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FX Equilibrium: Economic Theories, Macroeconomic Variables, Models and connection between Linear Regression and Vector Correction(VEC)

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Introduction

In simple terms, market equilibrium foreign exchange rate is defined as the rate that balances the demand and supply of currency in the absence of official intervention. Just as we have in the common markets where goods and services are traded, the equilibrium foreign exchange rate is achieved as a result of the interaction of forces of demand and supply. This means if there is a shortage or surplus of a currency in the exchange market, the forces of demand and supply will interact until an equilibrium point is reached. However, in real-life scenarios, the foreign exchange equilibrium rate movement goes beyond just the effects of demand and supply. According to research work carried out by Clark and Macdonald (1997), the foreign exchange rate was noted to display a time-dependent dynamic relationship because certain economic parameters will influence the equilibrium exchange rate from the short term to the mid-term and eventually to the long term. This concept of dynamism is explained towards the end of this paper.

Economic Theories and Models used to calculate Foreign Exchange Equilibrium

1. Purchasing Power Parity (PPP)

PPP is a theory which states that exchange rates between two currencies are in equilibrium when the worth of each currency i.e. ability of each currency to purchase goods and services is the same in both countries. Therefore, the exchange rate between two currencies can be expressed as the ratio of the cost of a fixed pool of goods and services expressed in terms of both currencies. The fundamental justification for the PPP theory is the "Law of one price". The law of one price is explained with the principle of "no arbitrage" between markets i.e. price of goods and services will always remain competitive across various markets and even if there is inconsistency in the price, the forces of demand and supply will eventually make the price consistent within a very short period of time. The version of PPP explained above is regarded as an absolute PPP. Another version is the Relative PPP. Relative PPP puts into consideration the changes in price level between the two economies/ countries considered by checking for equivalency between the rate of depreciation of one currency relative to the other currency and the difference in aggregate price inflation between the countries.

The PPP theory is simple but it is not without limitations. Some are mentioned below

> i. The Law of one price may lose its validity due to certain factors such as levies, tariff, and non-tariff barriers, pricing policy of each country, etc. These factors will invariably cause a significant difference between the prices of goods and services across the two countries considered.

> ii. Even if the Law of one price holds, after some time, there will likely be variations in the quality and rank of goods and services used in the basket of goods used to evaluate the PPP parameter. This is due to the fact that consumer preferences will make producers supply only goods that will generate large volumes of revenue so that profit can be maximized. When this happens, the PPP assumption of having an identical basket of goods becomes violated.

2. Purchasing Power Parity (PPP)

Though obsolete, Mint Parity Theory seeks to explain the determination of the exchange rate based on the "metallic" standard of currencies available for exchange. According to the mint parity theory, the exchange rate under gold standard is equivalent to the gold content of one currency relative to that of another. i.e. the rate

of foreign exchange is determined in terms of the gold content of the two given currency units.

3. Interest Rate Parity (PPP)

Interest rate parity (IRP) is an exchange theory in which the exchange between two countries is equal to the interest rate difference between the forward rate and the spot rate. Interest rate parity plays an essential role in foreign exchange markets, connecting interest rates, spot rates, and foreign exchange rates.

The model for interest rate parity is given as, and parameters explained below;

$$Fo = So exp(r - rf)$$

Fo = Forward Rate

So = Spot Rate

r = Interest rate (local currency)

rf= Interest rate (foreign currency)

T = Time frame (in years)

The spot rate is the current interest rate and the forward rate is the exchange rate between the two currencies at any future point in time.

4. Fundamental Equilibrium Exchange Rate (FEER)

This concept is largely credited to Williamson (1985 and 1994). It works with the justification that the real exchange rate is compatible with both internal and external balance for a stated number of countries at the same time. Internal balance is described to be the state of a country's economy when productivity through employment is at maximum level and also having the benefit of possessing a low inflation environment. On the other hand, external balance is described as a state of having a sustainable balance of payment position within a mid-term period, generating an appreciable net difference in resources and external debt sustainability. Another observable trait of the FEER approach is that it concentrates on key "economic basics" which are expected to remain persistent within the mid-term period. Therefore, the FEER approach is considered as a normative indicator of equilibrium exchange rate because it follows the trend of ideal economic circumstances of both internal and external balances mentioned earlier.

5. Behavioral Equilibrium Exchange Rate (BEER)

The Behavioral Equilibrium Exchange Rate works with the theoretical assumption that Real Uncovered Interest Parity (UIP) with a risk premium and/or expected future movements in real exchange rates are determined by economic fundamentals that are not necessarily measured at maximum employment yield. Therefore, the BEER approach is an extension of the FEER approach but it is differentiated by the absence of the macroeconomic balance and also, the BEER approach is applied for a short time horizon.

Description of the models used to calculate Equilibrium FX

The two models discussed below have been surveyed extensively by (Taylor, 1995; Frankel and Rose, 1995; Sarno and Taylor 2002). The two models are the Monetary and Portfolio based approach.

1. The Monetary Model

This model interprets the exchange rate in terms of the relative prices of currencies by considering the justification that the relative price is dependent upon the relative demand and supply of money stocks. This model is further broken down into the Monetary Flex Price Model and the Sticky Price Model. The emphasis of the Monetary Flex Price Model is that the exchange rate level reflects a perfect correlation with the level of the relative money supply in the long-time horizon. The demand for money function is stable and the supply quantity is set by the appropriate regulatory and monetary authorities. Therefore, it can be inferred that this Monetary Flex Price Model is an extension of Purchasing Power Parity theory (PPP) because it applies the theory of price level determination to a PPP equation in order to explain the rate of exchange [Fischer (1984), Ghosh et al. (1995)]. On the other hand, the Sticky Price Model justifies the instability of the exchange rate under the floating system and also the over-projection beyond the long run equilibrium. According to (Dornbusch 1995), the sticky model subscribes to the assumption that when currency is devalued, the prices of goods remain fixed for short-run, therefore, the currency value may 'overshoot'.

2. Portfolio Balance Models

The Portfolio Balance Models is unique because it follows the assumption that assets denominated in multiple currencies are not perfectly replaceable with one another. This model is better explained with domestic and foreign bonds. The model applies the assumption that any change in the economic circumstances of a country will lead to direct changes in demand and supply of both local and foreign bonds. This model works with the following assumptions;

Summary of the different theories used in measuring equilibrium

Name	Theoretical Assumptions	Relevant Time Horizon	Statistical Assumption	Dependent Variable	Estimation Method
Purchasing Power Parity (PPP)	Constant equilibrium Exchange Rate	Long tun	Stationary	Real or Nominal	Test for Stationarity
Behavioral Equilibrium Exchange Rates (BEER)	Real UIP with a risk premium and/or Expected future movements in real exchange rates determined by fundamental	Short run (also forecast)	Nonstationary	Reall	Direct
Fundamental Equilibrium Exchange Rates (FEER)	Real exchange rate compatible with both internal and external balance. Flow not full stock equilibrium	Medium run	Nonstationary	Real Effective	Underlying Balance
Desired Equilibrium Exchange Rates (DEER)	As withFEERs, but the Definition of external Balance based on optimal policy	Medium run	Nonstationary	Real Effective	Underlying Balance
Atheoretical Permanent Equilibrium Exchange Rates (APEER)	None	Medium run/Long run	Nonstationary (extract permanent component)	Real	Direct
Permanent Equilibrium Exchange Rates (PEERS)	As BEERs	Medium/Long run	Nonstationary (extract permanent component)	Real	Direct
Natural Real Exchange Rates Structural Vector Auto Regression (NATREX)	As with FEERs, but with the assumption of portfolio balance (so domestic real interest rate is equal to the world rate)	Long run	Nonstationary	Real	Direct
Structural Vector Auto Regression	Real exchange Rate affected by supply and demand (but not nominal) shocks in the long run	Short (and long run	As with theoretical	Changes in the real	Direct
Dynamic Stochastic General Equilibrium Models (DSGE)	Models designed to Explore movements in real and/or nominal Exchange rates in response to shocks	Short (and long) run	As with theoretical	Change relative to longrun steady state	Simulation

i.   The exchange rate is expected to maintain a constant value

ii.   The Purchasing Power Parity (PPP) does not hold

iii.   Bonds are perfect replacements for one another

iv.   The Uncovered Interest Parity does not hold

v.   There are only 3 assets available for household investments and they are; money, domestic bonds, and foreign bonds

vi.   There is a narrow transaction costs in the money market

vii.   There is perfect capital mobility without capital controls and barriers to investments

Macroeconomic variables used in determining FX

Numerous macroeconomic variables determine equilibrium FX-rate. Some are discussed and listed below

1. Inflation

Generally, inflation bears an inverse relationship with the value of a currency, higher inflation reduces currency value and a reduced inflation has the opposite effect. Countries operating at a relatively high rate of inflation will be able to make their currency fall in value relative to the currencies of countries with lower inflation rates.

2. National Debt

Debt stimulates economic activities in a country but encourages inflation, and a high inflation reduces currency value as stated above.

3. Gross Domestic/National Product (GDP/GNP)

Relative gross domestic product countries with more positive and strong economic performance will attract more foreign capital and than ones with weak economy and political risk.

4. Imports/Exports/Trade flows

Relative deficit/surplus rate Increasing in the terms of trade shows' greater demand for the country's exports. This, in turn, results in rising revenues from exports, which

provides increased demand for the country's currency and vice versa if the terms of trade decreases

5. Balance of payments

Relative balance of payments a deficit in the balance of payment decreases the countries exchange rate as the nation's importing more than exporting increasing the demand for foreign currency

Other variables include:

6. MPR/Central Bank base rate

7. Stock market volatility index

Connection between Linear Regression and Vector Error Correction

Linear regression model is simply a model that predicts the relationship between dependent variables and one or more independent variables. On the other hand, VEC is a model constructed to model the relationship of vector dependent variables using vector independent variables. Vector Error Correction (VEC) model, which is a form of restricted Vector Autoregression (VAR) model is required when investigation is needed for modeling cointegrating relationships between given equations and variables. So, when in a model/ linear equation or set of equations, there may be exogenous variables with cointegrating relationships and VEC is best for such analysis. VEC uses multiple variables on both sides of the equation. The main aim of VEC is to capture the long-run stochastic trend of cointegration. VEC approach is useful for estimating both short-term and long-term effects of one time series on another. The term error-correction relates to the fact that last-period's deviation from a long-run equilibrium, the error, influences its short-run dynamics. Thus, VEC directly estimates the speed at which a dependent variable returns to equilibrium after a change in other variables.

References:

- Clark, P B and MacDonald, R (1999), 'Exchange rates and economic fundamentals: a methodological comparison of BEERs and FEERs', in MacDonald, R and Stein, J (eds), Equilibrium exchange rates, Kluwer Academic Publishers.
- Dornbusch, Rudiger. 1976. "Expectations and Exchange Rate Dynamics." Journal of Political Economy 84: 1161-76.
- Driver, R., Westaway, P. F. (2004). Concepts of equilibrium exchange rates. London: Publications Group, Bank of England.
- Edwards, S. and F. J. Losada (1994) 'Fixed Exchange Rates, Inflation and Macroeconomics Discipline, NBER 4661, www.nber.org/papers/w4661
- Frankel, J A and Rose, A K (1995), 'Empirical research on nominal exchange rates', in Grossman, G M and Rogoff, K (eds), Handbook of international economics, Volume 3, Elsevier Science Publishers B.V.
- Frankel, Jeffrey, 1984, "Tests of Monetary and Portfolio Balance Models of Exchange Rate Determination." in John Bilson and Richard Marston, eds., Exchange Rate Theory and Practice, Chicago: University of Chicago Press for NBER, 1984: 239-260.
- Hsieh, David, 1982, "The Determination of the Real Exchange Rate: The Productivity Approach," Journal of International Economics 12(2): 355-362.
- Influence of Macroeconomic Variables on Exchange Rates, Ravindran Ramasamy and Soroush Karimi Abar   Journal of Economics, Business and Management, Vol. 3, No. 2, February 2015
- Mark, Nelson, 1995, "Exchange Rates and Fundamentals: Evidence on Long Horizon Predictability." American Economic Review 85: 201-218.
- Taylor, M P (1995), 'Exchange-rate behaviour under alternative exchange rate arrangements', in Kenen, P B (ed), Understanding interdependence: the macroeconomics of the open economy, Princeton University Press.