Unraveling the Exchange Rate – Balance of Payments Correlation: Economic Policy Recommendation via the Mundell-Fleming Apparatus

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Abstract of " Unraveling the Exchange Rate-BOP Correlation: Economic Policy Recommendation Via the Mundell-Fleming Apparatus".

The recent unprecedented deficit in balance of trade of US economy has been a subject of much discussion in economic literature. While several views prevail about the predictive behavior of US balance of trade, some have suggested that this trend cannot continue for a long time with out serious consequences. This paper is an attempt to use the Mundell-Fleming Model to discover the consequences on the macro-economy and see its application to the US economy. We conclude that unless the US exports show significant increase in future, there is little chance of improvement in drastic trade imbalance of US economy.

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Introduction:

It is no secret that the US has an extreme case of deficit in the balance of payments sine 1998. As of recently "the U.S. current account deficit of about 5.7% of GDP in 2004 (6.2% in 2005 and approaching 7% in 2006) has already reached a historical record (McKinnon and Schnabl). As the deficit worsens, one has to wonder the economic repercussions. Thus, it will be prudent to utilize macro-economic theory in an attempt to better understand these consequences, and recommend policy actions accordingly. Furthermore, due to the numerous economic theories available to explain various phenomenons, it is important to use a model that is most relevant.

The Mundell-Fleming model was put forth in the early 1960s via the research of Robert Mundell (1962, 1963) and J.M. Fleming (1962) as an extension of the Investment/Savings-Liquidity preference/Money Supply model (IS-LM model) (Harrod 1937, Meade 1937, Lange 1938). It successfully aimed to incorporate the foreign sector within a Neo-Keynesian manifold through the insertion of the Balance of Payments conditions into the traditional IS-LM apparatus. It has since been used as an effective tool for policy-makers to analyze the effects and potential impacts of international trade policy. However, to better grasp the meaningfulness of Mundell-Fleming Analysis it is necessary to examine the derivation of its components.

The IS-LM model illustrates the point at which commodity and money market equilibrium intersect at a specific interest rate (r)-real GDP (Y) combination of an

economy. The IS Curve thus being the locus of interest rate and real GDP combinations at which the commodity market is in equilibrium, or rather the total expenditures are equal to total income in an economy. This can be expressed as the schedule of points where real GDP is equal to the summation of the consumption (C), investment (I), export (X) and import (M) functions plus government expenditure (G) (or $Y = C + I + G + X - M$). In other words, national income is equal to consumer spending plus private investment in capital (where investment equals consumer savings, government surplus, and trade surplus) plus government expenditure.

Furthermore the IS Curve must slope downwards from left to right since any decrease in interest rate would yield more investment spending in capital. Ergo, as the interest rate decreases, the opportunity cost of returns to the marginal efficiency of capital investment (MEC) (such as machinery, equipment, etc.) becomes greater than the returns to investments in financial institutions (r). The derivation of the slope thus depends upon the elasticity/responsiveness of investment with respect to changes in interest rate. For example, a highly elastic relationship between investment and interest rate yields a 'flatter' IS Curve. Verily, a small change in interest rate must also cause a greater change in real GDP when elasticity is high.

Also, the degree of slope derivation is determined by the magnitude of the 'open economy multiplier'… meaning that any change in investment must cause a greater change in GDP (y) due to its subjectivity to the multiplier effect. In essence the multiplier can be thought of as the result of the circular flow of an economy. Furthermore, the open economy multiplier is defined by the inverse marginal propensities for consumers to save (MPS) and the importation of goods and services abroad (MPI):

$$\Delta I\ [1/\ (MPS+MPI)] = \Delta Y$$

It should be noted that a change in any autonomous factor (government expenditure as well as any other changes in variables independent of various coefficients present in the total expenditure function) are also subject to the multiplier process to give us the change in real GDP. e.g. algebraically we can deduce:

$$Y = C + I + G + X - M$$

$$\text{Or} \quad Y = \alpha + \beta y + I_t + G_t + X_t - (M_\alpha + M_\beta y)$$

$$\text{Or} \quad \alpha + I_t + G_t + X_t - M_\alpha = Y - \beta y + M_\beta y$$

Where, $\alpha + I_t + G_t + X_t - M_\alpha$ are autonomous represented as (Å), therefore,

$$Å = Y\ (1 - \beta + M_\beta)$$

$$Å = Y\ (MPS + MPI)$$

$$Y = Å/\ (MPS + MPI)$$

$$\text{Thus, } \Delta Y = \Delta\ Å\ [1/\ (MPS+MPI)$$

Where Y = real GDP

C = total consumption expenditure, given by consumption function = $f(\alpha + \beta y)$

α = autonomous consumption

β = marginal propensity to consume (MPC) coefficient

Note that MPC + MPS = 1

I_t = total investment

G_t = total government expenditure

X_t = total exports

M = import function = $f(M_\alpha + M_\beta y)$

M_α = autonomous imports

M_β = MPI coefficient of Y in the import function.

A shift in the IS Curve is caused when any change in GDP occurs without any change in interest rate; meaning any change in autonomous factors, such as an increase in government expenditure (expansionary fiscal policy) or an increase in exports. Using these assumptions it is now possible to demonstrate a graphically derived IS Curve:

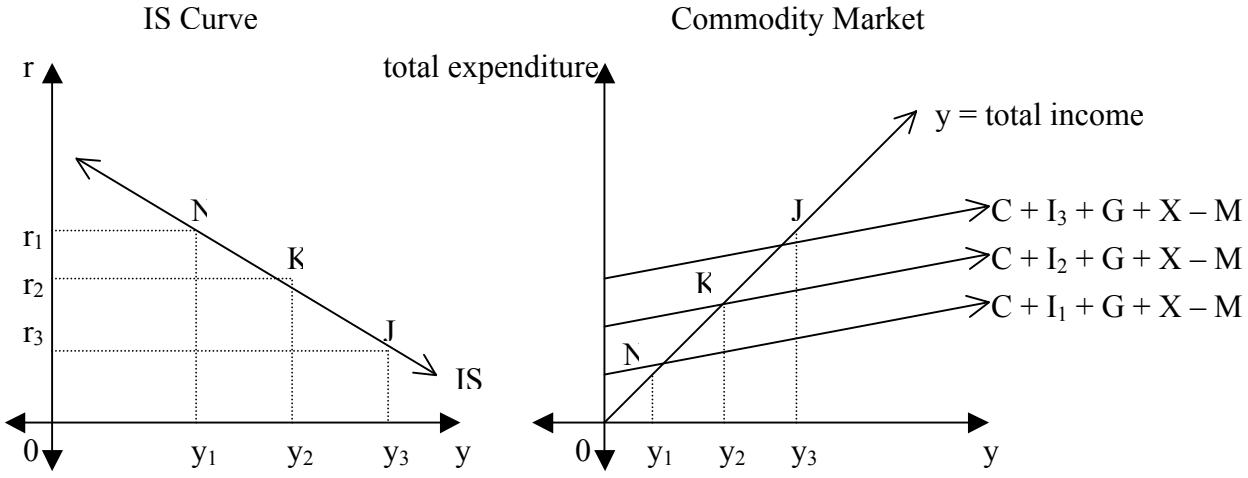

Figure 1

Figure 1 (above) demonstrates how any changes in interest rate must be positively correlated for the IS Curve and commodity market to have corresponding points of equilibrium with increasing GDP. Recall that as interest rate decreases the investment level increases (which causes the GDP to expand); this can be witnessed in an upward shift of the total expenditure function as seen in figure 1 [$\downarrow r \rightarrow \uparrow I$ (if $r < MEC$) $\rightarrow \uparrow y$].

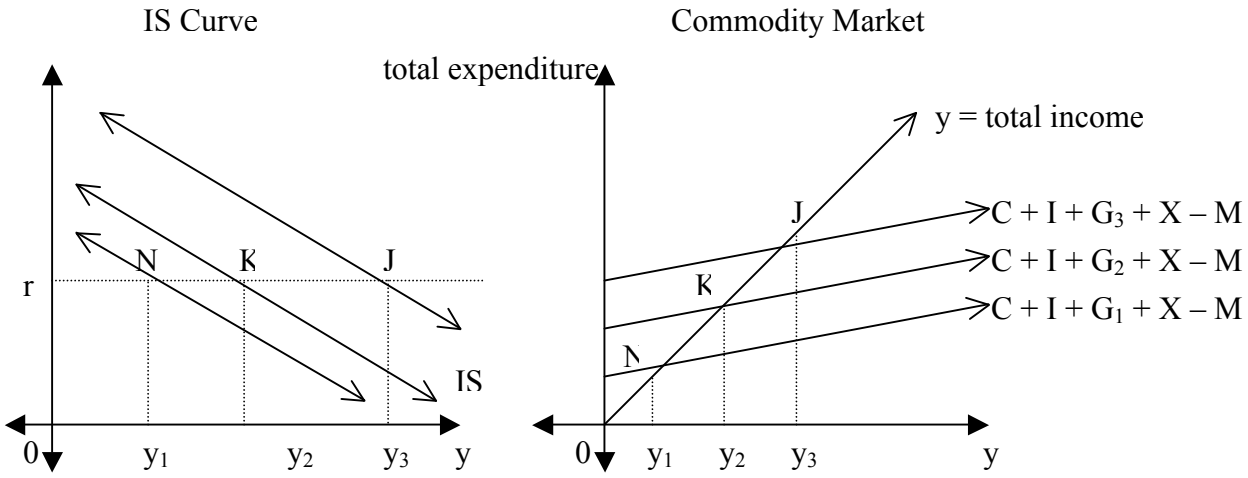

Figure 2

Figure 2 (above) demonstrates how the IS curve can reflect changes in GDP via changes in an autonomous factor; thus causing the total expenditure function to shift up without affecting interest rate.

The LM Curve is the locus of all possible combinations of interest rate and real GDP in which the money market is in equilibrium. The money market is the relationship between interest rate and the quantity of money. This continuum thus finds equilibrium at the point at which the demand for money intersects the money supply (MS).

In an open economy the money supply is the summation of domestic reserves (D) plus foreign reserves (R):

$$MS = D + R$$

Furthermore, in the United States the money supply is controlled by monetary policy vis-à-vis the Federal Reserve. The decisions of which are all made autonomously of other variables.

The demand for money (MD) can be defined as the amount of money in the economy that is held in cash as well as non-interest earning checking accounts.

Concordantly there are several determinants of money demand. Classified into three motives, they are: transactions motive, precautionary motive, and speculative motive of money demand. Transactions motive is based upon the cash used for everyday transactions. Obviously this demand would increase with any increase with any increase in income (y). Precautionary motive is simply cash kept aside as a means to be adverse to the risk of illiquidity. Finally, the speculative motive is any remaining cash after any decisions made to purchase bonds. Clearly the price of bonds would be of paramount importance in determining this choice. Hence, bond price can be understood to be the inverse of the interest rate (1/r). For example, the interest rate increase; the quantity of money demanded decreases. This is because the opportunity cost of keeping cash on hand increases since more and more potential interest accrued revenue from bonds is forgone.

Furthermore, the slope of the LM Curve is determined by the elasticity of money demand apropos a change in interest rate. A high elasticity must therefore mean that any change in interest rate causes a greater response in the demand for money. This would consequently cause large disequilibria in the money market. To correct; a large change in GDP must be attained to offset this disequilibrium. As a result a small change in interest rate is associated with a large change in GDP when elasticity is high in order for money market equilibrium to persist. The LM Curve and money market equilibrium can now be rendered via the utilization of these assumptions:

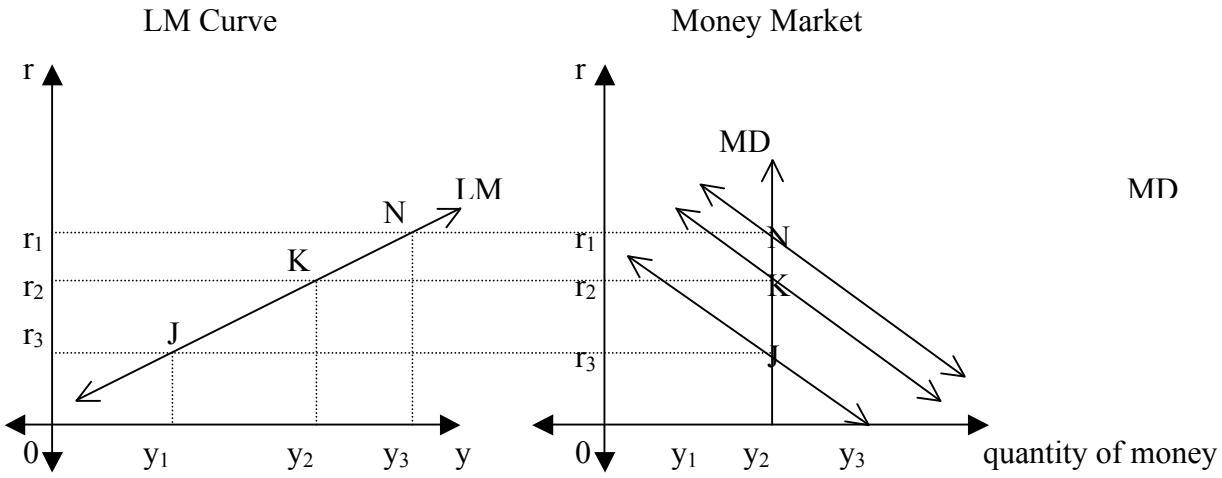

Figure 3

Figure 3 (above) demonstrates how any changes via a shift in the money demand invoke a change in interest rate (and visa versa)… that any changes in interest rate/GDP must be negatively correlated to monetary expansion for the LM Curve and money market to have corresponding points of equilibrium.

Additionally, a shift in the LM Curve is revealed whenever there is a change in interest rate while holding GDP constant. Any change in money supply will have this effect. For example, total banks deposits increases as the money supply expands. Since deposits are a liability upon banks, the amount of lending must increase in order to compensate. Thus the level of competition amongst banks issuing loans increases… causes interest rates to fall ceteris paribus. Interest rate can therefore be interpreted as the 'price' of money. Verily, an expansion of the money supply must be met with a decrease in interest rate if indeed money is a normal good.

Another example of the inverse relationship between money supply and interest rate can be observed whenever the Federal Reserve enacts expansionary monetary policy. By purchasing treasury securities from the public via 'open market operations' the Fed

effectively pushes out the money supply. These actions ostensibly raise demand for bonds. Hence the price of bonds increases as interest rates fall [↓(1/r) → ↑r].

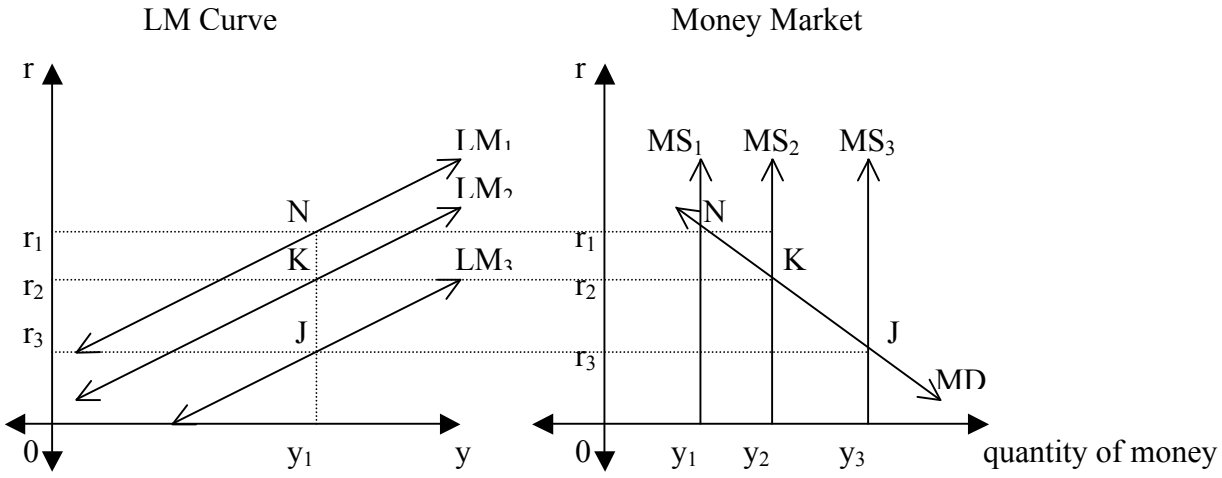

Figure 4

Figure 4 (above) depicts an outward shift in the money supply, causing interest rate to fall. Holding demand for money constant the LM Curve shows a corresponding shift with a decrease in interest rate and no change in GDP.

The foreign sector is incorporated into the Mundell-Fleming model via the insertion of a third component; termed the BP Curve. It is the locus of combinations of interest rate and GDP in which the Balance of Payments (BOP) is in equilibrium. To clarify, the BOP is simply a method of double entry accounting that can be reduced to ledgers that must be equal to each other. Being that the current account must be equal to the capital account so that the BOP is equal to zero. Ergo:

Current Account Balance + Capital Account Balance = 0

Negative Current Account Balance = Capital Account Balance

Current Account Deficit = Capital Account Surplus

The current account is the measure of the trade balance. It is the summation of all goods and services imported and exported from an economy. Therefore the current account balance must be determined by the import (M) and export (X) functions of an economies' total expenditure schedule. To elaborate:

$$M = f(M_\alpha + M_\beta y)$$

$$X = f(M_\alpha^* + M_\beta^* y^*)$$

Where '*' indicates the foreign sectors import function

Based upon these functions, it should be evident that a change in GDP (y) would have the most impact on any changes on imports… essentially, as a country's income increases; so to does its imports. Furthermore, any increase of imports will be recorded as a deficit on the current account.

The capital account is a measure of the inflows and outflows of financial capital. It is primarily determined by the interest rate. Higher interest rates thus causing capital inflows, and therefore lead to a surplus in the capital account.

Recalling that the BP is the locus of combinations of interest rate and GDP… it must then be true that as national income increases; so too must the interest rate. For instance, any GDP increase will also increase the level of imports. Hence there is a deficit on the current account. To maintain equilibrium on the BP curve, the capital account must enter into surplus to offset the current account. Concordantly interest rates increase relative to GDP increases. Apropos the BP curve slopes upwards.

Furthermore, there are two determinants to the slope of the BP curve. The first is the elasticity of imports with respect to GDP, meaning that it is the magnitude of change in imports relative to an initial change in GDP. A high elasticity of imports thus requires

high levels of interest rate change in order to adequately compensate. The second determinant is the intensity of capital mobility present in the economy. In the case of developed world countries (such as the US), capital mobility is near perfect. This means that interest rate changes are extremely sensitive in terms of moving capital. For instance, a slight interest rate change could flood, or dry out the economy's capital. Too clarify, a high elasticity causes the BP curve to be steep, high capital mobility causes the curve to be flatter, if perfect capital mobility exists than the BP curve is completely flat.

A shift in the BP curve occurs when there is a change of the interest rate while holding GDP constant via a change in the exchange rate. Consider an increase in the exchange rate. Consequently there will be a decrease in imports since foreign goods and services have become relatively more expensive do to local devaluation. Exports now increase since the domestic currency is essentially 'cheaper', and therefore domestic goods and services are cheaper as well. Thus, exports increase since the price of imports to foreigners has decreased. Verily there is a surplus in the current account. To compensate the interest rate must decrease to create a capital account deficit. Hence, a depreciation of domestic currency creates a rightward shift of the BP curve (as seen in figure 5 below).

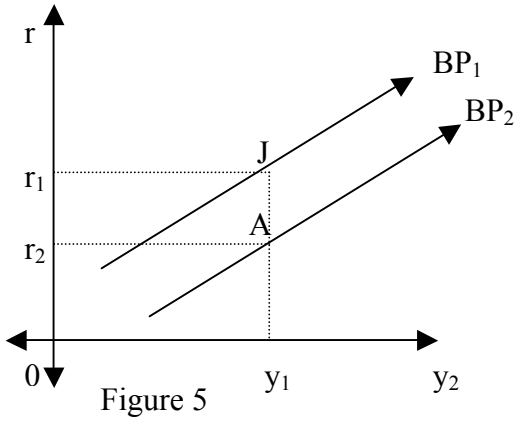

Figure 5

The Mundell-Fleming model is a demonstration of general equilibrium in the economy, concordantly the model can also be used to analyze an economy in disequilibrium and thus prescribe policy recommendations to remedy the situation. The model itself is a synergy of the derived components. Ergo, if the commodity and money market are in equilibrium, as seen through the IS-LM curve, than the BP curve must pass through that point as well. This phenomenon is a property of Walrus' Law; stating that if there are 'n' numbers of markets in an economy, and if 'n – 1' are in equilibrium, than the 'n^{th}' market must also be in equilibrium. Thus, at the point in which all three curves intersect, there simultaneously exists:

• Aggregate demand = aggregate supply

(Commodity market equilibrium at total expenditure = total income)

• The quantity of money demand = quantity of money supplied

(Money market equilibrium)

• Balance of Payments = 0

(Foreign sector equilibrium)

At this point the economy is in general equilibrium.

A preliminary modeling of the US economy can now be examined through a Mundell-Fleming analysis.

Theoretical State of US Economy One

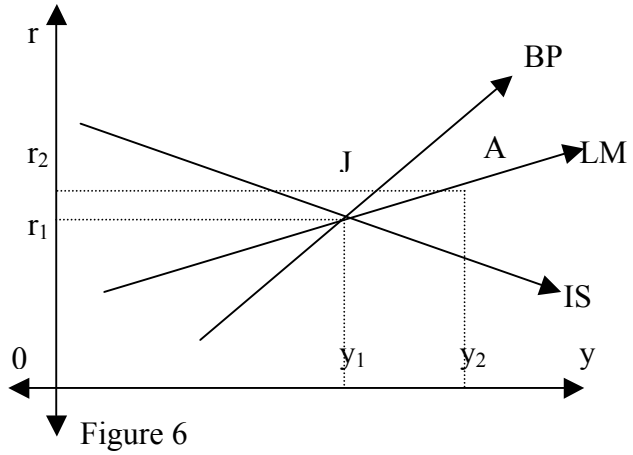

Figure 6

In reference to figure 6 (above)… general equilibrium exists at point J, however, the actual US economy lies on point A. At point A with y_2 GDP the commodity market is in disequilibrium due to higher interest rate than is required for aggregate demand to equal aggregate supply. Essentially, with interest rate too high there is not enough investment occurring, thus the total expenditure function is below total income, meaning there is an excess of inventories in the economy.

Also, the Balance of Payments is in deficit at point A. This is because GDP is higher than is required for the economy to exist on the BP curve, or rather the interest rate is too low. Recall that as income increases, so to does importation. Therefore, either a lower GDP, or a higher interest rate is needed.

A hypothetical solution to the situation in figure 6 can now be theorized based upon constituent derivations of the Mundell-Fleming model's components (see figure 7 next page):

Hypothetical Solution to US Theoretical Economy One

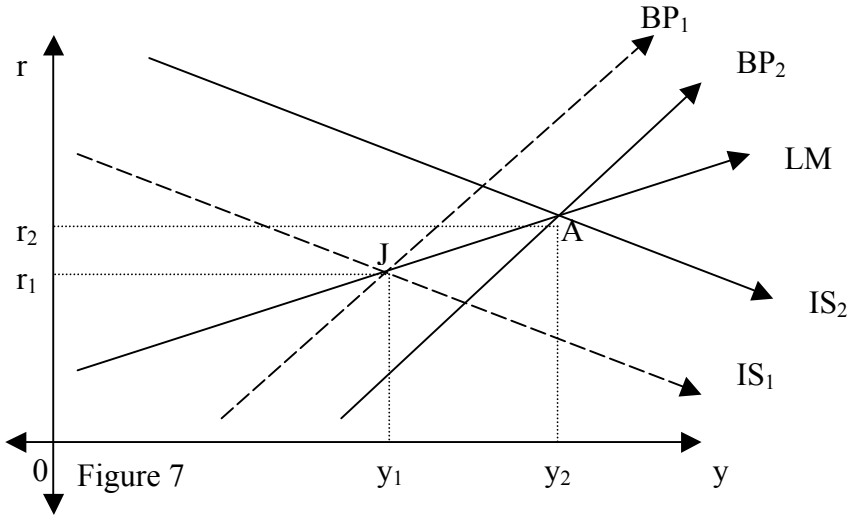

Figure 7

In order to cure the situation in the commodity market it necessary to shift the IS curve (from IS_1 to IS_2) (see figure 7). This is possible if expansionary fiscal policy is considered. For instance, suppose government expenditure increases beyond tax revenue (or taxes are decreased, or combination of the both) i.e. the government runs a budget deficit. As a result, the total expenditure function shifts north and consequently the IS_1 curve repositions at IS_2 with both the commodity and money market in equilibrium at point A.

However, at point A the balance of payments is still in deficit (BP_1) due to a high GDP bringing in high imports. Yet because of the budget deficit caused by the expansionary fiscal policy, the government is forced to sell treasury bonds to the public in order to finance the deficit. Hence, the supply of bonds increases, causing the price of bonds to fall, and interest rate to rise [$\downarrow(1/r) \rightarrow \uparrow r$].

To solve the balance of payments deficit at point A with BP_1 curve, there must be an increase in the exchange rate under the flexible exchange rate system that the US subscribes too. Recall that as the exchange rate increases, the domestic currency

devalues. Thus imports would decline, and exports would rise. Accordingly, with the increase in exchange rates, the BP_1 curve shifts right to BP_2.

The final conclusion of this expansionary fiscal policy solution results in the economy returning to general equilibrium with higher interest rates and a depreciation of the dollar.

Another possible rendering of a theoretical US economy that may currently exist can be demonstrated as seen in figure 8 (below):

Theoretical State of US Economy Two

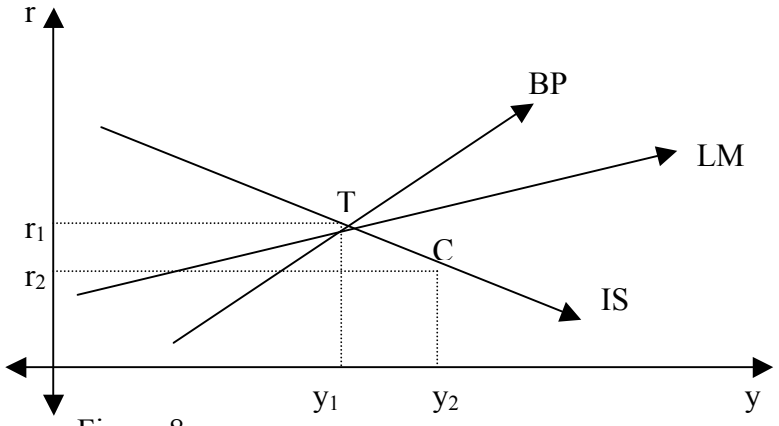

Figure 8

Point T represents the general equilibrium of the economy, however, the economy actually may exist at point C. At point C the money market is in disequilibrium with interest rate to low for what is required for equilibrium. Hence, there is an excess demand for money (since the price of money is low). Furthermore the balance of payments is in deficit at point C as well.

A hypothetical solution to this dilemma can be observed in figure 9 (next page):

Hypothetical Solution to Theoretical State of US Economy Two

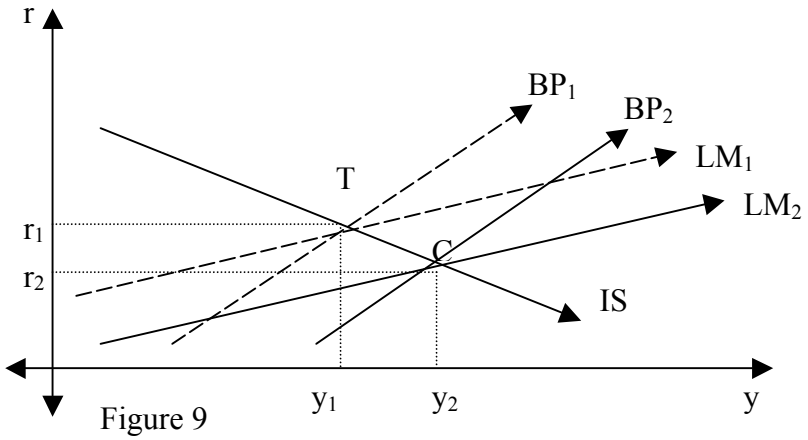

Figure 9

A rightward shift of the LM_1 curve to LM_2 at point C represents the implementation of expansionary monetary policy. Concordantly this would expand the money supply to meet the excess demand. This of course causes the interest rate to fall via an increase in banks deposits and also the open market operations conducted by the Fed, which would increase bond prices through an increase in demand for bonds. The balance of payments under a flexible exchange rate system shifts outward to BP_2 by way of domestic currency devaluation (increase in exchange rate). Thus the end result of which is the economy moving towards general equilibrium with lower interest rates and a higher exchange rate.

The solutions to these two theoretical US economies both show a definite similarity… both involving a devaluation of the dollar as a means to correct the balance of payments deficit. This is especially meaningful due to the extreme case of the United States' actual trade deficit. In order to determine if there is a real significance involved, historical data from the approximately past 30 years was used to plot a time series analysis to demonstrate a correlation between exchange rate and balance of payments. The evidence and findings follow (chart 1, figure 10):

Year	Net Exports	Percent Changes Net Exports	Exchange Rate	Percentage Changes in Exchange Rate
1978	-25	0	0.8	0.00
1979	-23	-8	0.774	-3.25
1980	-13	43.47826087	0.768	-0.78125
1981	-13	0	0.848	10.416
1982	-20	53.84615385	0.906	6.839622642
1983	-52	160	0.936	3.311258278
1984	-103	98.07692308	0.972	3.846153846
1985	-115	11.65048544	0.966	-0.617283951
1986	-133	15.65217391	0.853	-11.69772257
1987	-145	9.022556391	0.774	-9.261430246
1988	-110	-24.13793103	0.742	-4.134366925
1989	-88	-20	0.78	5.121293801
1990	-78	-11.36363636	0.738	-5.691056911
1991	-28	-64.1025641	0.731	-0.948509485
1992	-33	17.85714286	0.71	-2.872777018
1993	-65	96.96969697	0.716	0.845070423
1994	-94	44.61538462	0.699	-2.374301676
1995	-91	-3.191489362	0.659	-5.722460658
1996	-96	5.494505495	0.689	4.552352049
1997	-102	6.25	0.726	5.370101597
1998	-160	56.8627451	0.737	1.515151515
1999	-261	63.125	0.731	-0.814111262
2000	-380	45.59386973	0.758	3.693570451
2001	-367	-3.421052632	0.785	3.562005277
2002	-424	15.53133515	0.773	-1.52866242
2003	-501	18.16037736	0.714	-7.632600259
2004	-624	24.5508982	0.675	-5.462184874
2005	-727	16.50641026	0.677	0.296296296
2006	-850	16.91884457	0.68	0.443131462

Chart 1

Chart 10 (previous page) is a compilation of data taken from the OECD statistical database as well as IMF Balance of Payments Statistics. The data used includes the year, net exports, and exchange rates. To derive a more meaningful correlation, these two data ranges were further calculated to show the percent change from each previous year using the following formula: [(post – initial)/initial].

Figure 10 (below) shows the percentage change in exchange rates superimposed along percent change in net exports plotted along a time series. It clearly demonstrates an increase in imports correlated with an increase in exchange rates, meaning that as the balance of payments situation worsens the dollar historically devalued.

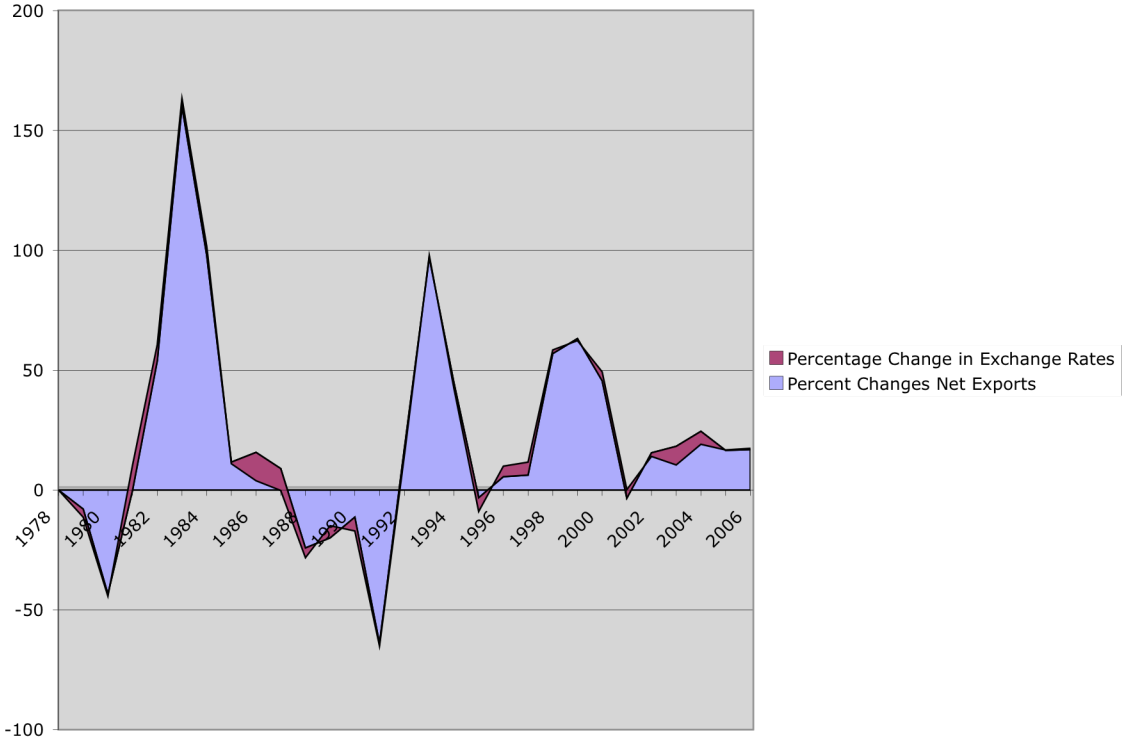

Figure 10

However, the causal direction of the correlation is unclear with this graph alone. It is uncertain if the balance of payments causes the exchange rate to move, or visa versa.

Furthermore, despite dollar devaluation, the balance of payments only increases in deficit. Yet, it should be noted that the percent changes in exchange rates are small when compared to percent changes in net exports. Thus it may be that the changes in exchange rate need to be much larger in order for there to be a market correcting mechanism via the floating exchange rate system to occur… contingent upon the causal direction of the relationship. To help clarify this uncertainty, it is essential to seek the findings of professional academics, as well as the opinions of business journalists.

Kenneth Rogoff in his article "Global Imbalances and Exchange Rate Adjustment" calls upon theoretical evidence proposed by Peter Hooper and John Morton of the Federal Reserve during the late 1970s, that there is indeed an empirical correlation between the exchange rate and the current account. In a recent experiment they graphed the real world U.S. Current Account (1980-2005) in step with a simulative model that "explains the dollar exchange rate by the nexus of current accounts" (Rogoff). The simulated exchange rate was thus superimposed over the actual exchange rate, which both moved alongside the actual current account.

At this point we must revisit the relevancy of the publicity given to a deficit in the current account, and why it is popularly seen as a 'bad thing'. A CQ weekly political economy columnist, John Cranford, published "That Pesky Strong Dollar" in late 2005. The article calls upon Federal policy makers to utilize fiscal and monetary tools to adjust the exchange rate in such a way as to devalue the dollar, citing that a depreciated dollar will ease the current account deficit by allowing American firms to increase their exports while simultaneously decreasing imports. It appears he was referring to the same or

similar theoretical evidence as Rogoff. However, Cranford neglects to explain why a current account deficit is a problem.

In reference to "Devaluing the Dollar: A critical analysis of William Cline's case for a New Plaza Agreement", the problem of the current account deficit is revealed. To summarize: The U.S. imports an extremely substantial portion of its trading partners exports, more over it is impossible to say exactly how long such a global imbalance can be sustained. This makes the world economy very susceptible to any shocks that would realign the exchange rate and thus put the economy back into balance. The housing bubble in the U.S. (should it have a hard landing), for example, would radically affect interest rates in such a manner as to produce a capital flight so that the exchange rate would drastically increase. Thus radically appreciating the trade weighted partners of the U.S. by as much as 39% as predicted by Cline's econometric model (McKinnon and Schnabl). Needless to say global economic instability and chaos could result as U.S. trade partners witness a crash in export intensive industries, not to mention the havoc that would unfold for countries using a de-facto dollar standard. Hence, many economists believe that a gradual readjustment of the exchange rate is what is needed to prevent such a calamity.

However, McKinnon and Schnabl ("Devaluing the Dollar") criticize the pro-devaluation argument. Claiming that, Cline's econometric model does not properly incorporate the demand elasticity of the aggregate imported goods and services to the U.S. High elasticity being that any change in price will have a huge affect on quantity demanded, verily, a low elasticity could see a significant change in price without much of a change in quantity demanded. Energy is a great example of an inelastic good (as was

witnessed during the oil shocks of the 1970s). Therefore, if the aggregate demand for imports to the U.S. were inelastic any change in the exchange rate would have a minimal effect on the balance of payments.

Based upon these sources it becomes clear that discrepancies exist. All agree that there is indeed a direct correlation between exchange rates and the balance of payments, and that the current account deficit for the U.S. does pose a problem in terms of global economic stability. Yet, the extent of this correlation, and the causal direction of it are in dispute. In one camp economists argue that the exchange rate is the dominant causal factor, and that a devaluation of the Dollar is needed to correct the current account deficit. The other side claims that the econometric model used does not accurately predict the causal nature of the exchange rate-balance of payments relationship. Thus any meddling with the exchange rate in an attempt to correct the deficit could merely be superfluous, or worse, could cause financial upheaval. In conclusion… uncertainty remains.

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