Stream Space Inductance

Currency Exchange Via Universal Stream Inductance

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Currency exchange occurs only in pairs. A fiat currency standing alone has no value. It must always be measured against something else of value. The value of one fiat currency is transitive toward that of a second relative to a third. There must always be some basis for comparison. One consequence of these observations is that: Although one would expect the condition of the economy of an entity issuing a fiat currency to have some effect upon its valuation, this alone is indeterminate. Without any exchange of goods or services between various entities that issue fiat currency, the quantity of currency issued by those various entities is irrelevant. While prudence would seem to dictate that the quantity of currency issued ought to vary in proportion to the quantity of exports the issuer can sustain, the value of the currency depends solely upon its relationship to currency issued by other entities with whom it interacts.

Understanding this implies less emphasis upon the productive capability of currency issuers and more upon the desirability of currencies for exchange transactions. What matters most is the use a currency achieves in all transactions. If all transactions of a highly desired commodity occur exclusively using a particular currency, then that currency gains in relation to its exchange with all other currencies. Although they themselves are fiat currencies, cryptocurrencies, such as Bitcoin, exclude themselves from this category. This would suggest an intrinsic value for Bitcoin; but none seems possible to assess. Instead, Bitcoin, and all other cryptocurrencies, are valued primarily in terms of their worth measured in United States Dollars. Yet, Bitcoin and the cryptocurrencies could serve as the basis upon which to measure all sovereign fiat currencies, i.e., those issued by government entities and not wholly within the control of the public domain.

I began my analysis of currency exchange rates by applying the fundamental proposition of finance rheology. That is, I built unbounded isosurfaces constructed from the random variables of interest to a particular financial situation. When utilizing linear isosurfaces one is able to obtain a closed form analytical solution for the optimum points of the ratio of two currency exchange rates. The construction of isosurfaces enables comparison of probability states without resorting to the adoption of a normalized probability distribution. Regardless of whether or not an underlining probability distribution exists, and presuming that it could be found, for a particular interaction of financial random variables, the use of the zero contour level isosurface permits the construction of a potential function, among other things, built upon it. Another such other thing is to be shown here.

We shall consider the exchange rate of two currencies x and y measured relative to a third. We suppose that mere transposition of the two exchange rates does not yield an optimum; be it either maximum, minimum or saddle point. Since we regard financial markets to exist rarely within an equilibrium state, we suppose mere transposition of the two exchange rates relative to a third currency to yield the markets embrace of transient conditions. The zero contour level for a linear isosurface composed of these two random variables is shown as equation (1):

$$0 = \upsilon x + \nu y + \omega \tag{1}$$

Here υ, ν and ω are the undetermined coefficients of a three dimensional surface that are to be defined through a least squares regression criterion.

How well a linear isosurface conforms to the empirical data used within the least squares regression to calculate the coefficients υ, ν and ω determines the degree of success of the procedure. However, as one will soon see, the conformity of the data to the structure of the isosurface is readily apparent. Statistical measures of the fit of the data within the regression analysis indicate little. The best determination remains classic graphical visualization. We achieve this by first defining a transformation of the two independent random variables, x and y, to a new set of variables, ξ and ζ, respectively. We define them as:

$$\xi = \frac{\upsilon x}{\omega} \tag{2}$$

and

$$\zeta = \frac{\nu y}{\omega} \tag{3}$$

Using both definitions from (2) and (3) within our equation for the isosurface (2) yields:

$$0 = \xi + \zeta + 1 \tag{4}$$

We have in equation (4) a simple algebraic relationship. There is nothing universal about it. It cannot hold under all circumstances. It only when holds true ξ and ζ add to negative unity. One needs to break this determinacy to add flexibility.

To accomplish this task we define a stream function, ψ. Our two transformed random variables, ξ and ζ, will define the phase space for this function. We define them in terms of the stream function as:

$$\xi = -\frac{\partial \psi}{\partial \zeta} \tag{5}$$

and

$$\zeta = \frac{\partial \psi}{\partial \xi} \tag{6}$$

Note that stream functions exist when potential functions do not. This is most notable for rotational fields.

Using our stream space variables within the algebraic (4) makes it a first order partial differential equation:

$$0 = \frac{\partial \psi}{\partial \xi} - \frac{\partial \psi}{\partial \zeta} + 1 \tag{7}$$

This equation is time invariant. It is not a wave equation. No similarity variables exist for it. We have no boundary nor initial conditions to impose upon it. It has the general solution:

$$\psi = \frac{\xi^2 + \zeta^2}{2} + \xi\zeta + \frac{\xi + 3\zeta}{2} + \psi_0 \tag{8}$$

Here ψ_0 is a constant of the integration. It determines the level of the surface above the $x - y$ plane at $z = 0$ in a right-handed Cartesian coordinate system. Its virtue is that its gradient defines the phase space for our transformed currency exchange rates. Its height above, or below, the horizontal plane a $z = 0$ is determined by the choice of the currency pair being analyzed. Figure 1 presents a plot of the unbounded isosurface with the integration constant ψ_0 set equal to zero.

Every point on the isosurface defines the two components of the gradient. They in turn represent the transformed currency exchange rate variables. After one has evaluated the isosurface coefficients υ, ν and ω, one can then transform stream space variables back into the original currency exchange rates. As a check upon the suitably of the method, one must inspect the phase space plot of the stream variables. If the empirical data falls within an acceptable straight line, then the method may be used. The gradient is unaffected by the value of the height constant ψ_0. But it does move different values of the gradient to the intersection of the horizontal plane at the origin. This is why, as one will soon see, the phase space plots for different currency pairs have differing magnitudes on their axes.

Figures 2 and 3 present the stream variables phase space for the USA Dollar conversion with the Pound Sterling using the Basecoin, and then the Bitcoin, as the reference basis, respectively. In this particular case the Bitcoin basis provides a superior linearity curve-fit to the empirical data. Such data is to be found on the Grisafi website. Figure 4 presents the stream variables phase space for the Euro Dollar conversion with the Pound Sterling using the Bitcoin as the reference basis. Figure 5 shows the stream space for the Swiss Franc conversion with the Euro Dollar using the USA Dollar as the reference basis. Both phase

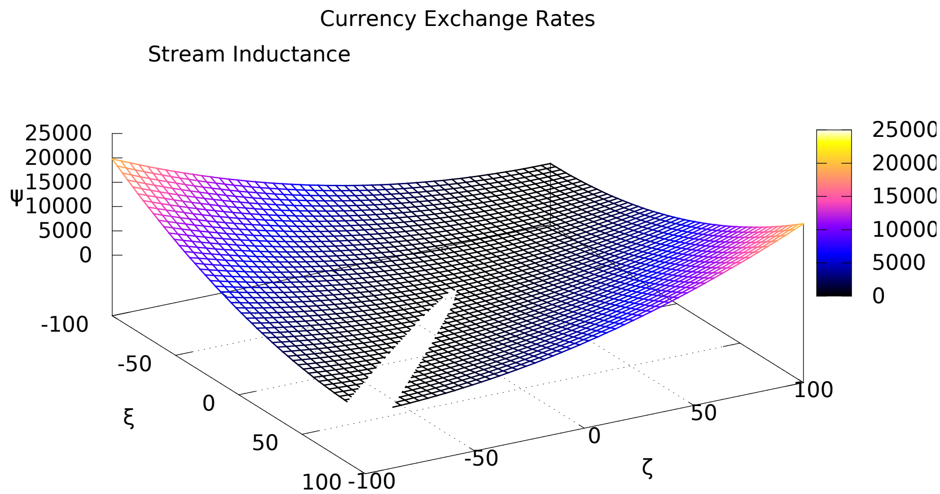

Figure 1: Stream Inductance Function

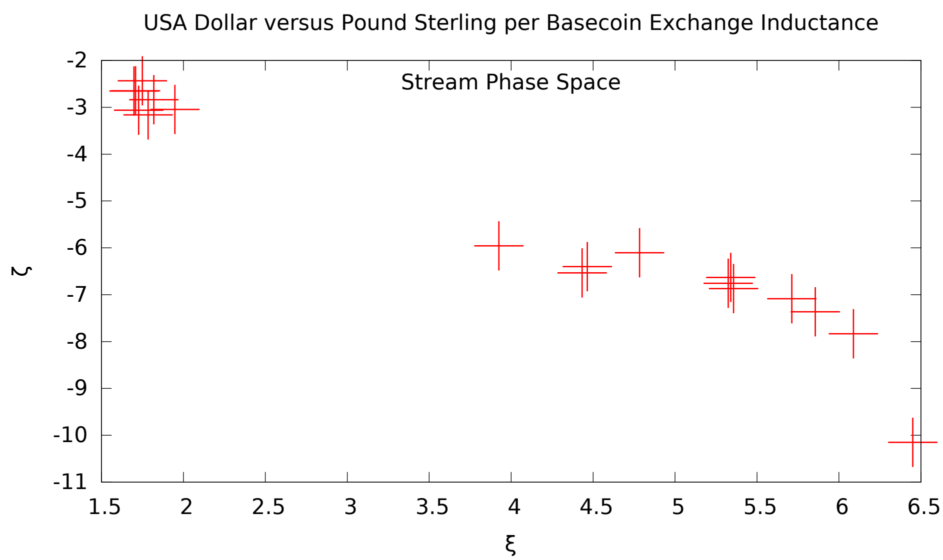

Figure 2: USA Dollar versus Pound Sterling via Basecoin

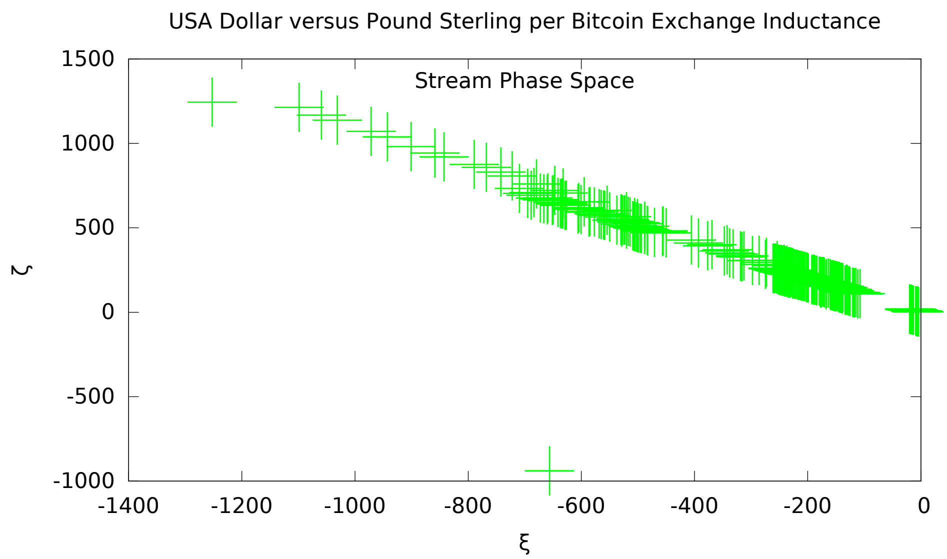

Figure 3: USA Dollar versus Pound Sterling via Bitcoin

space plots show a good linear relationship indicating a good fit for the isosurface to the empirical data.

Figure 6 shows the stream space for the Pound Sterling versus Basecoin conversion utilizing Bitcoin as the reference basis. The plot indicates some degree of linearity. But it is not as good as that shown for any of the other Pound Sterling conversion plots. Figure 7 shows the stream space for the conversion of the Swiss Franc with the Pound Sterling using the USA Dollar as the reference basis. As with figure 6, the plot indicates some linearity. But the curve-fit is not as good as that for the Swiss Franc conversion with the Euro Dollar using the USA Dollar as the reference basis that is shown in figure 5. In such cases, when the indication of linearity is weak, one would then consider the statistics of the least squares regression used to fit the coefficients υ, ν and ω to the empirical data. One would need to decide the precision that one is to apply to an estimate of the exchange rate. Finally, an adroit finance rheologist must remember that an isosurface analysis may yield convergence upon any optimum point, be it either maximum, minimum or saddle point. Since symmetry dictates that every maximum is also a minimum, depending upon the direction of the trade, one needs to invoke common sense and consider the magnitude of the exchange rate to decide which is which.

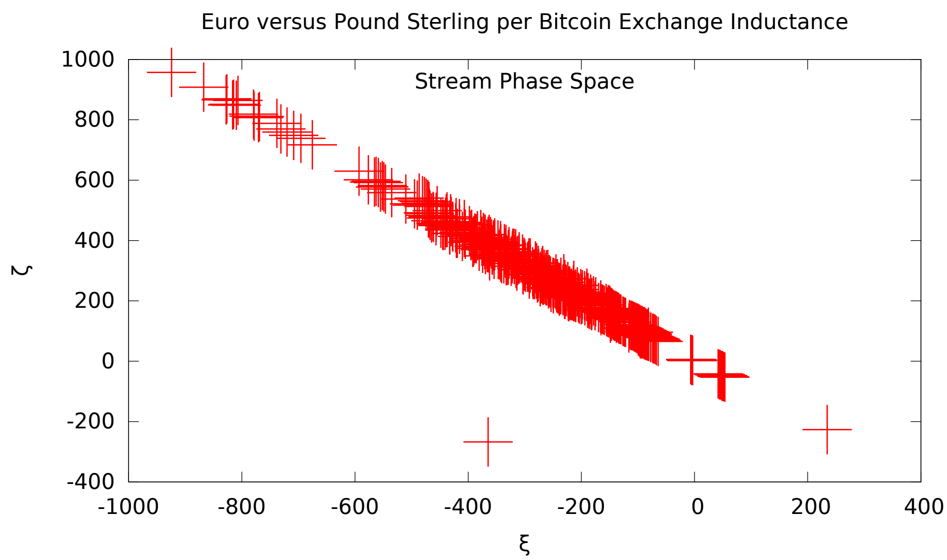

Figure 4: Euro versus Pound Sterling via Bitcoin

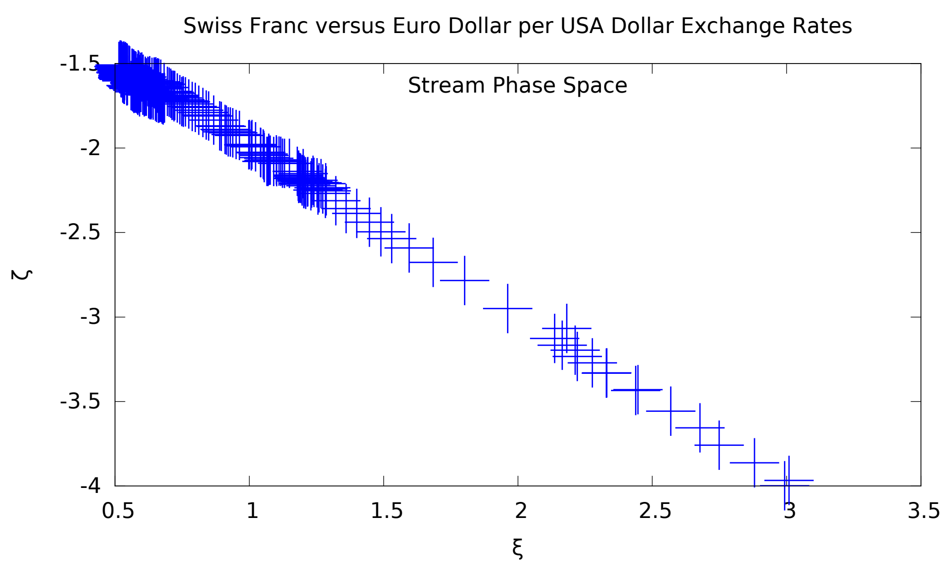

Figure 5: Swiss Franc versus Euro via USA Dollar

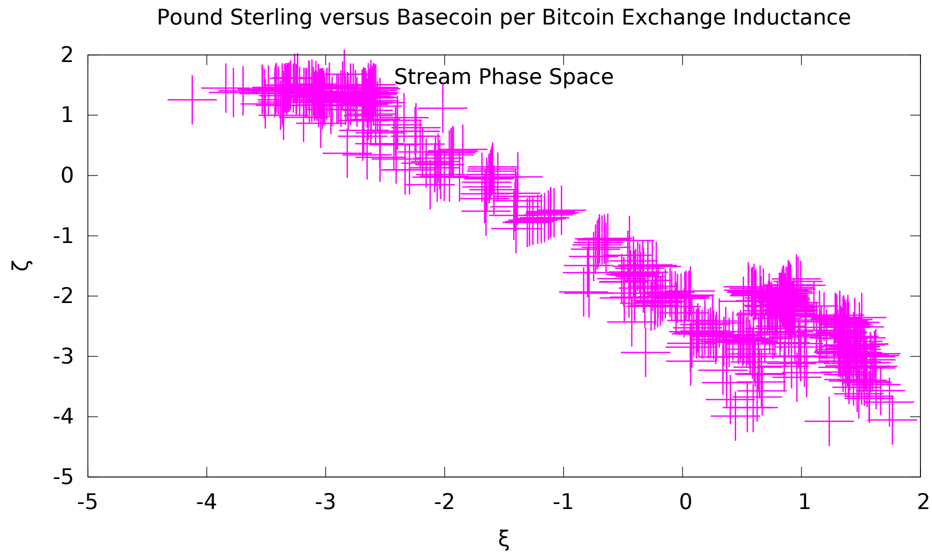

Figure 6: Pound Sterling versus Basecoin via Bitcoin

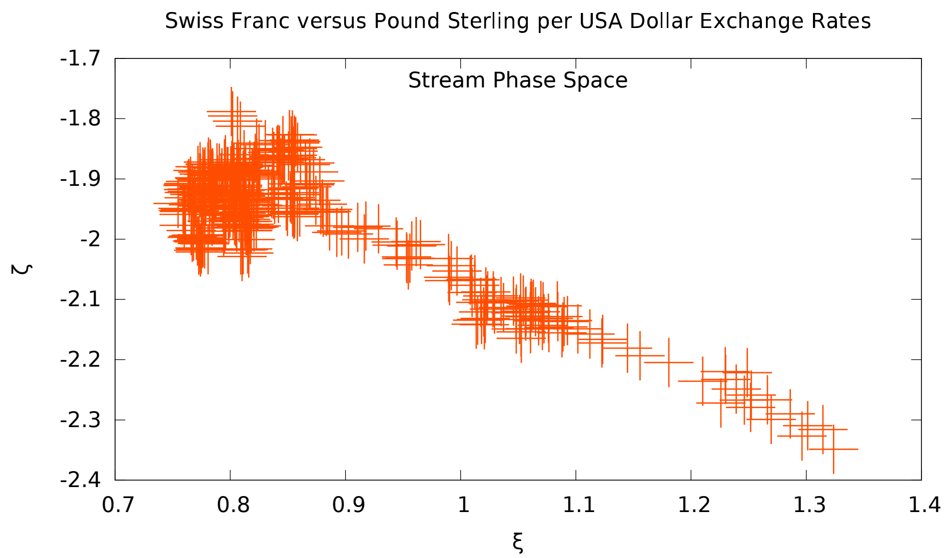

Figure 7: Swiss Franc versus Pound Sterling via USA Dollar