energy, pair production takes over, [32, 39, 40]. All the cross-sections, apart from resonance absorption, have a form $\sigma_{cross} \sim \omega^{\beta}$.

In the following, we go on to explore the consequences of the equations of economics and derive spectra of inflation, translating knowledge of electrodynamic radiation. We discuss economic situation which is analogous to electromagnetic radiation with power, $< \mathrm{P} > \sim \omega^{\alpha}$.

For that, we tabulate the discussed set of electromagnetic radiators and absorber/scatterers of power law type, in table, I.

TABLE I. **electromagnetic radiator, absorber/scatterer**

Radiator: Emitted power, $< \mathrm{P} > \sim \omega^{\alpha}$	Absorber/Scatter: Scattering cross-section, $\sigma_{cross} \sim \omega^{\beta}$
Hertzian-dipole: $< \mathrm{P} > \sim \omega^{2}$	Infinite medium like seawater at very low frequency: $\sigma_{cross} \sim \omega^{\frac{1}{2}}$
Broadband: $< \mathrm{P} > \sim \omega^{0}$	Infinite medium near resonance: $\sigma_{cross} \sim$ bumps
Multipole: $< \mathrm{P} > \sim \omega^{2+2l}$	Finite medium classical scatterer, at low frequency: $\sigma_{cross} \sim \omega^{4}$; near critical frequency: $\sigma_{cross} \sim \omega^{2}$
Horn: $< \mathrm{P} > \sim \omega^{2}$	Photoelectric effect absorber: $\sigma_{cross} \sim \omega^{\frac{7}{2}}$
Crab nebula: $< \mathrm{P} > \sim \omega^{-\delta}$	Compton scatterer: $\sigma_{cross} \sim \frac{1}{\omega} ln\omega$

PHILLIPS CURVE

In economics, inflation rate, Π, is defined as

$$\Pi = \frac{d}{dt} lnPi$$

Since,

$$\emptyset_e \leftrightarrow Pi_c, \frac{d}{dt} ln\emptyset_e \leftrightarrow \Pi.$$

i.e.time derivative of logarithm of scalar potential is expected to show features of economic inflation. We note from the theory of radiation in electrodynamics,

$$\frac{d}{dt} ln\emptyset_e \sim \omega,$$

for power law radiation, we are concerned with. Hence,

$$\Pi \leftrightarrow \omega.$$

Total power emitted, $< P >$, is given by

$$< P > \sim \omega^{\alpha}.$$

For the photoelectric effect, as an example, cross-section, σ_{cross}, or, probability for the process to occur is

$$\sigma_{cross} \sim \frac{1}{\omega^{\frac{7}{2}}}.$$

Photoelectric effect is producing free electrons at the cost of work-function. This phenomenon is similar to employment generation from the pool of unemployed youth at the cost of lump sum money. In India, this is like giving one-time small money/loan to buy, say, an auto/a cab to an unemployed young man and making him self- employed. Hence, employment generation rate, denoted as $< employment >$ is the analogue of total transition rate, $< P > \sigma_{cross}$. But $< P > \sigma_{cross} \sim \omega^{\frac{2\alpha-7}{2}}$, implying $< employment > \leftrightarrow \omega^{\frac{2\alpha-7}{2}}$. Moreover, product of employment generation rate and unemployment generation rate is constant, because the two processes occur in mutually exclusive sectors, influencing each other in extreme cases, viz. percolation of software jobs to mechanical and clerical sectors. In other words,

$$< employment >< unemployment >= constant.$$

This leads to $< unemployment > \leftrightarrow \frac{1}{\omega^{\frac{2\alpha-7}{2}}}$,or,

$< unemployment >^{\frac{2}{7-2\alpha}} \leftrightarrow \omega$. Since two economic quantities, II and$< unemployment >^{\frac{2}{7-2\alpha}}$, are analogue of ω, these two are proportional to each other i.e.

$$\Pi \sim < unemployment >^{\frac{2}{7-2\alpha}}.$$

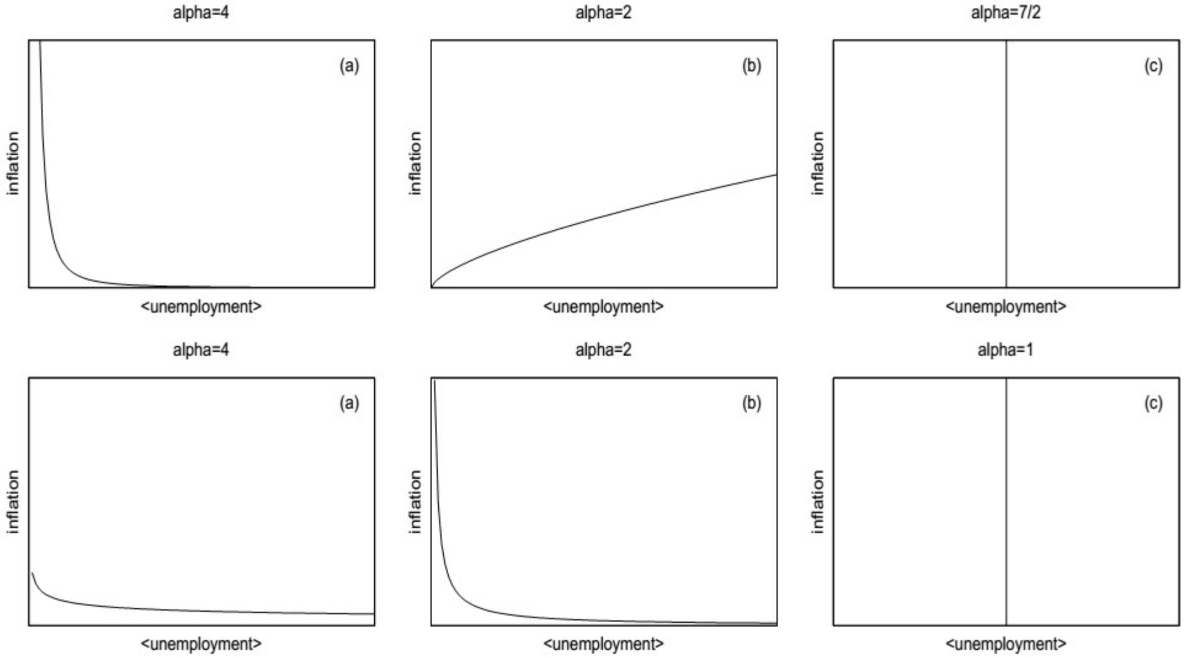

FIG. 1. Inflation as a function of rate of unemployment (qualitative plot) due to "photelectric effect absorption" ("Compton scattering") . Left figure, (a), represents Phillips curve, $inflation\sim\frac{1}{<unemployment>^2}$ ($inflation\sim\frac{1}{<unemployment>^{\frac{1}{3}}}$), for dipole i.e.$< P > \ \omega^{\alpha=4}$; middle figure, (b), refers to Philips curve, $inflation\sim\frac{1}{<unemployment>^{-\frac{2}{3}}}$ ($inflation\sim\frac{1}{<unemployment>}$), for $< P > \ \omega^{\alpha=2}$ i.e. Hertzian dipole and right figure, (c), is depiction of Phillips curve, $< unemployment > = constant,$ for $< P > \ \sim \omega^{\alpha=\frac{7}{2}}$($< P > \ \sim \omega^{\alpha=1}$).

Once plotted, this relation gives a curve like Phillips curve for a particular value of α.One interesting case is $\alpha = \frac{7}{2}$. Inflation increases with unemployment remaining constant, Fig.1(c).

On the other hand, Compton scattering is like pumping money in risky assets. Pair production is like bringing an woman to work place at the cost of a vacancy at the household cores. Consequently, in the domain where Compton scattering becomes important,[41], $\sigma_{cross} \sim \frac{1}{\omega} ln\omega.$, resulting in $\Pi\sim < unemployment >^{\frac{1}{1-\alpha}}$, apart from a slowly varying scale-dependent logarithmic part. $\alpha = 1$ is interesting, Fig.1(c) [42]. Inflation increases with unemployment remaining constant.

For multiple radiation of order l, the total power radiated is given by, [32], $< P >\sim \omega^{2l+2}$ which is a special case of power law radiation with $\alpha = 2l + 2$. For $l = 1$, it is dipole, Fig.1(a).

We summaries the ongoing analysis of deduction of Phillips curve and associated inflation exponent as

$$< P > \sim \omega^{\alpha}; \sigma_{cross} \sim \omega^{\beta} \Rightarrow < P > \sigma_{cross} \sim \omega^{\alpha+\beta} \Rightarrow < employment > \sim \omega^{\alpha+\beta}$$

$$\Rightarrow < unemployment > \sim \omega^{-\alpha-\beta} \Rightarrow \omega \sim \frac{1}{< unemployment >^{\frac{1}{\alpha+\beta}}}$$

$$\boxed{\Pi \ (inflation) \sim \frac{1}{< unemployment >^{exponent}}.} \quad (1)$$

In the above Eq.(1),

$$\boxed{\text{exponent} = \frac{1}{\alpha+\beta}.}$$

This is positive for usual Phillips curve type situation. For original Phillips curve, exponent is $\frac{14}{10}$ with wage inflation in place of price inflation.

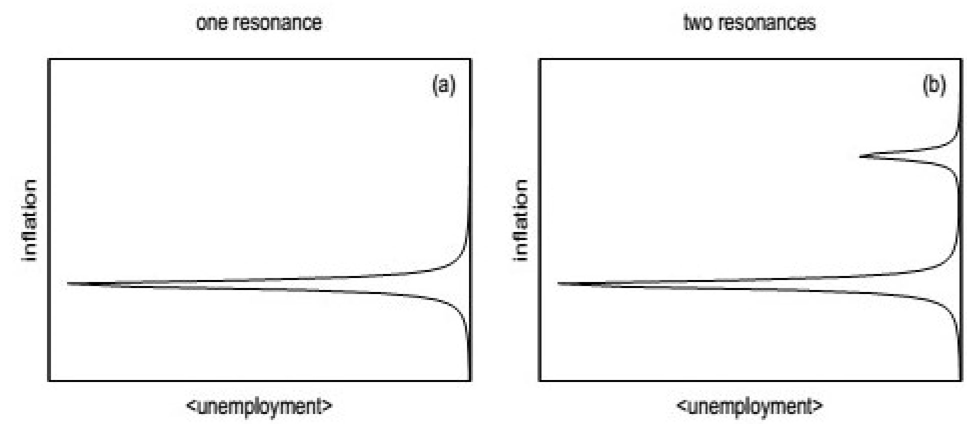

FIG. 2. Inflation as a function of rate of unemployment (qualitative plot) due to ”resonance absorption”. Left figure, (a), represents Phillips curve for one resonance and right figure, (b), refers to Phillips curve for two resonances type situations.

ECONOMIC ” RADIATORS” AND ” ABSORBER” /” SCATTERER”

We now go over to motivate and apply the analysis to broader set of economic systems. To do that we display the economic systems, we are tentatively putting forward, in this letter, on plausibility ground, in tabular form in the table, II.

TABLE II. **economic ’’radiator”, ”absorber”/”scatterer”**

”Radiator”: emitted power, $< P > \sim \omega^{\alpha}$	”Absorber”/”Scatterer”: scattering cross-section, $\sigma_{cross} \sim \omega^{\beta}$
Supply chain covering a small distance: $< P > \sim \omega^{2}$	An economic system with infinite skilled plus subsistence sector, like Jamalpur, absorbing, at very low frequency with $\sigma_{cross} \sim \omega^{1/2}$
Supply chain criss-crossing country: $< P > \sim \omega^{0}$	An economic system like Jamalpur near frequency (appropriate for mechanical skill) absorbing with σ_{cross} ~bumps
Oscillating distribution of notes over a geographical location:$< P > \sim \omega^{2+21}$	An economic system with finite skilled plus subsistence sector, like a village/township with few employable persons, along a particular trend, at low frequency absorbing with $\sigma_{cross} \sim \omega^{4}$; a village/township with strong social fabric, at low frequency absorbing with $\sigma_{cross} \sim \omega^{2}$
Small scale war zone: $< P > \sim \omega^{-0.35}$:	An economic system with a pool of unemployed young men, absorbing at high frequency, corresponding to loan or, one time lumpsum money being given, with $\sigma_{cross} \sim \omega^{-7/2}$
Intense war or, fierce fighting zone: $< P > \sim \omega^{-1.50}$	An economic system, at higher frequency, absorbing corresponding to money being pumped in risky assets, with $\sigma_{cross} \sim \frac{1}{\omega} ln\omega$

For very low frequency, say, radio frequency, wave comes and gets scattered as, $\sigma_{cross} \sim \omega^{1/2}$, putting electrons in forced vibrations with that of external frequency, in electrodynamics. In an analogous economic system, a segment of populace will respond little at the passing of the flow, creating few direct and indirect jobs. This yields, ala Eq.(1),

$$\Pi \sim \frac{1}{<unemployment>^{\frac{2}{1+2\alpha}}}. \quad (2)$$

For low frequency situation, if there is an absorptive resonance, say in ultraviolet region, all the electrons of a molecule get excited in collective oscillation mode called plasmon mode in electrodynamics. In our model, this is like full populace getting involved, huge amount of direct and indirect jobs having been created.

Infinite/finite medium is like infinite/finite skilled plus subsistence sector. When production unit comes to a place, absorption resonance occurs at specific production skills. As an example, let us consider Jamalpur in Bihar in India. There was the earliest Railway engine factory. It used to be known as Birmingham of the east. If mechanical-skilled intensive production unit comes there, it will be fully absorbed by the people over there.

For absorptive medium, near resonance(s), bump(s) appear in the cross-section. As a result, inflation vs rate of unemployment curve is as shown in Fig.2(a)(2(b)). Finite medium is like a small village/township with few employable persons along a particular trend; say, mechanical skill is there only in a certain section of people. Hence, for low frequency, when an economic activity flow comes there, we see scattering with cross-section going as ω^4, leading to, via Eq.(1),

$$\Pi \sim \frac{1}{<unemployment>^{\frac{1}{4+\alpha}}}. \quad (3)$$

When that economic activity comes across a small place with very strong social fabric, we observe sort of critical scattering with cross-section going as ω^2, resulting in

$$\Pi \sim \frac{1}{<unemployment>^{\frac{1}{2+\alpha}}}. \quad (4)$$

To motivate ’’radiators”, represented by various values of α, we recall that note and scarcity, in equal magnitude form dipole, [18] and an arbitrary distribution of notes(scarcities) over spatial region can be cast in the form of multipole expansion. Oscillation of distribution of notes in USA population, due to the propensity of the people to spend, even borrowing, acted as a source of multipole radiation which when reached China, led to manufacturing boom of the previous decades. Supply chain criss-crossing country, say East-West corridor, can act like half-wave or, full-wave or, broad-band antenna. Supply chain covering a small distance, on the other hand, is similar to an elementary Hertzian dipole. Network of supply chains in a city can yield considerable Hertzian dipole type radiations. When economic power flow from Jack Ma led the then domestic internet company with courier as its main segment, [43], reached New York stock exchange(NYSE) listing, it drew highest ever IPO in history. On the other extreme, in war zone, notes move very fast, change hands very quickly, enabling us to envision war zone as a relativistic gas of notes, radiating economic power flow like ” crab nebula”. Small scale war corresponds to crab nebula with $\delta = 0.35$. Intense war or, fierce fighting zone stands for crab nebula with $\delta = 1.50$.

SPECTRA OF INFLATION

Putting values of α in the expression of the inflation vs rate of unemployment, Eq.(1), we deduce spectra of inflationary exponents and put the exponents, as a summary, in the tabular form, in the table, III. We deduce the exponents as follows.

TABLE III. **spectra of inflation**

”Scatterer”/ ”absorber” / ”Radiator”	”very low frequency absorber”	”classical scatterer”	”critical scatterer”	”photo electric effect absorber”	”Compton scatterer”
Hertzian dipole”/”horn”	2/5	1/6	1/4	-2/3	1
”Broadband”	2	¼	½	-2/7	-1
”multipole” of order l	2/(5+4l)	1/(2l+6)	1/(2l+4)	2/(4l-3)	1/(2l+1)
”crab nebula (δ = 0.35)”	6.7	0.26	0.61		
”crab nebula (δ = 1.5)”				-0.2	-0.4

For ”Hertzian dipole”, α = 2. When economic activity flow from ”Hertzian dipole” comes and falls in a region and gets absorbed in the ”very low frequency region”, we get, through Eq.(2),

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{\frac{2}{5}}}.$$

The spectral exponent is $\frac{2}{5}$. In the ”low frequency region” or, ”classical scattering regime”, via Eq.(3), we obtain

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{\frac{1}{6}}}.$$

The spectral exponent is $\frac{1}{6}$. When ”Hertzian dipole” emitted economic activity flow reaches a small place with strong social fabric, we get

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{\frac{1}{4}}}.$$

The spectral exponent is $\frac{1}{4}$. On the otherhand, when high frequency ”Hertzian dipole” emitted economic activity flow suits ”photoelcetric absorption” in a place, we have

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{-\frac{2}{7-2\times 2}}}.$$

The spectral exponent is $\frac{-2}{3}$. At still higher frequency, we come across

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{-\frac{1}{1-2}}}.$$

for ”Compton scattering” phenomenon, if suitable populace, ”Hertzian dipole” emitted economic activity flow lands in. The spectral exponent is 1

For ”Broadband”, α = 0. When economic activity flow from ” Broadband” comes and falls in a region and gets absorbed in the ”very low frequency region”, we get, through Eq.(2),

$$\Pi \sim \frac{1}{<unemployment>^{\frac{2}{1+2\times 0}}}.$$

The spectral exponent is 2 . In the ”low frequency region” or, ”classical scattering regime”, via Eq.(3), we obtain

$$\Pi \sim \frac{1}{<unemployment>^{\frac{1}{4+0}}}.$$

The spectral exponent is $\frac{1}{4}$. When ”Broadband” economic activity flow reaches a small place with strong social fabric, we get

$$\Pi \sim \frac{1}{<unemployment>^{\frac{1}{2+0}}}.$$

The spectral exponent is $\frac{1}{2}$. On the otherhand, when high frequency ”Broadband” economic activity flow suits ”photoelcetric absorption” in a place, we have

$$\Pi \sim \frac{1}{<unemployment>^{-\frac{2}{7-2\times 0}}}.$$

The spectral exponent is $\frac{-2}{7}$. At still higher frequency, we come across

$$\Pi \sim \frac{1}{<unemployment>^{-\frac{1}{1-0}}}.$$

for ”Compton scattering” phenomenon, if suitable populace, ”Broadband” economic activity flow lands in. The spectral exponent is -1

For ”multipole of order *l*”, α = 2+2*l*. When economic activity flow of ” multipole” type comes and falls in a region and gets absorbed in the ”very low frequency region”, we get, through Eq.(2),

$$\Pi \sim \frac{1}{<unemployment>^{\frac{2}{1+2(2+2l)}}}.$$

The spectral exponent is $\frac{2}{5+4l}$. In the ”low frequency region” or, ”classical scattering regime”, via Eq.(3), we obtain

$$\Pi \sim \frac{1}{<unemployment>^{\frac{1}{4+2+2l}}}.$$

The spectral exponent is $\frac{1}{2l+6}$. When ”multipole of order *l*” emitted economic activity flow reaches a small place with strong social fabric, we get

$$\Pi \sim \frac{1}{<unemployment>^{\frac{1}{2+2+2l}}}.$$

The spectral exponent is $\frac{1}{4+2l}$. On the otherhand, when high frequency ”multipole of order l” emitted economic activity flow suits ”photoelectric absorption” in a place, we have

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{-\frac{2}{7-2(2+2l)}}}.$$

The spectral exponent is $\frac{2}{4l-3}$. At still higher frequency, we come across

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{-\frac{2}{1-2(2+2l)}}}.$$

for ”Compton scattering” phenomenon, if suitable populace, ”multipole of order l” emitted economic activity flow lands in. The spectral exponent is $\frac{1}{2l+1}$

For ”Crab nebula”, α = -δ = -0.35. When economic activity flow from ”Crab nebula” comes and falls in a region and gets absorbed in the ”very low frequency region”, we get, through Eq.(2),

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{\frac{2}{1+2(-0.35)}}}.$$

The spectral exponent is 6.7 . In the ”low frequency region” or, ”classical scattering regime”, via Eq.(3), we obtain

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{\frac{1}{4-0.35}}}.$$

The spectral exponent is 0.26 . When ” Crab nebula” emitted economic activity flow reaches a small place with strong social fabric, we get

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{\frac{1}{2-0.35}}}.$$

The spectral exponent is 0.61. Moreover,” photoelectric absorption” in a place, may suit ” Crab nebula α = -δ = -1.50” emission. Then we have

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{-\frac{2}{7-2(-1.50)}}}.$$

The spectral exponent is -0.2. At still higher frequency, we come across

$$\Pi \sim \frac{1}{\langle unemployment \rangle^{-\frac{1}{1-(-1.50)}}}.$$

for ”Compton scattering” phenomenon, if suitable populace, ” Crab nebula α = -δ = -1.50” emitted economic activity flow lands in. The spectral exponent is -0.40.

Some exponents are negative, unlike original Phillips curve. When exponent of inflation is negative, we have the interesting possibility of high inflation coupled with high unemployment. Combined with Cobb-Douglas production function, [18, 44-46],

$$q = K^{\gamma} L^{\delta}$$

where, q is rate of production, in the particular case of high production due to high capital, K, infusion, low labour, L, usage, leads us to a situation where, GDP is high, unemployment is high, inflation is also high.

On the top of it, big scale war like all engulfing world war leads to positive exponent i.e. high employment, high inflation in one place; negative exponent i.e. high inflation, high unemployment in another place. A quick look at the "crab nebula" rows in the table, III, corroborates this experience. Figs.3(a), 3(b) depict the first case and Fig.3(c) portrays the second situation.

CPI vs WPI

For electric multipole, inflation refers to inflation from consumer's side, relates to consumer price index or, CPI. For magnetic multipole, inflation is inflation from supplier's side. For magnetic multipole it is current loop which is equivalent to fictitious magnetic multipole, with corresponding fictitious magnetic scalar potential, hence the relevant inflation is supply side inflation, the relevant price index is fictitious WPI. Magnetic multipole radiation is much smaller, [36], compared to electric multipole radiation of the same order. That's why CPI is more important than the fictitious WPI

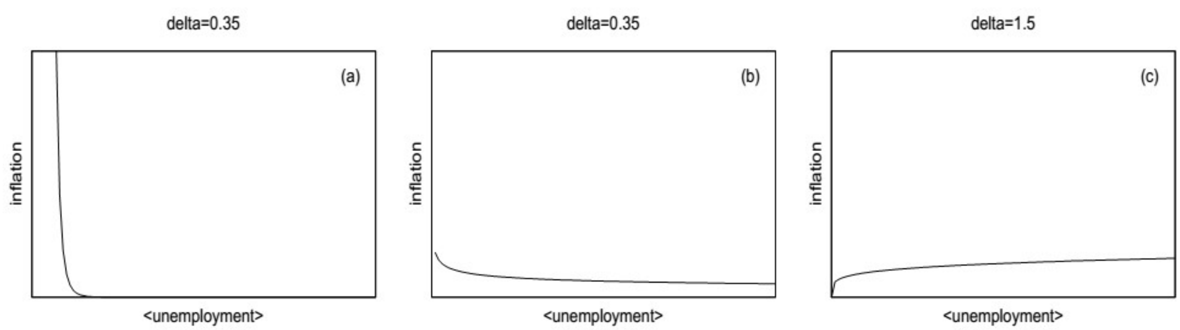

FIG. 3. Inflation as a function of rate of unemployment (qualitative plot). Left figure, (a), represents Phillips curve, $inflation \sim \frac{1}{<unemployment>^{6,7}}$ due to "very low frequency absorption", and middle figure, (b), refers to Phillips curve, $inflation \sim \frac{1}{<unemployment>^{0.26}}$, due to "classical scattering", for economic power flow from "crab nebula" with $< \mathrm{P} > \sim \omega^{\delta=0.35}$ respectively. Right figure, (c), corresponds to Phillips curve,$inflation \sim \frac{1}{<unemployment>^{-0.2}}$, due to" photoelectric effect absorption" for economic power flow from " crab nebula" with $< \mathrm{P} > \sim \omega^{\delta=1.5}$.

Similarly, electromagnetic radiation coming from capital *l*-pole variation, is c^2 times smaller than from note *l*-pole variation. There is an accompanying factor of capital density divided by note density, [35, 36]. c stands for maximum ambition. This is deduced as follows. Applying duality transformation, $\delta = \frac{\pi}{2}$,

$$\vec{C}' = c\vec{P}$$

$$c\vec{P}' = -\vec{c}$$

$$cn' = -\rho_K$$

$$\rho_K' = cn$$

note dipole moment density, *p=nd*. Capital dipole moment density, $m = \rho_K d, where,\ p_d = n_d d = \frac{\rho_K d}{c} = \frac{m}{c}$. For note dipole oscillation,

$$\vec{c} = -\frac{k_0 p \omega^2}{4\pi}\frac{\sin\theta}{r}\cos[\omega(t-\frac{r}{c})]\hat{\theta}$$

$$\vec{P} = -\frac{k_0 p \omega^2}{4\pi c}\frac{\sin\theta}{r}\cos[\omega(t-\frac{r}{c})]\hat{\emptyset}$$

$$\vec{E}_p = \frac{k_0 c}{32\pi^2}\frac{\omega^4}{c^2}p^2\frac{\sin^2\theta}{r^2}\,\hat{r}$$

For capital diploe oscillation with amplitude of capital diploe moment *m* with corresponding dual note diplole moment amplitude, p_d,

$$\overrightarrow{c'} = -c\frac{k_0 p_d \omega^2}{4\pi c}\frac{\sin\theta}{r}\cos[\omega(t-\frac{r}{c})]\hat{\emptyset}$$

$$\overrightarrow{P'} = \frac{1}{c}\frac{k_0 p_d \omega^2}{4\pi}\frac{\sin\theta}{r}\cos[\omega(t-\frac{r}{c})]\hat{\theta}$$

$$\vec{E}_p = \frac{k_0 c}{32\pi^2}\frac{\omega^4}{c^2}({p_d}^2)(\frac{\sin^2\theta}{r^2})\,\hat{r}$$

$$i.e. \vec{E}_p = \frac{k_0 c}{32\pi^2}\frac{\omega^4}{c^2}\frac{m^2}{c^2}\frac{\sin^2\theta}{r^2}\,\hat{r}$$

Hence, the economic power flow vector, $\vec{E}_p$, due to note dipole oscillation divided by that due to capital dipole oscillation is equal to $c^2\frac{p^2}{m^2}$ or, $c^2\frac{n^2}{(\rho_K)^2}$.

With heavy industries becoming out of fashion, ratio of note density to capital density increases more and more. As a result, employment generation rate is becoming more and more due to economic power flow from note *l*-pole variation compared with capital *l*-pole variation. Consequently, unemployment generation rate is less due to economic power flow from note *l*-pole variation compared with capital *l*-pole variation. Hence, for a given unemployment generation rate, inflation is much more due to economic power flow from note *l*-pole variation compared with capital *l*-pole variation. Price index associated with note *l*-pole variation i.e. CPI is much more relevant compared with price index attached with capital *l*-pole variation i.e. WPI. Hundred year back, situation was opposite. Age was of heavy industries. Printing of notes was in control. WPI was relevant. Supply side inflation was subject of study for Solow and Samuelson.

In the same vein, oscillation of distribution of workers in USA, due to the propensity of the people to leave a job and to take up a new job acted as a source of multipole radiation in the capital sector which when reached China, contributed to the manufacturing boom of the previous decades, but less than that due to oscillation of note distributions. For it's down by a factor of square of maximum ambition.

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